VERMONT INTEGRATED
ARCHITECTURE, PC

TOWN OF CORNWALL
TOWN HALL RENOVATIONS

PROJECT SPECIFICATIONS

SEPTEMBER 1, 2016

FINAL CONSTRUCTION DOCUMENTS
ISSUED FOR CONSTRUCTION

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011000 – SUMMARY AND GENERAL REQUIREMENTS

1. OVERVIEW

The Town of Cornwall will be renovating the existing Town Hall, located on Route 30 in Cornwall Village. All work will take place within the existing footprint of the building, although new foundations will be placed under the eastern portion of the building. Interior renovations will improve building functionality, and a new lift and exit stair will improve accessibility and emergency egress. Mechanical, electrical and plumbing work will be mostly adding to existing systems, though new equipment will be added to ventilate and dehumidify portions of the building. Structural improvements will also be required, notably at the existing roof trusses. The footprint of the existing town hall building is approximately 2,300 SF, and some work will occur on the basement, main and upper levels.

2. FORMAT OF SPECIFICATION

Vermont Integrated Architecture, P.C. (VIA) has prepared these architectural specifications in totality. These specifications are not based on Master Spec (outline or full length), rather they are intended to be easy to navigate yet more focused than an outline specification, defining specific methods and materials as appropriate. Each specification section is organized as follows:

1. SUMMARY
   Describes the products and processes applicable in this section.

2. SUBMITTAL PROCESS
   Matrix indicates what type of submittal is required and any specific information or material required as part of the submittal. Blank matrix appears below:

Submittal	Req.	Specifics
Shop Drawings	X	
Product Cut Sheets	X	
Product Samples	X	
Mock-ups	X	
Closeout submittals	X	

3. PRODUCTS
   A list of all products represented in this specification section is listed here. Where possible, we try to identify specific manufacturers. In addition, material-specific information is also noted (i.e., dimension, tested values, finishes, colors, etc.)

4. EXECUTION & QUALITY CONTROL

Often this section includes a general description for installation and quality control. In addition, it includes specific required practices for each product listed in Section 3. These practices always consider the manufacturer's recommended installation practices and often include measures above and beyond such practices. This section may also indicate any testing or inspection required to ensure quality and condition of material and installation.

NOTE: VIA welcomes input regarding the format and content of these specifications from contractors, installers, and manufacturers. Such input may be directed to Andrea Murray at andrea@vermontintegratedarchitecture.com .

3 . SUBMITTAL PROCESSES & PROCEDURES

Submittals are critical to the success of this project. You can expect the following for the review process:

TIMING: Submittals will be reviewed within 10 days of receipt. If VIA is unable to achieve this turnaround, VIA will request an extension of this time from the construction manager. If a review is required in less than 10 days, it should be clearly noted in the submittal transmittal, and VIA will make every effort to meet the deadline requested.

SUBMISSION: VIA requests that all submittals be accompanied by a transmittal that clearly identifies the specification section(s) to which it is responding. The transmittal shall also identify everything that is included in the submission.

VIA requests that all shop drawings, product cut sheets, and warranty information be submitted in electronic format (Adobe pdf file preferred). Individual file sizes should not exceed 10 mb.

Actual product samples and sample mock-ups shall be accompanied by a transmittal, and all samples shall be clearly labeled for reference.

SUBSTITUTIONS:

If the contractor is requesting a product substitution for the product, equipment, or method of construction specified herein, the submittal must include comparison information to the items listed in the specification as well as any deviations in the cost of the substitution, from that which was specified and contracted originally. In addition, a written description as to why the contractor believes the substitution to be a better product is requested.

SPECIFICATION:

Each specification section herein features the matrix shown above. Required submittals are clearly marked and specifics noted.

REVIEW ACTIONS:

After review, VIA will return submittals marked as follows:

1. **Reviewed (no comment)**: Work covered by submittal may proceed provided it complies with requirements of Contract Documents. Final acceptance will depend upon that compliance. The term "Reviewed" shall only indicate that there is no exception taken to the submittal.

2. **Reviewed (see comments)**: Work covered by submittal may proceed provided it complies with notations and corrections on submittal and requirements of Contract Documents. Final acceptance will depend upon that compliance.

3. **Reviewed (revise and resubmit)**: Do not proceed with work covered by submittal including purchasing, fabricating, and delivering. Revise or prepare new submittal in accordance with notations and resubmit.

4. QUALITY CONTROL

Quality Assurance:
Activities, actions, and procedures performed before and during execution of the work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements is the responsibility of the individual contractors.

Quality Control:
Tests, inspections, procedures, and related actions during and after execution of the work to evaluate that actual products incorporated into the work and completed construction are the responsibility of the contractor or owner as noted herein. In addition, the architect and construction manager will regularly inspect workmanship.

Recommended Standards - Compliance:
All products shall be stored, protected, and installed in compliance with manufacturer's recommendations. In addition, material warranties shall be consulted by contractors to ensure installation practices do not, in any way, void a manufacturer's or installer's warranty. Any discrepancies shall be brought to the attention of the Architect during the submittal review process.

5. PROJECT ADMINISTRATION

General Coordination:
Planning, scheduling and overall coordination of all construction activities are responsibility of the contractor.

Progress Documentation

The contractor shall document the progress of the construction job with digital photos, to be provided to the Owner at the conclusion of the project. Photos of particular importance include photos of conditions that will be covered in the final state of the project, such as sub-grade or sub-slab conditions, or photos of the framing before insulation and finishes have been added.

Project Meetings

The contractor shall schedule a kick-off meeting at the beginning of the project, to review project planning with the Owner and project team. Note that some specification section call for pre-installation conferences or meetings. These can occur as part of the kick-off meeting, or during weekly project meetings (see below), based on the availability of the appropriate sub-contractors.

The contractor shall schedule and run weekly project meetings with the Owner and the Architect, to ensure smooth progress and communications. The contractor shall produce minutes from the weekly meetings, due by Town of Cornwall regulation within 5 calendar days of the meeting. The minutes shall be used to track open issues and document decisions made.

At the conclusion of the project, after punchlist and substantial completion, the contractor shall schedule a project closeout meeting to review outstanding work items, equipment training requirements, final payments, Operations and Maintenance information submittals and any other closeout issues. Any record drawings that the contractor or sub-contractors have produced should be provided to the Owner at this time.

Temporary Facilities

The Town of Cornwall will provide access to water and electricity for the project during construction, as well as building heat during construction. The contractor is responsible for providing temporary toilet facilities for the construction personnel (use of the existing toilet facilities in the building is prohibited). A construction field office is not required for this project. The contractor is responsible for all safety and security during the course of the project, including fire safety, safety of construction personnel and the general public, and security of the building and building contents during construction.

Final Cleaning

The contractor shall conduct a final cleaning of the entire building at the conclusion of construction, removing all construction waste and debris, and dirt and dust from construction processes.

END SECTION 011000 – SUMMARY

012100 – ALLOWANCES

1. SUMMARY

This section includes administrative and procedural requirements for allowances.

An Allowance is an amount required to be included by all bidders in their proposed bid price, and acknowledged on the Bid Form, for certain work as enumerated in this specification section.

Related Sections:
All drawings and specifications included in the construction documentation.

2. PROCEDURES

A. Schedule: A schedule of allowances is included at the end of this Section. Schedule contains a description of each allowance.

3. SCHEDULE OF ALTERNATES

Allowance No. 1: CARPET TILE

Unit price allowance: Include the unit price of Thirty-eight dollars per square yard ($38.00/SY) for carpet tile, as noted in Specification Section 096813 Tile Carpeting.

Allowance will be resolved upon final selection of tile carpeting material.

Allowance No. 2: MAIN LEVEL CEILING WIRING

Lump Sum Allowance: Include a lump sum value of Fifteen-hundred dollars ($1,500.00) to address unknown condition of electrical wiring distribution on the old ceiling above the existing ACT ceiling on the main level of the Town Hall. If the existing electrical distribution wiring was run across the ceiling without attachment to the framing above, wiring will need to be secured and possible relocated to allow final installation of the new gypsum board ceiling on strapping at those locations.

Allowance will be resolved after demolition of main level ceiling reveals condition of wiring above.

END SECTION 012300 – ALLOWANCES

012300 – ALTERNATES

1. SUMMARY

This section includes administrative and procedural requirements for alternates.

An Alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

Related Sections:
All drawings and specifications included in the construction documentation.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	**X**	-
Product Cut Sheets	**X**	-
Product Samples	**X**	
Mock-ups	NA	
Closeout submittals	**X**	

3. PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Schedule contains alternate requirements for materials necessary to achieve the work described under each alternate.

4. SCHEDULE OF ALTERNATES

Alternate No. 1: BASEMENT UNDERDRAIN

Base Bid: No underdrain in existing basement under basement floor moisture control layers.

Alternate: Provide perforated pipe underdrain in wrapped stone as noted on Drawing A-2.0, draining to a new drywell east of the building.

Alternate No. 2: UPPER LEVEL ENERGY RECOVERY VENTILATION

Base Bid: No mechanical ventilation at upper level.
Alternate: Install new Energy Recovery Ventilation as show on Mechanical drawings M1.11 and M1.21.

END SECTION 012300 – ALTERNATES

015240 – CONSTRUCTION WASTE MANAGEMENT

1. SUMMARY

This section outlines the procedural requirements for the recycling and reuse of non-hazardous construction waste as well as the disposal of any non-hazardous construction waste.

Related Sections:
021419 Selective Demolition

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets		
Product Samples		
Mock-ups		
Closeout submittals		
Other	**X**	1. Contractor's Waste Management Plan – for review at least 7 days prior to the commencement of construction.

3. PRODUCTS - STRATEGIES

A. CONSTRUCTION MANAGER'S WASTE MANAGEMENT PLAN

i. General: Develop a plan consisting of waste identification and reduction. The plan shall be submitted to the Owner and Architect for review, discussion and approval.

ii. Waste Identification: Indicate and anticipate types and rough quantities of demolition and construction waste to be generated by the project.

iii. Waste Reduction: Prepare a guide indicating types of waste, whether it will be recycled, reused, or disposed of in a landfill.

a. Recycled Materials: Include destination (local processors and receivers of recyclable materials).

b. Reusable Materials: Include a list of materials to be set aside and reused in the new construction as well as those that are of good condition to be made available to members of the community. Develop procedure with the Town of Cornwall for making these materials available to end users.

c. Disposed Materials: Indicate how and where remaining materials will be disposed of.

4. EXECUTION & QUALITY CONTROL

A. WASTE MANAGEMENT CONFERENCE

i. Construction Manager to conduct conference at the start of construction and routinely to inform workers and subcontractors of requirements and desired

outcomes for waste management practices. Notice of the location, date, and time of the conference shall be provided to the Owner.

B. RECYCLING CONSTRUCTION WASTE

i. Packaging
   a. Cardboard & Boxes: break down into flat sheets. Bundle and store in dry location.
   b. Pallets: As much as possible, require deliveries that use pallets to remove pallets from project site. For pallets that remain on site, offer to owner, workers before breaking down and adhering to policies for recycling wood.
   c. Crates: Break down crates and adhere to policies for recycling wood.

ii. Wood Materials:
   a. Clean lumber cut-offs: Offer to owner, workers, before grinding or chipping into small pieces.
   b. Clean sawdust: Bag sawdust that does not contain painted or treated wood.
   c. Engineered Wood Products: Offer any segments 3'-0" or longer to owner, workers, before disposal.

iii. Gypsum Board: Stack large, clean pieces on wood pallets and store in dry location.

iv. Metal: All metals shall be sorted for recycling and salvageable scrap. Any scrap metal shall be salvaged and proceeds returned to the owner.

v. Roofing:
   a. Slate Roofing removed from the Cornwall Town Hall shall be evaluated for re-use by the contractor or roofing sub-contractor, and recycled or disposed of at their discretion.
   b. Standing Seam Metal Roofing Scraps shall be recycled by the Standing Seam Metal Roofing Contractor.

vi. Insulation:
   a. Any spray foam insulation scraps, which should be minimal as it is only being used for air sealing, shall be separated from other construction debris and disposed of appropriately.
   b. Any fiberglass insulation removed from the Janes House or scrap from mechanical insulation shall be bundled and disposed of properly as landfill waste.

C. DISPOSAL OF WASTE

i. General: Except for items to be salvaged, recycled, or otherwise reused, remove waste materials from project site and legally dispose of them in a landfill or transfer station.
   a. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on site.
   b. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

ii. Burning: do not burn waste materials.

END SECTION 015240 – CONSTRUCTION WASTE MANAGEMENT

024119 – SELECTIVE DEMOLITION

1. SUMMARY

This section includes information for demolition of portions of the existing structure.

Related Sections:

011000	Summary and General Conditions
015240	Construction Waste Management

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	As required by related specifications
Product Cut Sheets		
Product Samples		
Mock-ups		
Closeout submittals	X	Warranty Information

3. PROJECT CONDITIONS

A. OCCUPATION OF BUILDING

i. Building will be partially occupied by owner from October 17, 2016 to November 10, 2016. Occupied portions will largely be the Town Offices and Small Meeting Room areas, and the Entry and Restroom. It is assumed that the construction work during this time period will focus on roof structural repairs, demolition, foundation and concrete work, and any work in the basement. After November 10, 2016, the building will not be occupied by the owner until the completion of construction.

B. HAZARDOUS CONDITIONS

i. Note that during the design process, two failed roof-truss-to-column connections were discovered, both on the westernmost roof truss in the attic. Remediation of these failed connections has been addressed in the structural drawings, and this work must occur before any other work occurs on the building.

C. HAZARDOUS MATERIALS

i. Remediation if encountered: by Owner.

D. PHOTO DOCUMENTATION:

i. Completely photograph all spaces prior to demolition. Provide digital photo files to Owner for record.

4. EXECUTION & QUALITY CONTROL

A. SELECTIVE DEMOLITION SCHEDULE:

i. See drawings for extent of selective demolition. General descriptions of demolition noted below:

ii. Basement Level - Demo portions of the existing boiler room to allow installation of new lift floor structure and new circulation; Remove east doors and a portion of the foundation wall to allow new door installation; remove existing structure under east portion of building (current storage room) – note this work must be coordinated with shoring or new structure installation – see structural drawings.

iii. Main Floor Level - Demo interior partition walls as shown on floor plan drawings; remove a portion of the floor for lift hoistway; create new door opening between main building and east storage (future Library 110 and Stair 111); remove interior wall surface in east storage room; remove exterior doors and windows in east storage room; remove a portion of the floor in the east storage room to allow for installation of the new stairs; remove existing ACT ceilings including window boxouts and all insulation above ceiling of main building as noted on drawings – note wood ceiling in east storage room to be preserved.

iv. Upper Level - Demo interior partition walls, parts of stage floor system, and regular floor structure to allow the construction of the lift hoistway and the interior exit stairs; demo a portion of exterior wall for new stair opening; demo south portion of east storage ceiling joists for new stairway opening; note that small portions of the ceiling under the western-most roof truss in the attic will need to be removed to allow repairs to the truss-column connection above.

v. Roof – Remove existing slate roof on the main portion of the building, including associated sheet metal flashings. Preserve lead counter-flashings at both chimneys, for reuse with new roofing; Cut holes in soffit for new soffit vents – make sure each end of each soffit board is positively attached after holes are cut; Cut out roof sheathing boards at ridge to allow ridge venting; note that at least one hole will need to be cut through the existing roof sheathing to allow the installation of the structural repairs at the attic level.

vi. Exterior – Remove both exterior stair structures on the north side of the building, including associated electrical components. Flush concrete foundations can remain in place; Cut concrete sono tube foundations flush with grade. Re-open rough opening for window that was removed to allow construction of the main external exit stair; Remove upper level exit door to create rough opening for replacement window.

vii. All unused interior doors should be salvaged and returned to the Owner.

viii. See structural drawings for extent of structural demolition.

ix. See Mechanical, Electrical and Plumbing (MEP) drawing for demolition associated with modifications to existing and proposed MEP systems.

x. All other miscellaneous demo as required to execute the project.

B. DISPOSAL:
   i. See Construction Waste Management Plan for requirements around waste disposal.
   ii. Every effort shall be made to recycle all recyclable materials.
   iii. Contractor to provide dumpster(s) for disposal of all materials.
      a. Location of dumpster to be north of building, preferably on paved parking lot.
   iv. Provide legal disposal of all demolition materials.
      a. Provide landfill records for disposal of any hazardous material.

END SECTION 024119 SELECTIVE DEMOLITION

025000 – HISTORIC RESTORATION

1. SUMMARY

This section includes information related to the historic elements of the Cornwall Town Hall. Although there is minimal construction work that directly affects historic portions of this building, one intent of this project is to preserve and restore the historic nature of the building. If adjacent works requires removal of historic character-giving elements, remove historic elements and preserve for reuse. If historic items cannot be removed without destroying them, replacement of said items should match prior item as closely as possible.

Related Sections:
024119 Selective Demolition
085200 Windows

See structural drawings for required structural reinforcing.
See MEP drawings for new building systems.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		- As required by related specifications
Product Cut Sheets		- As required
Product Samples		- As required
Mock-ups		
Closeout submittals		- Warranty Information

3. HISTORIC RESTORATION

A. NEW WINDOWS IN NORTH WALL

i. The intent of the replacement windows in the north wall is to match the windows as closely as possible to the (non-historic) existing windows, and the historic trim. Since the original wood windows have been replaced with vinyl or fiberglass windows, the intent is to construct the new windows, window trim and shutters to match the existing windows.

B. LOWER LEVEL SIDING

i. The board and batten siding at the lower level (east portion) of the building will be preserved in place. This will be fussy work, with the intent of preserving the exterior look of this building element. Note that the bottom portion will need to be cut level to allow installation of the foundation wall, in steps as shown on the building elevations.

C. SOFFITS

i. Holes will be cut into the existing flat soffits to allow for the installation of new soffit vents. New holes should be centered between decorative brackets and carefully laid out and cut.

D. LIBRARY CEILING

i. The existing ceiling in the east Library 110 space is stained wood bead board. This ceiling needs to be cleaned, and repaired where it has become disconnected from the ceiling joists above. If replacement material is required, the walls of this room are covered with the same material, which is slated to be removed. Preserve enough of the wall material to make necessary repairs.

E. STAGE WALL (PROSCENIUM)

i. The lower portion of the stage wall at the upper level will need to be modified on each side of the stage to allow for the installation of the lift and of the exit stair door and rated enclosure. The goal is to retain as much of the wall as possible, especially above the lift door "alcove". The rated wall for the exit stair enclosure will need to be constructed behind the stage wall, with the required elements for fire rating.
ii. The steps in front of the stage wall shall be carefully removed and saved for re-installation. The steps should be re-installed centered on the 4^{th} and 7^{th} panels that form the lower front of the stage.
iii. On the south side of the stage wall, the cutting of the exit door opening will require the removal of one trimmed panel on the stage front (currently behind the steps). This cut should be made cleanly at the edge of the panel. On the north, the clearances around the lift door will require the removal of one whole panel and a part of the next panel. The trim on the north side of that panel should be carefully removed, and re-installed to form a smaller panel aligned with the north edge of the stage opening.
iv. If possible, reuse the existing wood casing trim on the stage doors to form the lift alcove opening, and to trim the new exit door.

F. LOWER LEVEL WOOD FLOORS

i. The lower level wood floor will be the finished floor in any space not scheduled with a floor covering. Protect this floor during construction, and clean, prep and repaint the floor at the end of the construction process, using two coats of Porch and Floor Enamel paint.

G. UPPER LEVEL WOOD FLOOR

i. The upper level wood floor will remain as is – protect the surface of this floor from adjacent construction work.

END SECTION 025000 HISTORIC RESTORATION

061000 - ROUGH CARPENTRY

1. SUMMARY

This section includes all wood framing not noted on the structural drawings (including interior non-load bearing partitions, non-load bearing ceiling joists, soffit framing, miscellaneous framing, wood strapping at ceilings and exterior walls, wood furring, blocking and nailers in the building, and plywood backing panels for electrical panels and equipment. This section also specifically dictates the types of wood sheathing to be used as exterior wall sheathing and roof sheathing for the low-sloped portions of the roof. In addition, this section addresses the fasteners, finishes, and best practices for installation. Provide allowance for miscellaneous blocking and shimming that may be required in the building.

Related Sections:

064013	Exterior Architectural Woodwork
064023	Interior Architectural Woodwork
072500	Envelope Control Layers
076100	Standing Seam Metal Roofing.
085200	Windows
100000	All of Division 10- Specialties

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	**X**	- Shoring Plan for structural engineering review.
Product Cut Sheets	**X**	- Wood-preservative treatment and fire-retardant treatment data from manufacturer.
Product Samples	N	
Mock-ups		
Closeout submittals	**X**	Warranty Information

3. PRODUCTS

A. PRESSURE TREATED LUMBER

i. Product: Pressure Treated 2x lumber in sizes and locations as shown on the Drawings.

ii. Dimension: 1 ½” x 3 ½”, 5 ½”, 7 ¼”, or 9 ¼ " as required.

iii. Protection: Flashing membrane installed between PT lumber and metal framing.

iv. Locations: Window bucks, any wood in damp locations or in contact with concrete or masonry, blocking at roof perimeter, miscellaneous locations.

v. Fasteners Stainless steel or proven compatible with pressure treated lumber

B. DIMENSIONAL LUMBER
- i. Product: 2x lumber in sizes and locations as shown on the Drawings.
- ii. Dimension: 1 ½" x 3 ½", 5 ½", 7 ¼", or 9 ¼ " as required.
- iii. Locations: All framing locations not noted as pressure treated.
- v. Fasteners Galvanized or coated steel.

C. EXTERIOR WALL SHEATHING PLYWOOD
- i. Product: ½" exterior grade ZIP System Sheathing by Huber.
- ii. Locations: New lower east exterior walls
- iii. Installation: Per manufacturer's instructions. Note that this product is being relied on to provide air sealing performance.
- iv. Taping: All exterior seams of ZIP system plywood to be taped, including interior and exterior corners, and fastener heads in the field of the panel. Tape at edges of openings shall provide continuity with window sealing membranes and tapes.

D. EXTERIOR ROOF SHEATHING PLYWOOD
- i. Product: 1/2" CDX plywood.
- ii. Locations: All surfaces of main roof.
- iii. Installation: Nail new plywood sheathing over existing board sheathing. Use 12d nails along rafter framing, to penetrate through new plywood sheathing and existing board sheathing into rafters. Hold top edge of sheathing down from ridge to allow for ridge roof venting.

E. STAIR FRAMING
- i. Stringer: Dimensional Lumber #2 Spruce-Pine-Fir, notched to provide no more than a 7" rise 11" run stair. Install one stringer ledger-mounted at each side of stair, and two additional stringers evenly spaced in between. Each free-spanning stringer shall have a 2x6 sistered to each side, below the stair notch.
- ii. Treads: 3/4" plywood, glued and fastened to stringers, or 5/4" southern yellow pine treads.
- iii. Risers: Solid 1x or 3/4" plywood risers, glued and fastened to stringers.
- iv. Locations: New exit stair.
- v. Pre-Manufactured: Pre-manufactured wood stair units are acceptable, as long as they match the above stringer specification, or if they come with stamped structural calculations confirming that they can accommodate the 100 PSF floor loading.

F. MISCELLANEOUS FRAMING
- i. Product: dimensional and rough cut lumber, plywood.
- ii. Locations: Stage floor, replacement window openings.
- iii. Stage Floor: Existing framing under stage floor will not be known until adjacent demo opens up those areas. A new knee wall will likely need to be built under the

cut edges of the stage floor to transfer load to the floor below, or a ledger can be attached to the new walls built against the stage.

iv. Replacement Window Opening: Existing wall framing is non-standard dimension. Cut larger dimensional lumber to match existing framing around these rough opening, or use rough cut lumber to match the original size.

G. HANDICAP LIFT HOISTWAY

i. Product: Dimensional Lumber and ½" CDX Plywood

ii. Locations: Sheath all sides inside of lift hoistway with plywood. Provide solid built-up dimensional lumber blocking (generally double 2x12 header with 2x4 top and bottom, mounted vertically) at both rail locations, securely attached at top and bottom, per manufacturer's specifications.

G. PLYWOOD AND DIMENSION LUMBER BLOCKING

i. Product: ¾" exterior grade CDX plywood or 2x #2 lumber as indicated.

ii. Locations: Provide blocking as shown on the drawings and at the following:

a. Plumbing Fixtures including wall hung toilets and sinks, drinking fountains, grab bars, toilet partitions and all other toilet accessories: Plywood to extend 8" beyond fixture dimensions in all directions.
b. Base and Wall Cabinet attachment points: Centered at 34 inches for base cabinets, at top and bottom of wall cabinets as shown on the Drawings.
c. Handrail wall bracket locations: Plywood extending 8" beyond fixture dimensions in all directions.
d. Door stops: Plywood extending 8" beyond fixture dimensions in all directions.
e. Fire extinguisher hangers and cabinets: Plywood extending 8" beyond fixture dimensions in all directions.

H. PLYWOOD BACKING PANELS

i. Product: Exterior grade AC plywood, fire-retardant treated, ¾" thickness, where indicated on the drawings.

ii. Locations:

a. Boiler Room

I. WOOD STRAPPING

i. Product: 1x3 wood strapping

ii. Locations:

a. All gypsum board ceilings.
b. Interior surface of new walls in basement level east.

iii. Product: 2x4 wood strapping

iv. Locations:

a. Interior surface of new walls in new Library 110.

J. WOOD CRIBBING

i. Construct site built pressure treated wood stands for dehumidification fans located in the basement. See mechanical drawings.

K. FASTENERS
i. All Fasteners in rough carpentry to be galvanized or coated steel.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
i. 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.
ii. Attach items to substrates to support applied loading. Recess fasteners flush with surfaces unless otherwise indicated.
iii. Where wood-preservative-treated lumber is installed adjacent to metal framing or decking, install continuous flexible flashing separator between wood and metal.

B. Note that construction of the foundations and framing upgrades for the east shed portion of this building will require shoring, as will some of the truss repair and floor openings, and column removal. The strategies and implementation of the shoring are the responsibility of the contractor, but the contractor must communicate their plan for shoring in various locations to the structural engineer for approval of the concept.

END SECTION 061000 - ROUGH CARPENTRY

064013 – EXTERIOR ARCHITECTURAL WOODWORK

1. SUMMARY

This Section includes the following:

1. Exterior standing and running trim, including water table, corner boards, window and door casings and drip edges, and freeze boards.
2. Exterior decorative trim, including cornice mouldings, bed mouldings and coped flat ornamental trim.
3. Exterior trim blocks for lights and other wall mounted services.
4. Exterior soffit material
5. Exterior Wood Louver at north wall of east shed.
6. Metal drip caps/flashing as shown at horizontal trim conditions.
7. Miscellaneous exterior wood trim.

Related Sections:

025000	Historic Restoration
061000	Rough Carpentry
072100	Thermal Insulation
072500	Envelope Control Layers
099113	Exterior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets	X	For any pre-manufactured products
Product Samples	X	Each type of wood with exposed surface finished
Mock-ups		
Closeout submittals		

3. PRODUCTS

A. LUMBER TRIM FOR PAINTED FINISH

i. Species and Grade: Eastern White Pine, Eastern Hemlock-Balsam, fir-tamarack, Eastern Spruce. Grade B Select or Better
ii. Maximum Moisture Content: 15%
iii. Finger Jointing: Not Allowed
iv. Face Surface: Smooth
v. Any Knots to be BIN primed TWICE before painting.
vi. Pre-Primed stock is acceptable
vii. Will consider pre-manufactured, composite products at recommendation of contractor – per submittal process.

viii. Dimensions: as noted on drawings or to match existing trim.
a. Replacement

B. SHEET GOOD FOR SOFFITS
i. Venting will be introduced into the soffit of the east shed portion of the building. This venting is drawn as being cut into the existing soffit material, but removal of the soffit material and replacement with sheet goods is acceptable.
ii. Replacement Soffits at east sloped roof: 3/8" exterior grade MDO, primed and painted.
iii. Note – replacement of soffit material in the main roof soffits is not an option.

C. PAINTED WOOD SHUTTERS
i. Product: Brosco Atlantic Premium Shutter – 'ProSeries', Louvered Shutters
ii. Size: Match Existing Shutters
iii. Mounting: Surface mounted with coated screws.
iv. Finish: Factory prime, field painted 2 coats

D. PAINTED WOOD LOUVERS
i. Product: Brosco Rectangular Wood Louver, with flat casing.
ii. Size: B1020 (8 Slat), 1'-3 ¾" x 2'-2 1/2".
iii. Screen: Fiberglass mesh screen inside.
iv. Finish: Factory prime, field painted 2 coats

E. METAL DRIP FLASHING
i. Light gauge sheet metal "Z" flashing, with minimal (+/- 1/4") exposed leg.
ii. Color: White
iii. Location: At all locations where lap siding or clapboards come down above standing and running trim (window heads, trim bands and string courses, water tables, etc.)

F. MISCELLANEOUS MATERIALS
i. Fasteners: Provide galvanized steel nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
ii. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry.
iii. Sealants: Latex or silicone as appropriate for painted finish and water resistance.
iv. Drip edges and Z-flashing. Provide white painted drip edge and/or Z-flashing at top surface of all horizontal trim with water shedding elements above (ie siding).

4. EXECUTION & QUALITY CONTROL

A. PREPARATION

i. Store and install all lumber, sheet goods, and other material so it is flat and protected from weather and other sources of moisture.
ii. Stack lumber, sheet goods, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
iii. Do not install materials that are wet, moisture damaged or mold damaged.
iv. Clean and examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance.
v. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
vi. Proceed with installation only after unsatisfactory conditions have been corrected.

B. INSTALLATION, GENERAL

i. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
ii. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
iii. Scribe and cut exterior finish carpentry to fit adjoining work. Seal cuts and ends with same finish as material.
iv. Install to tolerance of 1/8 inch in 96 inches for level and plumb.
v. Use scarf joints for end-to-end trim joints.
vi. Stagger end joints in adjacent and related members.
vii. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
viii. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.
ix. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
x. Unless otherwise indicated, countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.
xi. Backprime all trim lumber and add primer & paint at all cuts made during installation.
xii. Sealant Use: Caulk all butt joints.
xiii. All James Hardie products to be installed per manufacturer's specific instructions for cutting, fastening, spacing, painting, etc.

C. REPAIRS AND PROTECTIONS

i. Replace exterior finish carpentry that is damaged or does not comply with requirements. Repair if work complies with requirements and shows no evidence of repair or refinishing.
ii. Protect installed products from damage from weather and other causes during construction.

END SECTION 064013 – EXTERIOR ARCHITECTURAL WOODWORK

064023 – INTERIOR ARCHITECTURAL WOODWORK

1. SUMMARY

This Section includes the following custom trim and millwork. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Interior Trim:

1. Painted wood Door 1x4 casings on all wood or composite doors.
2. Painted wood 1x4 casings and sills at all new windows, including apron.
3. Painted 5/4 x 6 wood casings, ripped to match width of existing window casings, at historic replacement windows. Install painted wood 1x stool and 5/4 apron to match existing windows. Provide painted wood extension jambs for these windows.
4. Painted wood 1x stops and extension jambs and 5/4 casings at new interior windows between Entry 101 and Town Offices 105. Extend thick head casing and associated mouldings over new opening. On the Entry side. cut existing bead board down under new window, and add new matching bead board under window in former door opening. On the Town Offices side, panels below windows will be painted gypsum board.
5. Painted wood casings around new Town Offices service window. Panel under countertop to be new wood bead board to match Entry bead board.
6. Painted wood shelves above copier in Town Offices 105.
7. Two 1x12 painted wood shelves and one hardwood closet rod in closet next to kitchenette in Small Meeting Room 104.
8. Painted wood 1x8 baseboard with beveled top to match existing at main level spaces. Note that existing baseboard removed from demolished locations may be reused in locations where the profiles butt together, to maintain continuity.
9. Clear finished hardwood handrail at new Exit Stair 211, 11 B11.
10. Clear finished hardwood wall cap at sloped top of dividing wall in Stair 111.
11. Miscellaneous interior wood trim.

Millwork:

1. Clear finished wood base cabinets and upper cabinets with PLAM countertops at kitchenette in Small Meeting Room 104.
2. Clear finished wood base cabinets with PLAM countertops at service counter in Town Offices 105.

Related Sections:

025000	Historic Restoration
061000	Rough Carpentry
081100	Doors and Frames
085200	Windows
092900	Gypsum Board
099110	Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	**X**	- Show locations of each item, dimensioned plans and elevations, large scale details, furring and blocking locations, size and location of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
Product Cut Sheets	**X**	- For plastic laminate, panel and solid-surfacing materials, cabinet hardware and accessories, finishing materials.
Product Samples	**X**	Lumber with transparent finish for each type of wood proposed, plastic laminate and solid surfacing materials, cabinet door panel, cabinet hardware and accessories.
Mock-ups	NA	
Closeout submittals	**X**	Warranty Information, O & M Information

3. PRODUCTS

NOTE: WOOD PRODUCTS AND ADHESIVES SHALL CONTAIN NO UREA FORMALDEHYDE.

A. WOOD FOR PAINTED FINISH
- i. Product: Poplar or Eastern White Pine (clear of knots), no finger jointed.
  - a. Sizes: 4/4 and 5/4 as noted on drawings.
- ii. Painting: Sherwin Williams or approved Equal – See Interior Painting Section 099110.
- iii. Priming: BIN prime any visible knots or blemishes. Prime all material on all sides prior to installation.
- iv. Sheen: Semi-gloss
- v. Fabrication: Fabricate and finish in shop where possible.

B. PAINTED WOOD MOULDINGS
- i. Product: Eastern White Pine
  - a. Sizes: N/A
  - b. Profile: Brosco, closest match to existing profiles
- ii. Priming: BIN prime any visible knots or blemishes. Prime all material on all sides prior to installation.
- iii. Sheen: Semi-gloss

C. HARDWOOD FOR CLEAR FINISH
- i. Product: Clear maple hardwood
  - a. Sizes: +/- 1 5/8" dia.
  - b. Profile: Brosco Profile #6040, or similar.
- ii. Clear Finish: Sherwin Williams, Minwax, Cabot or approved Equal – See Interior Painting Section 099110.
- iii. Fabrication: Fabricate and finish in shop where possible.

D. WOOD CABINETS
- i. Grade: Custom
- ii. AWI Type of Cabinet Construction: Flush Overlay.

iii. WI Construction Style and Type: Style B Face Frame, Type II, single-length sections to fit access openings.
iv. WI Door and Drawer Front Style: Shaker style Flat Panel Door, Flush Overlay Drawer Front.
v. Wood Species for hardwood: Clear Maple
vi. Wood Species and Cut for Exposed Surfaces: Maple, Grade A Sapwood, A1 book-matched, plain-sliced veneer panels.
vii. Wood Species and Cut for semi-exposed surfaces: Maple veneer B2 grade, plain-sliced hardwood plywood.
viii. AWI Finish System: Acrylic Lacquer or Catalyzed Polyurethane.

E. PLASTIC- LAMINATE COUNTERTOPS
i. Manufacturer: Formica Corporation, Nevamar Co., Wilsonart International or approved equal.
ii. Grade: Custom
iii. High-pressure decorative laminate Grade: HGS
iv. Colors, Patterns and Finishes
a. Match Architect's sample.
b. As selected by Architect from manufacturer's full range in the following categories: Solid Colors, matte finish, Patterns, matte finish.
v. Edge Treatment: Solid Maple Hardwood edge for transparent finish, species and cut to match cabinets. Note countertop at Service Counter will have Hardwood Edge on all edges.
vi. Core Material: Particleboard or medium-density fiberboard made with exterior glue.
vii. Backsplashes:
a. Hardwood backsplash for field application.

F. ADHESIVES AND SEALANTS
i. General: Adhesives shall not contain urea formaldehyde.
ii. VOC limits:
a. Wood Glues: 30 g/L.
b. Multi-purpose Construction Adhesives: 70 g/L.
c. Contact Adhesive: 250 g/L.
d. Sealants and caulks: 70 g/L.

G. HARDWARE
i. Include Stainless Steel vertical standards and clips for adjustable shelves. Include 10% extra clips.
ii. Rout standards into sides of bookshelves for flush mounting.
iii. See drawings for dimensions.

4. EXECUTION & QUALITY CONTROL

Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

A. FABRICATION, GENERAL
   i. Interior Woodwork Grade: Provide Custom-grade interior woodwork complying with referenced quality standard.
   ii. Ease edges to radius indicated for the following:
      a. Corners and edges of solid members and rails: 1/16”
   iii. Verify all dimensions in filed prior to fabrication and installation.

B. PREPARATION
   i. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
   ii. Examine shop-fabricated work for completion and quality. Complete work as required including back-priming.
   iii. Examine site for appropriate blocking as necessary.

C. INSTALLATION
   i. Install woodwork level, plumb true and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
   ii. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   iii. Anchor woodwork to built-in blocking.

D. ADJUSTING AND CLEANING
   i. Repair damaged and defective woodwork and/or other finishes listed, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork and/or other finishes listed. Adjust joinery for uniform appearance.
   ii. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
   iii. Protect finished woodwork from other construction as necessary to preserve integrity for final inspection and occupancy.

END SECTION 064023 – INTERIOR ARCHITECTURAL WOODWORK

071113 – FOUNDATION MOISTURE PROTECTION & DAMPROOFING

1. SUMMARY

This section identifies foundation damproofing required at the exterior surfaces of the concrete walls of the new foundation under the east portion of the building.

Related Sections:

033000	Cast-in-Place Concrete – see Structural Drawings
072100	Thermal Insulation & Envelope Control Layers

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets	X	- All listed products
Compatibility	X	- Provide confirmation of control layer and adhesive product compatibility with adjacent products.
Product Samples		
Mock-ups		
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. FOUNDATION WALL DAMP-PROOFING

i. Manufacturer: Tremco or approved equal

ii. Product: Tremco Watchdog H3, spray-applied polymer-enhanced asphalt liquid applied membrane.

iii. Properties: 40 mil cured thickness, 10 year warranty, 3' hydrostatic head resistance.

4. EXECUTION & QUALITY CONTROL

A. PREPARATION

i. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

a. Verify that substrates are free of oil, grease, dirt and other contaminants.

b. Verify that concrete is visibly dry and free of moisture and has cured for minimum time period recommended by damproofing manufacturer.

B. FOUNDATION DAMP-PROOFING

i. Apply from the top of the walls down to the top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
ii. Architect shall inspect and approve damp-proofing before installation of insulation and backfill.

C. PROTECTION
i. Keep all materials dry, clean, and protected from the weather prior to installation.
ii. Clean construction spills and remove masking materials after installation.

END SECTION 071113 – FOUNDTAION MOISTURE CONTROL & DAMPROOFING

072100 - THERMAL INSULATION

1. SUMMARY

This section identifies the thermal insulation to be used at the foundation, slab and walls, and roof, as well as interior sound insulation. In general, the foundation wall and under-slab insulation will be XPS rigid board. Rigid XPS board will also be used at specialized locations, like the edge of the slab. The existing basement will be insulated with new closed-cell polyurethane spray foam , applied over an existing layer, or over new concrete foundations. Wall insulation in new framed walls shall be dense packed cellulose insulation with rigid foam added outboard of the sheathing. Wall insulation in existing walls of Library 110 and Stair 111 will be closed-cell polyurethane spray foam, as will the sloped roof over the exist stair 111. Wall insulation in the top of the existing walls of the main building will be dense-packed cellulose. Insulation in attics and roofs will be loose-fill cellulose. Some difficult to insulate locations will require closed-cell spray foam. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Target insulation values for this project are:

Foundation walls and sub-slab	R-20
Above-Grade Walls	R-40
Roof Insulation	R-60

Note that this project will be subject to the Vermont 2015 Commercial Building Energy Standards (CBES). These regulations mandate thermal energy performance, as well as air tightness. The Thermal Insulation, Envelope Control Layers, Joint Sealant, Door, and Window specifications, in concert with the architectural drawings, provide the structure for satisfying the CBES requirements.

Related Sections:

061000	Rough Carpentry
072500	Envelope Control Layers
079200	Joint Sealant

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Details for board insulation attachment
Product Cut Sheets	X	- For each listed product
Compatibility	X	- Provide confirmation of insulation and adhesive product compatibility with adjacent products.
Product Samples		
Mock-ups		
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. FOAM-PLASTIC BOARD INSULATION
   i. Manufacturer: Dow Chemical Company, Foamular or approved equal.
   ii. Product: Extruded Polystyrene Board Insulation (XPS)
   iii. Foundation Walls: 2 layers of 2" R-10 for R-20 total, from top of footing to top of wall.
   iv. Sub-slab: 2 layers of 2" R-10 for R-20 total, under new east slab. No insulation required at new slab in boiler room.
   v. Slab Edge: 1 layer of 2" R-10 at joint between slab and foundation wall.

B. LOOSE FILL INSULATION – For Attics
   Cellulosic-Fiber Loose-Fill Insulation for Attics: chemically treated for flame resistance, processing, and handling characteristics.
   i. Manufacturer: NationalFiber
   ii. Density & Moisture Content per manufacturer's installation requirements.
   iii. Fill main attic over existing fiberglass insulation to total insulation depth noted on drawings.
   iv. Fill East shed attic to depth shown on drawings.

C. LOOSE FILL INSULATION – Dense Pack for Walls
   Cellulosic-Fiber Dense-Pack Insulation for Exterior Walls: chemically treated for flame resistance, processing, and handling characteristics.
   i. Manufacturer: National Fiber
   ii. Density & Moisture Content per manufacturer's installation requirements, 3.5 PCF minimum.

D. MINERAL-WOOL BATT- ACOUSTIC INSULATION
   i. Manufacturer: Roxul, Thermafiber or approved equal.
   ii. Product: "SafenSound" or SAFB acoustical insulation or approved equal.
   iii. Dimension: 3" thick batts where indicated.

E. RIGID BOARD INSULATION
   iv. Manufacturer: Dow Chemical Company, Johns Manville, Atlas, or equal
   v. Product: foil-faced polyisocyanurate rigid board insulation
   vi. Dimension: 2" board

F. CLOSED-CELL SPRAY POLYURETHANE FOAM
   i. Manufacturer: BASF Corporation, Dow Chemical Company, or approved equal.
   ii. Product: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, minimum density of 1.5 lb/cu. ft.
   iii. Dimension:
      a. 2" thick spray application on all basement walls of Janes House, over existing Spray Foam insulation.
      b. 3" spray application on new west foundation wall in main basement.
      c. Spray foam on basement walls shall be lapped onto new basement floor vapor barrier to form an air tight seal.

d. As shown on details for air sealing or where main insulation thickness is compromised, such as attic eaves and rim joists.
e. Insulate with 4" of spray foam at the intersection of second floor joists with the exterior wall (rim joist condition, along entire perimeter of the main building, with the exception of entry 101 and Stair 103, where this perimeter will not be exposed by adjacent ceiling work.
f. Spray foam to be installed in maximum lifts of 2" thick, with sufficient curing time between lifts. Curing time shall be based on ambient temperatures at the time of application, but shall be no less than two hours.

iv. Fire Barrier: In locations with exposed foam, provide 15 minute rated intumescent coating per life safety code.
v. Installer: Certified installer.

G. JOINT-AND-PENETRATION TREATMENT MATERIALS
i. Manufacturer: Todol Products or approved equal.
ii. Product: Pur-Fill 1G, non-CFC, Spray foam- low and high expanding as appropriate or approved equal.
iii. At window rough openings: Use only low expanding spray foam to fill cavity.
iv. At other penetrations through envelope: useSpray Polyurethane Foam. Pur-Fill can be used as necessary to supplement Spray Foam, but do not depend on Pur-Fill as air/weather barrier.

H. VENT CHUTES
i. Manufacturer: Brentwood
ii. Product: High-Energy Accuvent Original – at all loose fill or spray foam locations
iii. Product: Accuvent Cathedral Ceiling – at all dense-packed cellulose locations.

I. SOFFIT VENT – EAST SHED ROOF
i. Manufacturer: n/a
ii. Product: Continuous Aluminum Soffit Vent
iii. Size: 2" Wide
iv. Color: factory finished white
v.

J. SOFFIT VENT – MAIN ROOF
i. Manufacturer: Famco, Air Vent Inc., or similar.
ii. Product: Continuous Aluminum Soffit Vent
iii. Size: 4" Wide x 48" long. Note that segments must be purchased at 48" length to assure each vent ends with a solid border segment.
iv. Color: factory finished white.
v. Installation: Shim for vent surface to flush out with existing soffit surface. Cover nailing flanges with painted wood stops.

K. ATTIC HATCH
i. Manufacturer: N/A. Site-built – modify existing ceiling hatches.

ii. Process: Glue 6” rigid insulation board to top surface of both attic hatches. Extend edges of hatch 18” with 3/4" plywood to create a dam to hold loose fill cellulose. Plywood dam must be securely attached to ceiling framing.
iii. Seal: Weatherstrip with Conservation Technologies silicone bead or equal.

L. FASTENERS
i. Manufacturer: Adhesives.
ii. Product: Use insulation manufacturer's recommended adhesive and fastener attachment spacing for each type of insulation.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. GENERAL
i. Install only insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
ii. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
iii. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise indicated.

B. INSTALLATION OF BELOW GRADE INSULATION
i. Vertical surfaces: If not otherwise indicated extend 2” (R-10) of insulation from top of wall to top of footing and cover with a second 2” (R-10) layer with staggered joints.
ii. Horizontal surfaces: Loose lay and tightly abut horizontal insulation units. Extend insulation over the entire horizontal sub-slab surface unless otherwise indicated.

C. INSTALLATION OF EXTERIOR WALL RIGID INSULATION
i. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

D. INSTALLATION OF SPRAY-APPLIED INSULATION
i. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets penetrating walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.

E. INSTALLATION OF LOOSE FILL/DENSE PACKED CELLULOSE
i. Install per manufacturer’s recommendations.
ii. Air seal all penetrations, base and top plates prior to installation of cellulose.
iii. Install dense packed to optimum density of 3.5 PCF.

F. INSTALLATION OF INTERIOR SOUND INSULATION BATTS
i. For framed wall cavities where cavity insulation heights exceed 96 inches, support un-faced blankets mechanically.

ii. Where batts are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend wall insulation 12 inches beyond height of ceiling insulation.

END SECTION 072100 – THERMAL INSULATION

072500 – ENVELOPE CONTROL LAYERS

1. SUMMARY

This section identifies the vapor barrier used under the slab on grade, vapor, air and weather barriers at the exterior walls, and associated fasteners, sealants, and best practices for installation.

Related Sections:

033000	Cast-in-Place Concrete
061000	Rough Carpentry
072100	Thermal Insulation
073113	Foundation Moisture Protection & Damproofing
085200	Windows
079200	Joint Sealants

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets	**X**	- All listed products
Compatibility	**X**	- Provide confirmation of control layer and adhesive product compatibility with adjacent products.
Product Samples	**X**	All listed products
Mock-ups		
Closeout submittals	**X**	Warranty Information

3. PRODUCTS

A. VAPOR BARRIER SHEET MEMBRANE: SUB-SLAB AND BALLASTED WITH PEA STONE IN MAIN BASEMENT
   i. Manufacturer: Stego Industries, LLC
   ii. Product: Stego Wrap Vapor Barrier 15 mil.
   iii. Dimension: 14 ft x 140 ft roll.
   iv. Protection: Cover with 3” of pea stone, in non-slab locations.

B. JOINT-AND-PENETRATATION TREATMENT MATERIALS: ALL LOCATIONS
   i. Manufacturer: Stego Industries LLC
   ii. Product:
      a. Stego Tape- 3.75" x 180' roll polyethylene tape w/ acrylic adhesive.
      b. Stego Mastic-

C. VAPOR-RETARDER
   i. Manufacturer: Pro Clima/ Moll bauökologische Produkte
   Imported by 475 High Performance Building Supply

131 Union Street, Brooklyn NY, 11231 Tel: 718-622-1600
Email: info@foursevenfive.com; Web: www.foursevenfive.com

ii. Product: Reinforced Polyethylene Copolymer Vapor Retarder membrane 'Intello +' Class A, B & C, 15 mils thick
iii. Permeance Rating: variable
iv. Vapor-Retarder Tape and Fasteners: Pressure-sensitive tape and fasteners of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
v. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.
vi. Pipe, duct and cable sealing in Reinforced Polyethylene Copolymer Vapor Retarder: ROFLEX and KAGLEX gaskets.

D. AIR INFILTRATION BARRIER
i. Taped ZIP System Sheathing - See 061000 Rough Carpentry

E. MISCELLANEOUS MATERIALS
i. Product: Adhesives as specified by manufacturer for listed products.
ii. Product: Neoprene boots as required to accommodate stack expansion and contraction.
iii. Product: Acoustical Sealant- joint sealant for interior gaps under ¼".

4. EXECUTION & QUALITY CONTROL

Careful attention to sealing seams and penetrations in the slab vapor barrier is important to preventing any vapor transmission from the existing site soils. Store and install according to manufacturer's written instructions unless indicated otherwise.

A. PREINSTALLATION CONFERENCE
i. Perform pre-installation conference with all installers associated with the building envelope before construction of envelope components

B. PREPARATION
ii. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
a. Verify that substrates are free of oil, grease, dirt and other contaminants.
b. Verify that concrete is visibly dry and free of moisture and has cured for minimum time period recommended by air-barrier manufacturer.

C. PERFORMANCE REQUIREMENTS
i. General: Air/vapor barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration.

ii. Air/vapor-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

iii. Air/Vapor-Barrier Assembly Air Leakage: Maximum 0.1 cfm per sq. ft. of exterior shell at 50 Pa pressure.

D. GENERAL

i. See Sequence of Operations noted on the Drawings for installation procedures for each air/vapor barrier system. Install joint sealants and treatments and transition strips per manufacturer's written instructions.

E. FIELD QUALITY CONTROL

i. Inspections:

a. Air/vapor-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Notify architect before starting critical air sealing steps and as specified below.

b. Inspections will include the following:

1. Continuity of air/vapor-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air/vapor-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

ii. Testing: The Contractor shall schedule the Owner's testing agency when the building is totally enclosed, fully insulated, air barrier is installed and completed, window and doors are installed, and all items penetrating the building envelope are installed, but before any interior trim work or interior floor and ceiling finishes have been installed. The Architect and Owner shall be informed of the testing date two weeks in advance.

a. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage with smoke pencil and/or infrared camera with pressurization or depressurization.
b. Quantitative Air-Leakage Testing: Blower Door Test to comply with performance requirements.
c. Repair or remove and replace deficient air-barrier components for retesting as specified above.
d. Final Testing upon completion of the project to confirm that the project is in compliance with the CBES.

F. INSTALLATION OF VAPOR RETARDERS

i. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation. (See drawings.)
ii. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c. Tape all overlaps. Use a PRESSFIX tape pressurization tool to ensure there is sufficient back-pressure when applying the pressure sensitive Pro Clima tapes. Make sure that tape joints are not permanently under stress, i.e. are supported by a batten or by cross taping the taped joint with 12” long pieces of tape every 12”
iv. Firmly attach vapor retarders to solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
v. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders as required by vapor retarder manufacture's specifications.
vi. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

G. SUB-SLAB VAPOR BARRIER

i. Overlap seams a minimum of 6" and tape using Stego tape.
ii. Allow at least 24" overhang at edge of slab to allow wrapping from perimeter of slab up to wall sheathing and fastening with wall air/vapor barrier.
iii. Use cut pieces of Stego Wrap, Stego tape and Stego mastic to fully seal around column openings and other openings or punctures through vapor barrier.
iv. Create continuous vapor barrier around elevator pit with Stego Wrap, cut and taped as required.
v. Architect shall inspect and approve vapor barrier installation before slab pour.

H. ROOF AIR-SEALING

i. Where plumbing, HVAC, penetrate the air barrier, use a neoprene boot or appropriate tape method to seal the gap around the stack while permitting movement due to stack expansion or contraction.
ii. Seal wall air/vapor membrane to roofing membrane at parapets and coping to complete air/vapor barrier envelope.

I. PROTECTION
   i. Protect air/vapor barrier: If exposed to UV light and harmful weather exposure for more than 90 days (or as required by manufacturer), remove and replace air/vapor barrier or install additional, full-thickness, air/vapor barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
   ii. Clean construction spills and remove masking materials after installation.
   iii. Protect air/vapor barrier from contact with incompatible materials and sealants not approved by air/vapor barrier manufacturer.

END SECTION 072500 – ENVELOPE CONTROL LAYERS

074600 – SIDING

1. SUMMARY

This section includes information for the lap siding to be used for repair, replacement, and patching of the existing siding at locations where doors and exit stairs were removed. This section also addresses new lap siding for the lower wall of the east shed. In addition, this section addresses the fasteners, finishes, associated sealants, and best practices for installation.

Related Sections:

061000	Rough Carpentry
072500	Envelope Control Layers

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets		
Product Samples		
Mock-ups		
Closeout submittals	**X**	Warranty Information and maintenance information

3. PRODUCTS

A. SPRUCE OR PINE LAP SIDING
   i. Product: Ward Clapboard Mill square –edged quartersawn Spruce or White pine clapboards.
   ii. Grade: 2nd Clears.
   iii. Exposure: Match exposure on the main building (+/- 3”). Match exposure on the east shed portion of the building (+/- 3.5”). Provide minimum of 2” overlap.
   iv. Finish: Pre-primed and painted according to 099113 Exterior Painting and Staining
   v. Fasteners: Stainless steel siding nails in concert with manufacturers installation instructions.
   vi. Location: as noted above and on drawings.

B. SHEET METAL FLASHINGS AND TRIM
   i. Manufacturer: Various
   ii. Product: provide painted metal z-flashing at window head trim or any other location where lap siding intersects adjacent horizontal trim or building element.

C. GENERAL MISCELLANEOUS MATERIALS
   i. Product: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for a complete siding system and as recommended by siding manufacturer.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. INSTALLATION

i. General: Comply with all of siding manufacturer's written installation instructions.
ii. Prepare the substrate for siding application.
iii. On patches and repairs, install over 30# felt.
iv. On lower east wall, install over vertical 1x strapping, spaced 16" OC max.
v. End lap all flashing and trim at least 3".

END SECTION 074600 – SIDING

076100 – STANDING SEAM METAL ROOFING AND ACCESSORIES

1. SUMMARY

This section identifies the standing seam metal roofing to replace the slate roofing on the main building. In addition, this section addresses the fasteners, finishes, associated sealants, and best practices for installation. Note that the clip spacing on the south side of the roof will need to be designed to support future solar panels.

Related Sections:

061600	Rough Carpentry
072500	Envelope Control Layers

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Fabrication and installation layouts of flashing, trim, fasteners, cleats, clips and other attachments including plans, details of roof penetrations, edge conditions, and vented ridge cap. - Clip spacing plan, for regular roof and roof with future solar.
Product Cut Sheets	X	- For each listed product including individual components and finishes. - Roofing contractor installation authorization
Product Samples	X	Factory applied color samples of metal panel, snow guard
Mock-ups		
Closeout submittals	X	Warranty Information and maintenance manuals.

3. PRODUCTS

A. METALLIC-COATED STEEL SHEET

i. Manufacturer: Englert or approved equal.

i. Product: 24 gauge aluminum-Zinc Alloy-Coated Steel Sheet.

ii. Size and Finish: Double lock standing seam, max. 20” wide finished panels, smooth, flat.

iii. Performance: Assemblies to comply with UL 580, Class 90 wind-uplift resistance.

iv. Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping

v. Color: As selected from the manufacturer’s full range.

vi. Warranty: Provide twenty (10) year Warranty on finish, two (2) year labor and materials warranty and twenty (20) year warranty for weather tightness from date of Substantial Completion.

B. SELF-ADHERING SHEET UNDERLAYMENT
- i. Manufacturer: W. R. Grace or approved equal.
- ii. Product: Grace Ice and Water Shield or approved equal.
- iii. Dimension: 3 foot wide rolls.
- iv. Locations: At all valleys, headwalls, sidewalls, and eaves and where roofs meet adjacent building elements. Provide one 3'-0" band at all eaves.

C. HI-PERFORMANCE ROOFING UNDERLAYMENT
- i. Manufacturer: RKW Finland or approved equal.
- ii. Product: RoofTopGuard II, 5 ply polyethylene and polypropylene laminated vapor barrier roofing underlayment.
- iii. Size and Finish: 60" wide x 200' rolls.
- iv. Location: Under standing-seam metal roofing except where Ice and Water Shield is specified.
- v. Warranty: Fifty (50) year limited material warranty.

D. SHEET METAL FLASHINGS AND TRIM
- i. Manufacturer: Use 24 gauge sheet metal to match roofing panels.
- ii. Product: Drip edge, rake and eave locations, chimney flashing, vented ridge cap, and miscellaneous flashings and trim, of same sheet metal as roof panels.

E. GENERAL MISCELLANEOUS MATERIALS
- i. Product: Provide materials and types of fasteners, protective coatings, separators, sealants, ridge vent, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.

F. PIPE BOOT AT PENETRATIONS
- i. Product: Premolded, EPDM or rubber pipe collar with flexible aluminum ring bonded to base.

G. SNOW GUARDS
- i. N/A

H. GUTTER
- i. N/A

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. QUALITY ASSURANCE
   i. Fabricator Qualifications: Provide record of successful in-service performance.
   ii. UL-Certified Roll-Forming Equipment: Install on-site, roll-formed sheet metal roofing fabricated from UL-certified equipment to comply with equipment manufacturer's written instructions for UL wind-uplift resistance class indicated. Provide sheet metal roofing of full length from eave to ridge unless otherwise restricted by on-site or shipping limitations.
   iii. Preinstallation Conference:
      a. Meet with General Contractor, Owner Representative, Architect, and sheet metal roofing installer. Review and finalize construction schedule; availability of materials, methods and procedures; flashing, details and roof penetrations; access and fall protection requirements during and after roof installation.

B. EXAMINATION AND PREPARATION
   i. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
   ii. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
   iii. Clean substrates of substances harmful to installation, including removing projections capable of interfering with panel attachment.

C. INSTALLATION
   i. Standing-Seam Sheet Metal Roofing: Fasten sheet metal roofing to supports with concealed clips at each standing-seam joint at location, at spacing, and with fasteners recommended by manufacturer of portable roll-forming equipment.
   ii. The standing seam shall be equidistant and shall align for corners, hips, valleys, mullions, and columns in accordance with architectural design parameters as shown on the drawing.
   iii. All panels shall be continuous from ridge to eaves with no horizontal end laps.
   iv. End lap all flashing and trim at least 3”.
   v. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended by SMACNA.
   vi. Bar Type Snow Guards: Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with set screws. Do not use fasteners that will penetrate metal roof panels.

D. CLEANING
   i. Clean off excess sealants and clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
   ii. Touch up all minor scratches and spots.

END SECTION 076100 – SHEET METAL ROOFING AND ACCESSORIES

079200 – JOINT SEALANTS

1. SUMMARY

This section identifies the joint sealants between elements in the interior and the exterior of the building. Each trade shall be responsible for sealants associated with work they own. For joint sealants associated with particular trades and systems see the individual specification sections as listed, but not limited to, below.

Related Sections:

064023	Interior Architectural Woodwork
072500	Envelope Control Layers
076100	Standing Seam Metal Roofing
092900	Gypsum Board
093000	Tiling
099113	Exterior Painting
099123	Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	- As part of other work
Product Cut Sheets	**X**	- For each product
Compatibility	**X**	- Provide confirmation of joint sealants and adhesive products compatibility with adjacent products.
Product Samples		
Mock-ups		
Closeout submittals	**X**	Warranty Information

3. PRODUCTS

A. GENERAL

i. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content.
   a. Architectural Sealants: 250 g/L.
   b. Sealant Primers for Nonporous Substrates: 250 g/L.
   c. Sealant Primers for Porous Substrates: 775 g/L.

B. TYPICAL EXTERIOR SEALANT AND BACKER ROD

i. Manufacturer: Tremco Sealants
ii. Product: Dymeric 240 FC Multi-component Polyurethane Sealant or other Tremco sealant if more suitable to the task.
iii. Line/Color: White
iv. Backer Rod: Closed cell polyethylene backer rod in sizes as indicated on the Drawings.

C. AIR SEALING

i. Provide continuous bead of sealant between wood-framed wall plates and concrete foundation walls. Follow manufacturer's instruction for sealing of interior vapor barrier membrane to underslab vapor barrier membrane.
ii. Provide continuous bead of sealant between the bottom plate of the upper level wood-framed wall plates and second floor deck sheathing. Follow manufacturer's instruction for sealing of interior vapor barrier membrane.
iii. Provide continuous bead of sealant at top plates.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless noted otherwise.

D. JOINTS BETWEEN MATERIALS

i. Material junctions: Install Backer rod and sealant to fill the width of the cavity.
ii. Install backer rod to allow sealant depth of approximately the full joint width for joints smaller than ½".
iii. Install backer rod to allow sealant depth of approximately one-half of joint width for joints ½" and larger.

END SECTION 079200 – JOINT SEALANTS

081100 – WOOD DOORS AND FRAMES

1. SUMMARY

This section identifies the insulated doors and frames at the exterior of the building and interior wood doors and frames, and hollow metal doors and frames. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

081110	Hollow Metal Doors and Frames
087100	Door Hardware
099113	Exterior Painting
099123	Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	**X**	- Elevations and details for each door and frame
Product Cut Sheets	**X**	- For each listed product and accessory
Product Samples		
Mock-ups	NA	
Closeout submittals	**X**	Warranty Information

3. PRODUCTS

A. EXTERIOR INSULATED FIBERGLASS DOOR
   i. Manufacturer: ThermaTru or approved equal.
   ii. Product: ThermaTru SmoothStar, 4 Panel Insulated Fiberglass, pre-hung door or approved equal.
   iii. Thickness and Edge: 1-3/4 inches thick, edge construction: Model 2, Seamless.
   iv. Frame: Frame saver frame, 6 9/16" jambs, pre-hung.
   v. Fully weatherstripped.
   vi. Finish: Paint interior and exterior.

B. WOOD INTERIOR DOORS
   i. Manufacturer: Simpson, Lemieux or approved equal.
   ii. Product: Wood door, clear pine, poplar or approved equal.
      a. 4 panel door with Ovolo sticking, Simpson #44 or approved equal.
   iii. Finish: Primed for paint.
   iv. Thickness: 1-3/4 inches thick.
   v. Frame: Pre-hung frame. Primed for paint.

C. FIRE RATED INTERIOR DOORS
   i. Wood Door: 45 min. positive pressure fire rated door in approved fire rated frame.
      a. Simpson 9244, 4 panel 1 ¾" interior pre-hung door primed for paint.
      b. Millenium Collection 6014, 4 panel 1 ¾" "Encore" door primed for paint.
   ii. Metal Door: Flush metal 45 min. positive pressure fire rated door.
      a. Flush Panel, square edge, Min. 20 gauge steel faces. Comply with ANSI/SDI A250.8.
      b. Thickness and Edge: 1-3/4 inches thick, edge construction: Model 2, Seamless.
      c. SDI Standard Duty: Level 1, Performance Level C.
      d. 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.
      e. Finish: Primed for paint.

D. STANDARD HOLLOW METAL FRAMES
   i. Manufacturer: TBD
   ii. Product: Hollow Metal Frames
      a. Interior Frames: Cold-rolled steel sheet. Primed for finish paint. Knock-down frame acceptable. "After Rock" frame required.
      b. Exterior Frames: Thermally broken frames fabricated from metallic-coated steel sheet.
   ii. Fabrication:
      a. Full profile welded frames with mitered corners unless otherwise indicated.
      b. Minimum .042 inch steel sheet for steel and wood doors and borrowed lights
      c. Shop Priming: Manufacturer's standard, fast-curing, lead- and chromate-free primer.

E. FRAME ANCHORS
   i. Jamb Anchors: Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   ii. Floor Anchors: Clip-type anchors formed from same material as frames, not less than 0.042 inch thick, with two holes to receive fasteners.

4. EXECUTION & QUALITY CONTROL

Deliver, store and install according to manufacturer's written instructions unless otherwise indicated.

A. PREPARATION
   i. 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 items to Project site in time for installation.

B. FABRICATION
   i. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

C. INSTALLATION
   i. Wood or Hollow Metal Frames:
      a. Set frames plumb, aligned and square with no twist- 1/16 inch tolerances, shim as necessary.
      b. Secure frames appropriately for the frame and wall type.

D. ADJUSTING AND CLEANING
   i. 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.
   ii. Protect Hardware from finish painting, sealing.

END SECTION 081100 - WOOD DOORS AND FRAMES

081113 - HOLLOW METAL DOORS AND FRAMES

1. SUMMARY

This section identifies the hollow metal doors at basement level of the building, including fire rated assemblies. In addition, this section addresses the fasteners, finishes, and best practices for installation. Note that the wheelchair lift doors should be provided by the wheelchair lift supplier.

Related Sections:

081100	Doors and Frames
087100	Door Hardware
099123	Interior Painting
144400	Wheelchair Lifts

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Elevations and details for each door and frame
Product Cut Sheets	X	- For each listed product and accessory
Product Samples	X	12" length of Frame material
Mock-ups		
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. STANDARD HOLLOW METAL DOORS:

i. Manufacturer: TBD

ii. Product: Flush Panel, square edge, Min. 20 gauge steel faces. Comply with ANSI/SDI A250.8.

iii. Thickness and Edge: 1-3/4 inches thick, edge construction: Model 2, Seamless.

iv. Interior Doors: Uncoated, cold-rolled steel sheet.

a. SDI Standard Duty: Level 1, Performance Level C.
b. Uncoated, cold-rolled steel sheet.
c. Core: Manufacturer's standard Kraft-paper honeycomb, polystyrene, polyurethane, mineral board or vertical steel stiffener.

v. Fire-Rated Door Assemblies:

a. 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.
b. Temperature-Rise Limit: At vertical exit enclosures and exit passageways provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
c. Glazing Dimension: 100 square inch window maximum.

vi. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet.
   a. SDI Extra Heavy Duty: Level 3, Performance Level A.
   b. Provide thermal-resistance value not less than R-4 at exterior doors.
   c. Core: Manufacturer's standard, polyurethane.

vii. Shop Priming: Manufacturer's standard, fast-curing, lead- and chromate-free primer.

B. STANDARD HOLLOW METAL FRAMES

i. Manufacturer: TBD

ii. Product: Hollow Metal Frames
   a. Interior Frames: Cold-rolled steel sheet.
   b. Exterior Frames: Thermally broken frames fabricated from metallic-coated steel sheet.

iii. Rating: Hollow Metal Frames
   a. Provide Assembly complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

iv. Fabrication:
   a. Full profile welded frames with mitered corners unless otherwise indicated.
   b. Minimum .042 inch steel sheet for steel and wood doors and borrowed lights
   c. Hardware reinforcement plates as required
   d. Shop Priming: Manufacturer's standard, fast-curing, lead- and chromate-free primer.
   e. Door Silencers: Except on weather-stripped doors, drill stop in strike jamb to receive three door silencers.

v. Throat Size:
   a. Provide frame throat size ¼" larger than assembly components

C. FRAME ANCHORS

i. Jamb Anchors: Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

ii. Floor Anchors: Clip-type anchors formed from same material as frames, not less than 0.042 inch thick, with two holes to receive fasteners.

E. STOPS AND MOLDINGS

i. Moldings for Glazed Lights in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

ii. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated

iii. Loose Stops for Glazed Lights in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed

4. EXECUTION & QUALITY CONTROL

Deliver, store and install according to manufacturer's written instructions unless otherwise indicated.

A. PREPARATION
   i. 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 items to Project site in time for installation.

B. FABRICATION
   i. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
      a. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections

C. INSTALLATION
   i. Hollow Metal Frames:
      a. Set frames plumb, aligned and square with no twist- 1/16 inch tolerances.
      b. At fire-protection-rated openings, install frames according to NFPA 80.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Secure frames appropriately for the wall type.
      e. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors or powder-actuated fasteners.
      f. Install door silencers in frames before grouting.
      g. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames
   ii. Hollow Metal Doors:
      a. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
   iii. Glazing:
      a. Secure stops with countersunk flat-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

D. ADJUSTING AND CLEANING
   i. 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.

END SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

083113 – ACCESS DOORS AND FRAMES

1. SUMMARY

This section identifies the access door and frames required for accessing portions of the mechanical, plumbing and fire protection systems. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:
061000 Rough Carpentry
092900 Gypsum Board

See Mechanical, Plumbing and Fire Protection Drawings for access door locations.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Elevations, sections, details of each door type, locations and extent of hardware blocking.
Product Cut Sheets	X	- For each type of door and frame indicated.
Product Samples		
Mock-ups		
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS
   i. Basis-of-Design Product: Acudor Products, Inc., DW-5040 Drywall, Flush Access Doors with Concealed Flanges.
      a. Size: as required, 12 inches wide x 12 inches high minimum.
      b. Finish: Prime Coated Steel. Field painted finish to match wall.
      c. Lock: Cylinder lock and key, Torx head cam Latch, or Spanner head cam latch.
      d. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless otherwise indicated.

A. INSTALLATION
   i. Install doors in drywall surfaces flush with adjacent finish surfaces before taping to receive finish material.
   ii. Adjust doors and hardware, after installation, for proper operation.

END SECTION 083113 – ACCESS DOORS AND FRAMES

085200 – WINDOWS

1. SUMMARY

This section identifies the new windows in the exterior walls of the main building and the east shed portion of the building.. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

025000	Historic Restoration
061000	Rough Carpentry
064023	Interior Architectural Woodwork
064013	Exterior Architectural Woodwork
072500	Envelope Control Layers
099110	Exterior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Plans, elevations, sections, details, attachment hardware
Product Cut Sheets	X	- For each listed product
Compatibility	X	- Provide confirmation of product and accessory product compatibility with adjacent products.
Product Samples	X	- Window corner section
Mock-ups		-
Closeout submittals	X	- Manufacturer's standard warrantee Information - Operations & Maintenance Information

3. PRODUCTS

A. FIBERGLASS WINDOWS:
   i. Manufacturer: Integrity Windows, or approved equal.
   ii. Product: Integrity Wood/Ultrex Windows
      a. Operable: Double Hung for replacement windows in the north wall of the main building.
      b. Operable: Casement windows for all windows in the Library 110 and Stair 111.
   iii. Color: Exterior-White fiberglass, Interior- factory finished white.
   iv. Performance: FW-LC50 rating, .30 cfm per square foot of frame max.
   v. Thermal Transmittance: Whole window U- factor of.28 max.
   vi. Glazing: 11/16" insulated glass, LowE2- 272 with argon, Solar Heat Gain Coefficient: .23.

vii. Simulated Divided Lites (SDL): 7/8", as shown on elevation drawings, white, interior white factory finish.
viii. Nailing Fin: Factory installed nailing fin at head, and side jambs, none at sill.
ix. Sizes: Standard sizes or custom sizes as shown on the Drawings.
x. Hardware: Standard Hardware, Color White

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless otherwise indicated.

A. EXAMINATION
i. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify rough opening dimensions, levelness of sill plate, and operational clearances
ii. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weather-tight window installation.
iii. Correct unsatisfactory conditions before proceeding with window installation.

B. INSTALLATION – NEW WINDOWS
i. Install window opening flashings in proper sequence with vapor/air barrier assembly.
ii. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weather tight construction. Follow manufacturer’s recommended installation and fastening instructions.
iii. Seal around window with low expanding spray foam and joint sealants.

C. ADJUSTMENT, CLEANING, AND PROTECTION
i. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weather tight closure.
ii. Clean exposed surfaces immediately after installing windows. Keep protective films and coverings in place until final cleaning.

END SECTION 085200 - WINDOWS

087100 – DOOR HARDWARE

1. SUMMARY

This section identifies the door hardware for all doors at the exterior and interior of the building and accessory hardware. In addition, this section addresses the fabrication, fasteners, finishes and best practices for installation.

Related Sections:

081100	Doors and Frames
081113	Hollow Metal Doors and Frames

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- For each product, including locations and schedule
	X	- Templates for door and frame fabrication for each product
Product Cut Sheets	X	- For each listed product
Product Samples		
Mock-ups		
Closeout submittals	X	Warranty Information, Maintenance information

3. PRODUCTS

A. INTERIOR AND EXTERIOR DOOR LOCKS AND LEVERS
   i. Manufacturer: Sargent Manufacturing Company (Assa Abloy)
   ii. Product: Sargent 10 Line Cylinder Locks- 2 1/8" bore, 2 3/4" backset, ½" min. bolt throw.
      a. Finish: US26D, 626 Satin brass, Chrome plated.
      b. Lever: P Lever

B. FIRE EXIT DEVICES FOR STANDARD DOORS
   i. Manufacturer: Sargent Manufacturing Company (Assa Abloy)
   ii. Product: Sargent 8800 Series Rim Exit Device
      a. Finish: US26D, 626 Satin brass, Chrome plated
   iii. Devices complying with NFPA 80.

C. KEYING
   i. Manufacturer: Sargent
   ii. Cylinders: Seven pin, stainless steel, manufacture's standard tumbler
      a. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, raised trim ring.

iii. Permanent Cores: Manufacturer's standard lock cylinders, face finished to match lockset, permanent cores that are interchangeable; Core insert, removable by use of a special key, usable with other manufacturer's cylinders.
iv. Construction Keying/Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
v. Keying system: Provide a factory registered keying system complying with the following:
   a. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
vi. Keys: Provide Nickel silver keys complying with the following:
   a. Stamping: Permanently inscribe each key with a visual key control number and include the following notation: "DO NOT DUPLICATE".

D. ELECTROMAGNETIC FIRE DOOR HOLDER
   i. Manufacturer: Sargent Manufacturing, Architectural Builders Hardware, DORMA Architectural Hardware, or approved equal.
   ii. Product: Surface wall mounted single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies, with die cast housing. Fail safe magnets hold until current is interrupted.
   iii. Alternate Product: LCN 4040SE Non-handed Sentronic Door Closer- Closes under fire conditions.

E. HINGES AND PIVOTS
   i. Standards: Comply with the appropriate BHMA standard, comply with NFPA 80 at fire-rated doors.
   ii. Provide three hinges for each door unless noted otherwise.
   iii. Hinge weight:
      a. Entrance Doors: Heavy-weight anti-friction bearing hinges.
      b. Interior Doors: Standard-weight anti-friction bearing hinges.
   iv. Hinge Base Metal:
      a. Exterior and Wet Areas: Stainless steel with stainless-steel pin.
      b. Interior and Fire-rated Assemblies: Steel with steel pin.
   v. Provide non-removable pins at out-swinging corridor doors with locks.

F. STRIKES
   i. Manufacturer: Sargent or approved equal.
   ii. Provide BHMA Grade 1 dustproof manufacturer's standard strike and strike box for each latch and bolt, with curved lip extended to protect frame, finished to match door hardware set.

G. CLOSERS
   i. Manufacturer: Sargent Manufacturing Company (Assa Abloy)

ii. Product: 1431 Series Aluminum Closer, non-handed arm with adjustable forearm assembly. Mounts hinge side, top jamb, or parallel arm. Single piece cast aluminum body. ANSI Grade 1.
iii. Adjustable to meet ADA code required time delays.

H. STOPS AND HOLDERS
i. Wall Stops: Typical, provide blocking at each location.
ii. Floor Stops: For locations where wall stops are impractical. Do not mount where door stops will impede traffic.
iii. Silencers for Metal Door Frames: BHMA Grade 1, neoprene or rubber, min. ½" diameter, fabricated for drilled-in application of frame.

I. DOOR GASKETING
i. Exterior Doors: Provide continuous weather-strip gasketing at perimeter, meeting stile, and door bottoms.
a. Air leakage not to exceed 0.5 cfm per foot of crack length.
ii. Fire-Label Gasketing: Included in door design, or comply with NFPA 80 for fire ratings indicated.

J. THRESHOLDS
i. Exterior Threshold: Thermally broken aluminum.
ii. Dimension: As shown on the Drawings.

4. EXECUTION & QUALITY CONTROL

Install according to manufacturer's written instructions unless specifically noted otherwise.

A. GENERAL
i. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
a. Standard Steel Doors and Frames: ANSI/SDI A250.8
b. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
ii. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
iii. Proceed with installation only after unsatisfactory conditions have been corrected.

B. LOCK CYLINDERS
i. Install construction cores to secure building and areas during construction period.
ii. Replace construction cores with permanent cores as directed by Owner or furnish permanent cores to Owner for installation.

C. ADJUSTMENT

i. 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.
ii. Provide occupancy adjustment 3 months after date of Substantial Completion.

D. CLEANING AND PROTECTION
i. Clean adjacent surfaces soiled by door hardware installation and clean operating items as necessary to restore proper function and finish.
ii. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END SECTION 087100 – DOOR HARDWARE

092900 - GYPSUM BOARD

1. SUMMARY

This section identifies the interior gypsum board to be used for wall finish and ceiling finishes in the interior of the building, as well as in rated assemblies. The gypsum board shall be installed on a wood studs or strapping, taped, and finished with paint or other finishes. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

061000	Rough Carpentry
096513	Resilient Base and Accessories
099123	Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	-
Product Cut Sheets	X	- for each listed material
Product Samples	X	- Expansion joint, tear-away bead, j-bead, corner bead
Mock-ups		
Closeout submittals	X	Warranty Information, O & M Information

3. PRODUCTS

A. INTERIOR TYPE "X" GYPSUM BOARD
- i. Manufacturer: USG, American Gypsum, Georgia Pacific or approved equal.
- ii. Product: Type “X” fire-rated gypsum wall board.
- iii. Dimension: 5/8"x 4'x 8-12' sheet
- iv. Locations: All locations except as noted for MR below.

B. MOISTURE AND MOLD-RESISTANT GYPSUM BOARD
- i. Manufacturer: USG, American Gypsum, Georgia Pacific or approved equal.
- ii. Product: Moisture and mold-resistant core and paper surface gypsum wall board.
- iii. Dimension: 5/8"x 4'x8' sheet.
- iv. Locations: All toilet rooms, Boiler room, and kitchenette.

C. INTERIOR TRIM ACCESSORIES
- i. Product: Galvanized or vinyl shapes.
  - a. Cornerbead – all cornerbead in circulation areas to be galvanized metal corner bead fastened with nails or screws at a minimum of 16” O.C.
  - b. Tear-away bead – for flat transitions to adjacent materials.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.

d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint. Required every 30' for walls longer than 30'.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

D. JOINT TAPES
i. Product: Paper tape allowed except at tile backer board locations.

E. JOINT COMPOUND FOR INTERIOR GYPSUM BOARD
i. Product: All-purpose compound or as required.

F. ACOUSTICAL AND FIRESTOP SEALANTS
i. Manufacturer: USG or approved equal.
ii. Product: "Sheetrock" brand acoustical Sealant, Low VOC, for acoustic joint assemblies.
iii. Product: see section 078400 Fire-Resistive Joint Systems for Firestop Sealant products and locations.

G. AUXILIARY MATERIALS
i. Products: Steel drill screws.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless indicated otherwise. Install control joints where indicated on the Drawings.

A. INSTALLATION, GENERAL
i. All interior gypsum work shall meet applicable standards for workmanship regarding appearance and structural integrity.
ii. Level 4 finish unless otherwise indicated- for primer and finish application see Section 099123 Interior Painting.

B. INSTALLATION, CEILINGS
i. All interior gypsum ceilings shall be mounted on 1x3 wood strapping, affixed to joists or framing above ceiling surface. Ceiling work shall meet applicable standards for workmanship regarding appearance and structural integrity.
ii. Level 4 finish unless otherwise indicated- for primer and finish application see Section 099123 Interior Painting.

C. PROTECTION OF WORK
i. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

ii. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
iii. Reject, remove and replace panels that are wet, moisture or mold damaged.

END SECTION 092900 – GYPSUM BOARD

093000 – CERAMIC TILE

1. SUMMARY

This section identifies the ceramic tile flooring in Accessible Restroom 104. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

092900	Gypsum Board
096513	Resilient Base and Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Tile layout and details for installation
Product Cut Sheets	X	- Each type of tile and other materials listed
Product Samples	X	Each tile and grout listed
Mock-ups		
Closeout submittals	X X	Warrantee Information Care and maintenance information

3. PRODUCTS

A. PORCELAIN MOSAIC TILE- TOILET ROOM FLOORS

i. Manufacturer: Daltile or approved equal.

ii. Product: Colorbody Porcelain ceramic mosaic porcelain tile dot-mounted on 12”x24” sheets.

a.Color 1: 2” hexagon x 1/4" thickness field tile, white with black accents. (Heaxagon DK16)

iv. Underlayment: 1/4" Hardi panel, screwed and thinset to existing wood floor.

iv. Setting Material: Latex modified thin-set on concrete.
v. Grout: Epoxy sanded grout for tile dot-mounted on 12”x24” panels.

B. WATERPROOFING MEMBRANE- AT ALL TOILET ROOM FLOORS
i. Manufacturer: Laticrete International Inc. or approved equal.
ii. Product: Laticrete Hydro Ban single component self-curing liquid rubber polymer waterproofing membrane, Greenguard Certified.

C. SEALANT/CAULK (JOINTS AND CORNERS)
i. Manufacturer: As chosen by Subcontractor.
ii. Product: Low VOC materials, as needed for a complete installation.

D. ACCESSORY MATERIALS
i. Schluter Reno-TK brushed nickel aluminum transition strip to adjacent non-tile flooring.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION
i. Substrates to be free of coatings, sealers or hardeners.

B. INSTALLATION
i. Install only after concrete and other substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, have cured, and are dry to bond with adhesive as determined by manufacturer's recommended test. Install after painting and ceiling operations have been completed.
ii. Waterproof concrete under toilet room tile according to manufacturer’s written instructions.
iii. Comply with manufacturer's written instructions for cleaning and protection after installation.

C. PROTECTION
i. Cover until Substantial Completion.

END SECTION 093000- TILING

096513 - RESILIENT BASE AND ACCESSORIES

1. SUMMARY

This section identifies the resilient base and accessories to be used for base trim. This section also includes the rubber stairs treads and flooring that occurs at new exit stairs. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:
096813 Tile carpeting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets	X	- For all listed products.
Product Samples	X	Resilient base, stair treads and accessories.
Mock-ups		
Closeout submittals	X	Warranty Information, Operations & Maintenance Information.

3. PRODUCTS

A. RESILIENT BASE
- i. Manufacturer: Burke Flooring, Endura Rubber Flooring, Felxco Inc., Nora Rubber Flooring, Roppe Corp. or approved equal
- ii. Product: Type TS (Vulcanized Thermoset Rubber), Group 1, (solid, homogeneous), straight at carpet, cove at resilient flooring
- iii. Dimension: 4" height, 0.125" minimum thickness, coils in manufacturer's standard length.
- iv. Corners: Job formed.
- v. Finish: Satin finish, colors as selected by Architect from the full range of industry colors.

B. RESILIENT STAIR ACCESSORIES
- i. Manufacturer: Burke Flooring, Endura Rubber Flooring, Felxco Inc., Nora Rubber Flooring, Roppe Corp. or approved equal.
- ii. Product: Type TS (vulcanized thermoset rubber), Class 2, Pattern,
  - a. Raised-square treads w/square nosing, integral smooth risers, 2" nosing height, 1/4 inch thickness tapered to back edge, one piece per tread.
  - b. Landing tiles (matching).
- iii. Colors: From full range of manufacturer’s colors including solids and patterns.

C. RESILIENT ACCESSORIES
- i. Manufacturer: Burke Flooring, Felxco Inc., Roppe Corp. or approved equal.
- ii. Product: Thermoset Rubber

a. Transition strips to adjacent flooring.

D. INSTALLATION MATERIALS
- i. Trowelable Leveling and patching compounds- Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- ii. Adhesives: Water-resistant, VOC content of 60 g/L or less.
- iii. Stair-tread-nose filler: Two-part epoxy compound.
- iv. Metal edge strips: Mill finish extruded aluminum.
- v. Floor polish: As recommended by manufacturer.

E. MAINTENANCE MATERIALS
- i. Resilient Flooring: Furnish sheet material or full-size units equal to 5 percent of amount installed for each type indicated, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION
- i. Prepare substrates to be free of coatings, sealers or hardeners. Fill cracks, holes and depressions w/ trowelable compound. Install only after concrete and other substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

B. INSTALLATION
- i. Comply with manufacturer's written instructions for installation using maximum lengths possible and inside and outside corners. Tightly adhere material to substrate throughout surface of each piece.
- ii. Install after painting and ceiling operations have been completed.

C. CLEANING AND PROTECTION
- i. Comply with manufacturer's written instructions for cleaning and protection after installation.
- ii. Cover until Substantial Completion.

END SECTION 096513- RESILIENT BASE AND ACCESSORIES

096813 - TILE CARPETING

1. SUMMARY

This section identifies the tile carpeting in Town Offices, Library and Reading room areas of the building. In addition, this section addresses the fabrication, fasteners, finishes and best practices for installation.

Related Sections:
096513 Resilient Base and Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets	X	- Documentation of CRI's "Green Label Plus" program compliance and adhesive VOC content for each product.
Product Samples	X	Of each type of carpet tile.
Mock-ups		
Closeout submittals	X	Warrantee Information

3. PRODUCTS

A. CARPET TILE
   i. Manufacturer: Bentley Price Street, Shaws, Mannington or approved equal.
   ii. Product: Tufted Carpet as selected by Tenant/Architect to meet the following specifications.
      a. Allowance: $38/square yard (installed).
      b. Warranty: 10 years
      c. Certification: Compliance with testing and product requirements of CRI's "Green Label Plus" program and/or Green Guard certified.
      d. Fiber Content: 100 percent nylon 6, 6.
      e. Pile Characteristic: Level-loop or multilevel-loop pile.
      f. Density: 8,400 oz./cu. yd.
      g. Face Weight: 28 oz./sq. yd.
      h. Installation: Direct glue-down.
   iii. Types indicated on Finish Schedule:

B. INSTALLATION ACCESSORIES
   i. Trowelable Leveling and Patching Compound: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
   ii. Adhesives: Water-resistant, VOC content of 50 g/L or less. Pressure-sensitive type to suit products and subfloor conditions indicated, for releasable installation.

iii. Metal Edge/Transition Strips: Extruded mill finish aluminum in profiles as required to neatly protect exposed carpet edges.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

i. Verify that slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

ii. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch.

B. INSTALLATION

i. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

ii. Do not mix dye lots in same area.

iii. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

C. CLEANING AND PROTECTION

i. Remove excess adhesive, seam sealer, protruding yarns, and other surface blemishes using cleaner recommended by carpet tile manufacturer.

ii. Vacuum carpet tile using commercial machine with face-beater element.

iii. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

D. MAINTENANCE MATERIALS

i. Carpet Tile: Furnish Full-size units equal to five percent of amount installed for each type indicated, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

END SECTION 096813 - TILE CARPETING

099113 - EXTERIOR PAINTING

1. SUMMARY

This section identifies the painting of the new exterior siding, trim boards, and soffit portions of the building. This section also addresses surface preparation and painting for patches and repairs to the existing building.

Related Sections:

062013	Exterior Finish Carpentry
099123	Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	**X**	- For each type of primer and paint
Product Samples		
Mock-ups	NA	
Closeout submittals	**X**	Warranty Information

3. PRODUCTS

A. PAINTS GENERAL
   i. Basis of Design:
   ii. VOC Content: Comply with the following:
      a. Low VOC - 50 g/L max. Eggshell, 150 g/L max. non-flat.
   iii. Colors: As selected by the Architect from the manufacturer's full range.

B. EXTERIOR PRIMER/SEALER FOR WOOD AND ENGINEERED WOOD
   i. Alkyd primer/sealer compatible with manufacturer's finish coat.

C. WATER-BASED PAINTS
   i. Latex Exterior Satin

D. MAINTENANCE MATERIALS
   i. Product: Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      a. Paint: portions of paint partially used for project work.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions and recommendations in "MPI" Manual unless specifically noted otherwise.

A. PREPARATION
   i. Examination of Substrates:
      a. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
         1. Concrete: 12 percent.
         2. Wood: 15 percent.
   ii. Clean substrates of substances that could impair bond of paints
   iii. Special care to be taken with historic building components and exterior painted brick at Janes House.
   iv. For existing building, test for lead as required by the State of Vermont.
   v. Fully scrape existing building as necessary. Contain and paint chippings that are loose and removed. Dispose of as required by the State of Vermont.

B. APPLICATION
   i. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
   ii. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. CLEANING AND PROTECTION
   i. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
   ii. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

D. EXTERIOR PAINTING SCHEDULE
   i. Wood Substrates
      a. Two finish coats over primer:
         1. Siding Finish: Exterior Satin, or match finish of existing siding.
         2. Trim boards, Soffits Finish: Exterior Satin, or match finish of existing trim.

END SECTION 099113- EXTERIOR PAINTING

099123 - INTERIOR PAINTING AND STAINING

1. SUMMARY

This section identifies the interior painting on gypsum, doorframes, trim, columns, and painted wood floors in the building. It also identifies the staining and finishing of interior wood trim.. In addition, this section addresses the best practices for installation.

Note that all interior walls and trim of all rooms on the main floor level will be repainted as part of this project, with the exception of W.C 102, Stair 103, Mop Closet 104B and Vault 106. Existing walls on the upper level will not be repainted, except as required by lift and stair work and roof truss repair work. New walls on all levels will be painted.

Related Sections:

064023	Interior Architectural Woodwork
081113	Doors and Frames
092900	Gypsum Board
099113	Exterior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	**X**	- For each type of primer and paint
Product Samples	**X**	30" square on-wall samples of main wall color.
Mock-ups		
Closeout submittals	**X**	Warranty Information

3. PRODUCTS

A. PAINTS GENERAL
   i. Manufacturer: Sherwin Williams or approved equal.
   ii. Product: ProMar 200 or approved equal.
   iii. VOC Content: Comply with the following:
      a. Low VOC flat or eggshell, < 150 g/L max. gloss.
   iv. Colors: As selected by the Architect.

B. INTERIOR PRIMER/SEALER
   i. Latex based interior: SW ProGreen Low Odor Interior Latex Primer or approved equivalent (MPI #50 or Institutional Low Oder/VOC MPI #149)

C. FLOOR PAINT
   i. Sherwin Williams Porch and Floor Enamel

ii. Satin Finish

D. WATER-BASED PAINTS
iii. Latex Interior Eggshell, (Gloss Level 2): MPI #44
iv. Latex Interior Semi-gloss, (Gloss Level 5): MPI # 54

E. STAINS AND TRANSPARENT FINISHES AND WOOD FILLER GENERAL
i. Manufacturer: As chosen by Subcontractor to meet criteria below unless Manufacturer is specified.
ii. VOC Content: Comply with the following:
a. Clear Wood Finishes, Polyurethane: VOC not more than 250 g/L.

F. CAULK/SEALANT
i. Non-VOC Caulks and Sealants as required for the work.

G. MAINTENANCE MATERIALS
i. Product: Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
a. Paint: 5 percent, but not less than 1 gal. of each main wall color and main trim color.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions and recommendations in "MPI" Manual unless specifically noted otherwise.

A. PREPARATION
i. Examination of Substrates:
a. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.
4. Plaster: 12 percent.
b. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
c. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
ii. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting. Reinstall items that were removed.

B. APPLICATION
   i. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
   ii. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. CLEANING AND PROTECTION
   i. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
   ii. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

D. INTERIOR PAINTING AND STAINING SCHEDULE
   i. Concrete Substrate:
      a. Water-Based Clear Sealer System- 2 coat system at basement level exposed concrete slabs.
   ii. Primed Steel Substrates: Door Frames
      a. Latex over Shop Primer System
         1. Touchup of Shop Primer; Intermediate Coat, semi-gloss, (Gloss Level 5); Topcoat, semi-gloss, (Gloss Level 5).
   iii. Gypsum Substrates:
      a. Two finish coats over primer
         1. Finish Coats: SW ProGreen Low Odor Interior Latex, (4 mils wet, 1.4 mils dry per coat)
            a. Gypsum Board Ceilings: Flat
            b. Gypsum Board Walls (excluding toilet room): Eggshell (Gloss Level 2)
            c. Gypsum Board Walls in Toilet Room: Satin
   iv. Wood Substrates, nontraffic:
      a. Window and Door Trim and other Wood Trim
         1. Two Finish Coats over primer: SW ProGreen Low Odor Interior Latex Semi-Gloss, (4 mils wet, 1.4 mils dry per coat)

   v. Wood Substrates, traffic:
      a. Re-finishing existing painted wood floors.
         1. Clean and prep existing floor prior to re-painting.
         2. Two Finish Coats over existing floor paint: SW Porch and Floor Enamel.

END SECTION 099123 - INTERIOR PAINTING

102800 - TOILET ACCESSORIES

1. SUMMARY

This section identifies the toilet accessories new Accessible Restroom 107

Related Sections:

061000	Rough Carpentry- blocking
092000	Gypsum Board
093000	Tiling

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Accessory schedule with type and quantity for each room using room numbers on the Drawings. - Location of wall blocking required for each accessory.
Product Cut Sheets	X	- Manufacturer's data sheets
Product Samples		
Mock-ups		
Closeout submittals	X	Warrantee Information. Cleaning, maintenance, and replacement parts information.

3. PRODUCTS

A. STAINLESS STEEL TOILET ACCESSORIES
   i. Manufacturer: Bradley, Bobrick
   ii. Product:
      a. Toilet Paper holder - Bobrick Model B-2840, surface mounted double-roll dispenser with Utility Shelf.
      b. Towel Dispenser: Bobrick Model B-4262, surface mount
      c. Mirror: Bobrick Model B-165, channel frame mirror 24"x36".

B. GRAB BARS
   i. Manufacturer: Bradley, Bobrick or approved equal.
   ii. Product: Bradley Model 832, Bobrick B-5806 straight grab bar, 36" behind toilet and 48" beside toilet.
   a. 1-1/4" (32mm) dia. tubing. Constructed of 18-gauge, type 304 satin- finish stainless steel tubing. Concealed mounting flange 1⁄8" thick, type 304 stainless steel plate, 2" W x 3 1⁄8" H, with screw holes for concealed anchors. Cover is 22-gauge, type 304 stainless steel with satin finish, 3 1⁄4" diameter. Cover snaps over mounting flange to conceal screws.

D. UNDERLAVATORY GUARDS
   i. Manufacturer: Plumberex Specialty Products, Truebro by IPS Corp. or equal.
   ii. Product: Insulating white molded plastic pipe covering for supply and drain piping assemblies; allow service access without removing coverings.

E. LIQUID SOAP DISPENSOR
   i. Manufacturer: Bradley, Bobrick
   ii. Product: Bradley Model 6562, Bobrick B-4112, 818615 or similar, 40 oz. capacity.

4. EXECUTION & QUALITY CONTROL

Install according to manufacturer's written instructions unless specifically noted otherwise.

A. INSTALLATION
   i. 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, conforming with ADA regulations.
   ii. Grab Bars: Install to withstand a downward load of at least 250 lbf.

END SECTION 102800 - TOILET AND BATH ACCESSORIES

104400 – FIRE EXTINGUISHERS AND CABINETS

1. SUMMARY

This section identifies new hand-carried fire extinguishers located in cabinets or on wall brackets. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:
061000 Rough Carpentry- blocking

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	**X**	- For each type of fire extinguisher and cabinet
Product Samples	NA	
Mock-ups	NA	
Closeout submittals	**X** **X**	Warranty Information Operations and Maintenance information

3. PRODUCTS

A. PORTABLE FIRE EXTINGUISHERS

i. Manufacturer: JL Industries or approved equal.
ii. Product: Multipurpose Dry-Chemical Type.
   a. "Cosmic" 10 lb ABC type extinguishers, UL Rating 4-A, 80-B:C
   b. Comply with NFPA 10, "Portable Fire Extinguishers.
iii. Locations: In cabinet in Library 110.
   Wall Mounted on Storage B01.

B. EXTINGUISHER CABINET

i. Manufacturer: JL Industries or approved equal.
ii. Product: Academy 1027V10 aluminum semi-recessed cabinet with partial acrylic sheet glazing and or approved equal.

C. INSTALLATION MATERIALS

i. Manufacturer: JL Industries or approved equal to match extinguisher.
ii. Product: Manufacturer's standard steel wall brackets where no cabinet is specified.

4. EXECUTION & QUALITY CONTROL

Install according to manufacturer's written instructions unless specifically noted otherwise.

D. EXAMINATION
   i. Examine fire extinguishers for proper charging and tagging.
   ii. Examine mounting surface for proper blocking.

E. INSTALLATION
   i. Install fire extinguisher, cabinets and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
      a. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher, square and plumb, at locations indicated.
   ii. Provide gypsum board wrapped recess where recessed cabinet occurs in a rated assembly.

END SECTION 104400 – FIRE EXTINGUISHERS AND CABINETS

144400 – WHEELCHAIR LIFTS

1. SUMMARY

This section identifies the vertical platform wheelchair lift located at rear of the Small Meeting Room 104. This lift will travel from the main level finish floor height up approximately 11'-5 1/2" to the upper level finish floor, thus requiring a 2-stop lift. The lift will require a side door configuration on both levels. In addition, this section addresses the hoistway doors and best practices for installation.

Note – this lift configuration requires automatic doors, to be provided as part of the lift system.

Related Sections:

061000	Rough Carpentry
092900	Gypsum Board

See MEP Drawings for electrical service and fire alarm systems.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	**X**	- Wheelchair lift plans, sections, details, pit and hoistway dimensions, electrical and mechanical requirements, operation, control and signal systems.
Product Cut Sheets	**X**	- For each listed product.
Product Samples	**X**	Exposed equipment finishes and Interior finish samples.
Mock-ups	NA	
Closeout submittals	**X**	Warranty Information, Operations and Maintenance information

3. PRODUCTS

A. VERTICAL PLATFORM WHEELCHAIR LIFT

i. Manufacturer: Savaria Prolift SCL Model Type 5 Commercial Wheelchair lift
ii. Platform/Enclosure: Provide full enclosure.
iii. Platform Size: 36" x 60"
iv. Capacity: 750 LB minimum.
v. Travel: 11'-5 1/2" floor-to-floor, 2 stops
vi. Power Supply: 208 V, 30 Amp three-phase at 60 Hz, or 230 V 40 Amp single phase at 60 Hz.
vii. Emergency Operation: Manual
viii. Lighting: Manufacturer's Standard
ix. Pit Depth: 8" Minimum

x. Cab Finishes:

a. Cab wall finishes: Melamine
b. Cab Floor Finishes: Rubber Mat
c. Cab Ceiling Finishes: Manufacturer's Standard

xi. Control Station Finishes: Stainless

xii. Hoistway Doors: Pro Auto Fire Rated Automatic Doors with Prolocks
a. Door Type: UL Fire Rated Hollow Metal
b. Frame Type: UL Fire Rated Hollow Metal
c. Vision Lite: 4" x 24" Rated Glass
d. Front and Rear Door Size: N/A
e. Side Door Size: 3'-6" width x 7'-0" height
f. Hardware: ADA Compliant

4. EXECUTION & QUALITY CONTROL

Deliver, store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. COORDINATION

i. Coordinate installation of sleeves, block outs, equipment with integral anchors, and other items that are attached to hoistway. Furnish templates, sleeves, equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

ii. Coordinate locations and dimensions of other work relating to wheelchair lift including pit; adjacent floors; electrical service; and location for external lift controls and equipment.

B. INSTALLATION

i. Alignment: Coordinate installation of hoistway entrances with installation of lift for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until lift is in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

ii. Leveling Tolerance: 1/4 inch, up or down, regardless of load and travel direction

C. PROTECTION

i. Provide cab with temporary covering to protect finishes from damage when in use during construction.

END SECTION 144400 – WHEELCHAIR LIFTS

SECTION 22 0500
PLUMBING GENERAL PROVISIONS

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 Contract requirements and the following basic mechanical materials and methods to complement other Division 21, 22 and 23 Sections.
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Concrete base construction requirements.
   4. Escutcheons.
   5. Dielectric fittings.
   6. Flexible connectors.
   7. Mechanical sleeve seals.
   8. Equipment nameplate data requirements.
   9. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section "Mechanical Identification."
   10. Nonshrink grout for equipment installations.
   11. Field-fabricated metal and wood equipment supports.
   12. Installation requirements common to equipment specification sections.
   13. Mechanical demolition.
   14. Cutting and patching.
   15. Touchup painting and finishing.

B. Pipe and pipe fitting materials are specified in Division 21, 22, and 23 piping system Sections.

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, crawl spaces, 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 use of the word “Provide”: Whenever the word “Provide” is used in the specifications and/or on the drawings, it shall mean “furnish and install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated.

G. The use of the word “Piping”: “Piping” shall include but not be limited to, in addition to piping or mains, all fittings, flanges, unions, valves, strainers, drains, traps, insulation, vents, hangers and other accessories relative to such piping.

H. The use of the word “Material”: Whenever the word material is used in the specifications and/or on the drawings, it shall mean any “product”, “equipment”, “device”, “assembly”, or “item”

required under the contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

I. The term "Mechanical Contractor", "HVAC Contractor", "Plumbing Contractor" or "Contractor" refer to the Sub Contractor or his Sub Contractors responsible for the furnishing and installation of all work indicated on the Mechanical, HVAC, and/or Plumbing drawings and in the Mechanical, HVAC, and/or Plumbing Specifications.

J. The term "Accessible" indicates ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, conduit, etc to gain access. "accessible ceiling" indicates acoustical tile type hung ceilings. Concealed spline or sheetrock ceilings with access panes shall not be considered accessible ceilings.

K. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

L. The following are industry abbreviations for rubber materials:
   1. CR: Chlorosulfonated polyethylene synthetic rubber.
   2. EPDM: Ethylene propylene diene terpolymer rubber.

1.04 CODES, STANDARDS, REFERENCES, AND PERMITS

A. All material and workmanship shall comply with all the latest editions of all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations.

B. In case of differences between the Building Codes, State Law, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the contractor shall promptly notify the Engineer in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary and bid purposes. However, no work will proceed until the Engineer determines the correct method of installation.

D. Should the contractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, the contractor shall bear all costs arising in correcting the deficiencies, as approved by the Engineer.

E. All potable water installations shall meet the following requirements: maximum weighted average lead content to 0.25 percent. This shall apply to pipes, fittings, fixtures, valves and other products that come in contact with drinking water

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

C. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

D. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.06 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.07 SYSTEM DESCRIPTION

A. Furnish and install all materials in order to provide functioning systems, upon completion, in compliance with all applicable codes, authorities having jurisdiction, manufacturer's requirements, performance requirements specified, and any modifications resulting from reviewed shop drawings and the field coordination drawings.

1.08 SCOPE OF WORK

A. The contractor is responsible for furnishing and installing all the devices and equipment shown indicated the Mechanical Drawings including materials and equipment required to create fully operational systems.

B. The contractor shall be responsible for reviewing the Architectural, Electrical, and Fire Protection Plans. In addition to all mechanical equipment, plumbing fixtures, and mechanical devices indicated on the Mechanical Plans, the contractor is responsible for mechanical installation of all the equipment and devices shown on the Architectural Plans and the Electrical Plans.

C. The contractor shall be responsible for reviewing the Architectural, Electrical, and Fire Protection Plans. Prior to bid, the contractor shall notify the Engineer of any discrepancies between the Architectural, Electrical, Mechanical, and Fire Protection Plans regarding equipment locations, equipment quantities, piping and duct work routing, device locations, light locations, chase locations, etc. otherwise it will be assumed the contractor is responsible for mechanical installation of all the equipment and devices shown on the Architectural Plans, Mechanical Plans, Plumbing Plans, Fire Protection Plans and the Electrical Plans regardless of whether they are indicated on the Mechanical Plans.

1.09 DRAWING INTERPRETATION

A. The project drawings are schematic in nature and indicate general arrangement of equipment. It is not the intent of the drawings to substitute for shop drawings. In many instances, equipment and devices are sized on one manufacturer's product. In the event of a field verification or coordination issue, report issue to Owners construction supervisor.

B. Piping and air duct plans are intended to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement. The drawings do not necessarily indicate all required offsets, details and accessories and equipment to be connected or encountered in the way of new work.

C. Generally, layout pipelines requiring drainage first, followed by large pipe mains, air duct and electrical conduit. Follow this procedure for an orderly installation but not to establish precedence of one trade over another. It must be understood that pipe and duct hanger installations must comply with seismic bracing requirements. Minimizing hanger lengths (structure to equipment and crossbars) to 12" and under minimizes the requirement for seismic bracing.

D. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines,

to avoid existing field conditions as well as to maintain clearances to equipment whether or not indicated on the drawings. The contractor shall provide all drains, traps and accessories as required for his work to effect these offsets, transitions and changes in direction. Consult Design Professional before making changes that effect the function or appearance of systems.

E. Do not install equipment, air ducting or piping in a non-code compliant fashion due to drawing interpretation. Provide modification of illustrated work in order to accommodate job conditions at no cost to Owner.

F. In some cases, drawings are based on products of one or several manufacturers, as listed on the contract documents. The contractor shall be held responsible for modifications made necessary by substitution of products or other manufacturers.

1.10 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.11 COORDINATION

A. Do not install any part of a system until all critical components of the systems and related systems have been approved. Coordinate individual parts of systems.

B. Coordinate contract work with other work specified in other sections. Relocate work if required for proper installation and functioning of other systems, at no extra cost to the Owner.

C. Install products in accordance with manufacturer's instructions. Notify Design Professional if Contract Documents conflict with manufacturer's instructions. Comply with Design Professional's interpretations,

D. In general, air duct, heating and sprinkler piping, and drainage lines take precedence over water, gas, and electrical conduits. The design professional will final decisions regarding the arrangement of work, which cannot be agreed upon by the contractors.

1.12 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.13 "AS-BUILT" RECORD DRAWINGS

A. Record daily progress on one set of construction documents. Utilize a permanent black or blue marking media. All progress of record drawings shall be provided in a neat and accurate fashion.

B. As-built drawing reviews will be completed on a monthly basis by the engineer of record. Release of requisitions will be based on the regular progress of As-built drawings. The latest As-built drawings shall be submitted for review with each requisition for payment.

C. Formal As-built drawings shall be submitted for review at the completion of each phase of the work. The as-built drawings shall be ¼" scale and created in electronic format utilizing both AUTOCAD Release 2010. At the completion of each phase of work, the mechanical contractor shall submit to the Engineer the original field progress as-built drawings, the electronic files of the formal as-built drawings, and four sets of final as-built drawings plotted on 24" x 36" 'D' sized sheets. Final payment for the phase of work and the start of the next phase shall be dependant of approval of the as-built drawings.

1.14 GUARANTEE

A. Provide written guarantee of all completed/installed work. Materials, equipment and workmanship shall be guaranteed for a minimum period of one year after Owners acceptance of work. Any failure due to defective material, equipment or workmanship shall be corrected at no additional cost to owner. This shall include damage completed to other areas of construction or facility resulting from this failure. Provide correction of any failure within an acceptable/reasonable time period.

B. Provide all equipment and material manufacturers guarantees and/or warranties to owner after acceptance of installation.

1.15 OPERATING AND MAINTENANCE MANUALS

A. Provide operating and maintenance information for all equipment, devices, systems, and materials. This shall include all maintenance and operations procedures, recommendations, and service requirements. All submitted data must include minimum equipment/device operations and maintenance requirements to fulfill manufacturers warrantees.

B. Submit all engineering selection and specification documentation with operating and maintenance information for all equipment, devices, systems, and materials.

C. Submit all data media in a detailed, organized, and complete manner. Provide a minimum of three copies to Owners construction supervisor for engineer/architect review. Submit in 3 ring bound enclosure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dielectric Flanges:
      a. Capitol Manufacturing Co.
      b. Central Plastics Co.
      c. Epco Sales Inc.
      d. Watts Industries, Inc.; Water Products Div.
   2. Dielectric-Flange Insulating Kits:
      a. Calpico, Inc.
      b. Central Plastics Co.
   3. Dielectric Couplings:
      a. Calpico, Inc.
      b. Lochinvar Corp.

4. Dielectric Nipples:
   a. Grinnell Corp.; Grinnell Supply Sales Co.
   b. Perfection Corp.
   c. Victaulic Co. of America.
5. Metal, Flexible Connectors:
   a. ANAMET Industrial, Inc.
   b. Flexicraft Industries.
   c. Mercer Rubber Co.
   d. Uniflex, Inc.
6. Rubber, Flexible Connectors:
   a. General Rubber Corp.
   b. Mercer Rubber Co.
   c. Proco Products, Inc.
   d. Uniflex, Inc.
7. Mechanical Sleeve Seals:
   a. Calpico, Inc.
   b. Metraflex Co.
   c. Thunderline/Link-Seal.

2.02 PIPE AND PIPE FITTINGS

A. Refer to individual Division 21, 22, and 23 piping Sections for pipe and fitting materials and joining methods.

2.03 JOINING MATERIALS

A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch 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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
   3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Fernco, Inc.
      c. Mission Rubber Company.
      d. Plastic Oddities, Inc.

2.05 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Dielectric unions: Dielectric unions are not acceptable.

C. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

D. Insulating Material: Suitable for system fluid, pressure, and temperature.

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

H. 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 .

2.06 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 250-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
   1. 2-Inch NPS and Smaller: Threaded.
   2. 2-1/2-Inch NPS and Larger: Flanged.
   3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.

B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

E. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig minimum working-pressure rating at 220 deg F. Units may be straight or elbow type, unless otherwise indicated.

2.07 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.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 MECHANICAL SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.09 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
   1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
   3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
   1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
   2. OD: Completely cover opening.

3. Cast Brass: Split casting, with concealed hinge and set screw.
   a. Finish: Rough brass.
   b. Finish: Polished chrome-plate.

2.10 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
   1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psig, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 MECHANICAL DEMOLITION

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

D. Disconnect, demolish, and remove Work specified in Division 21, 22, and 23 Drawings and Sections.

E. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

F. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

G. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

H. Removal: Remove indicated equipment from Project site.

I. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
   2. Existing Piping: Use the following:
      a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
      b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes with smooth concrete bore.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
   d. 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.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 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.

E. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

F. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

G. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.06 PAINTING AND FINISHING

A. Apply paint to exposed piping according to the following, unless otherwise indicated:

1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.

B. Do not paint piping specialties with factory-applied finish.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Provide 2” chamfered edges on top of concrete pads. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete." Provide broom finish.

B. The mechanical contractor shall fill each air handling unit fan inertia base with cast-in-place concrete. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

C. Mechanical Contractor shall be responsible for any patching of existing partitions after removal of duct work and HVAC piping.

D. The Plumbing Contractor Shall be responsible for any patching of existing partitions after removal of plumbing piping.

3.11 GROUTING

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

3.12 FIRESTOPPING

A. The mechanical contractor is responsible for providing proper U.L. Listed firestopping and smokestopping for all duct, pipe, controls conduit, and related electrical conduit installed by the mechanical contractor.

B. The mechanical contractor shall utilize the latest fire and smoke protection materials and installation methods. The mechanical contractor shall guarantee that all materials installed are fire and smoke stopped per U.L. Listing, NFPA, building code requirements.

C. The mechanical contractor shall utilize Architectural Life Safety Drawings to identify partition ratings. If the mechanical contractor is unsure of partition rating then he or she must inquire to Construction Manager.

END OF SECTION

SECTION 22 0519
METERS AND GAGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Positive displacement meters.

B. Pressure gages and pressure gage taps.

C. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS

A. Section 23 10 05 - Plumbing Piping.

B. Section 23 2113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014.

D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2015.

E. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2012.

F. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012.

G. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

H. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Project Record Documents: Record actual locations of components and instrumentation.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements. for additional provisions.

1.05 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

2.02 PRESSURE GAGES

A. Manufacturers:
   1. Dwyer Instruments, Inc; _____: www.dwyer-inst.com.
   2. Moeller Instrument Company, Inc; _____: www.moellerinstrument.com.
   3. Omega Engineering, Inc; _____: www.omega.com.
   4. Or Equal

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.

2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi and kPa.

2.03 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.04 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc; _____: www.dwyer-inst.com.
2. Omega Engineering, Inc; _____: www.omega.com.
3. Weksler Glass Thermometer Corp; _____: www.wekslerglass.com.
4. Or Equal

B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Accuracy: 2 percent, per ASTM E77.
4. Calibration: Degrees F.

C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Accuracy: 2 percent, per ASTM E77.
4. Calibration: Degrees F.

2.05 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1 inch dial thermometers.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gages in steam systems.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

F. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

G. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Dampers: Ceiling tacks, where located above lay-in ceiling.

C. Ductwork: Nameplates.

D. Heat Transfer Equipment: Nameplates.

E. Instrumentation: Tags.

F. Major Control Components: Nameplates.

G. Piping: Pipe markers.

H. Pumps: Nameplates.

I. Relays: Tags.

J. Small-sized Equipment: Tags.

K. Tanks: Nameplates.

L. Thermostats: Nameplates.

M. Valves: Tags and ceiling tacks where located above lay-in ceiling.

N. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.

3. Background Color: Black.
4. Plastic: Conform to ASTM D709.

2.03 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
1. HVAC Equipment: Yellow.
2. Fire Dampers and Smoke Dampers: Red.
3. Plumbing Valves: Green.
4. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Use tags on piping 3/4 inch diameter and smaller.
1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 0719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 07 8400 - Firestopping.

C. Section 09 9123 - Interior Painting: Painting insulation jacket.

D. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

E. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

F. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.

H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.

I. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2015.

J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010.

K. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

L. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.

M. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

O. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

P. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum _____ years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. Knauf Insulation; _____: www.knaufusa.com.
   2. Johns Manville; _____: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. Or Equal

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 650 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; _____: www.aeroflexusa.com.
   2. Armacell LLC; _____: www.armacell.us.
   3. K-Flex USA LLC; _____: www.kflexusa.com.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

2.04 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation; _____: www.jm.com.
      b. Or Equal
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 15 mil.
      e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 110 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 110 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
   1. Application: Piping 1 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

A. Plumbing Systems:

Service	Size	Insulation Thickness	Insulation Type
Domesitc Cold Water	1-1/4" and Smaller	1"	Glass Fiber
Domesitc Cold Water	1-1/2" and Larger	1-1/2"	Glass Fiber
Domestic Hot Water	1-1/4" and Smaller	1"	Glass Fiber
Domestic Hot Water	1-1/2" and Larger	1-1/2"	Glass Fiber
Domestic Hot Water Recirc.	1-1/4" and Smaller	1"	Glass Fiber
Domestic Hot Water Recirc.	1-1/4" and Larger	1-1/2"	Glass Fiber
Condensate Drains	All Sizes	1"	Glass Fiber

END OF SECTION

SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   3. Flanges, unions, and couplings.
   4. Pipe hangers and supports.
   5. Valves.
   6. Flow controls.
   7. Check.
   8. Water pressure reducing valves.
   9. Relief valves.
   10. Strainers.

1.02 RELATED REQUIREMENTS

A. Section 31 2316 - Excavation.

B. Section 31 2323 - Fill.

C. Section 31 2316.13 - Trenching.

D. Section 33 1300 - Disinfecting of Water Utility Distribution.

E. Section 07 8400 - Firestopping.

F. Section 09 9123 - Interior Painting.

G. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

H. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

I. Section 22 0553 - Identification for Plumbing Piping and Equipment.

J. Section 22 0719 - Plumbing Piping Insulation.

K. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

L. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

M. Section 31 2316 - Excavation.

N. Section 33 1300 - Disinfecting of Water Utility Distribution.

1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.

C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.

D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.

E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

G. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2011.

H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.

I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.

J. ASME B31.1 - Power Piping; 2014.

K. ASME B31.2 - Fuel Gas Piping; The American Society of Mechanical Engineers; 1968.

L. ASME B31.9 - Building Services Piping; 2014.

M. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2015.

N. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.

O. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.

P. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

Q. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2015.

R. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.

S. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

T. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.

U. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2011.

V. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.

W. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric); 1999 (Reapproved 2005).

X. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.

Y. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.

Z. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.

AA. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.

AB. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.

AC. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2002 (Reapproved 2010).

AD. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

AE. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

AF. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

AG. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.

AH. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.

AI. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

AJ. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

AK. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2014.

AL. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).

AM. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.

AN. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2015.

AO. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.

AP. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2013.

AQ. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.

AR. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2010.

AS. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2013a.

AT. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011.

AU. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

AV. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

AW. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

AX. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2013.

AY. AWWA C651 - Disinfecting Water Mains; 2005.

AZ. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2009.

BA. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2011.

BB. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.

BC. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.

BD. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2013.

BE. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2013.

BF. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

BG. MSS SP-67 - Butterfly Valves; 2011.

BH. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

BI. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

BJ. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2011.

BK. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

BL. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

BM. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.

BN. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

BO. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

BP. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

BQ. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

BR. NSF 372 - Drinking Water System Components - Lead Content; 2011.

BS. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Perform work in accordance with State of Vermont, standards.

C. Valves: Manufacturer's name and pressure rating marked on valve body.

D. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.

E. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

F. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Vermont plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Complete potable water installation shall meet the following requirements: maximum weighted average lead content to 0.25 percent. This shall apply to pipes, fittings, fixtures, valves and other products that come in contact with drinking water.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 with not less than 150 psi pressure rating.
   1. Fittings: ASTM D2466, PVC.
   2. Joints: Solvent welded, with ASTM D2564 Solvent cement.

2.04 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder (Lead-Free).

B. Cross-Linked Polyethylene Pipe: ASTM F876 or ASTM F877.
   1. Manufacturers:
      a. Uponor, Inc.; _____: www.uponorpro.com.
      b. Viega LLC; _____: www.viega.com.
   2. PPI TR-4 Pressure Design Basis:
   3. Fittings: Brass, HDPE, and copper.
   4. Joints: Mechanical compression fittings.

2.05 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

2.06 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Conform to ASME B31.9.
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, clevis.
3. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
4. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Other Types: As required.

2.07 BALL VALVES

A. Manufacturers:
1. Milwaukee Valve Company; _____: www.milwaukeevalve.com.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

C. Suitable for potable water service.

2.08 FLOW CONTROLS

A. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

B. Calibration: Control flow within five percent of selected rating, over operating pressure range of ten times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.09 SWING CHECK VALVES

A. Up to 2 Inches:

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

B. Over 2 Inches:
1. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.10 SPRING LOADED CHECK VALVES

A. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.11 WATER PRESSURE REDUCING VALVES

A. Up to 2 Inches:
1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

B. Over 2 Inches:
1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.12 RELIEF VALVES

A. Pressure Relief:
1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:
1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.13 STRAINERS

A. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly; refer to Section Roofing Specifications.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Excavate in accordance with Section 31 2316.

N. Backfill in accordance with Section 31 2323.

O. Install bell and spigot pipe with bell end upstream.

P. Install valves with stems upright or horizontal, not inverted.

Q. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

R. Install water piping to ASME B31.9.

S. Install strainer on inlet side of control valves, pressure-reducing valves, fuel oil pumps, and oil burner connections.

T. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

U. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

V. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

W. Sleeve pipes passing through partitions, walls and floors.

X. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.
   9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
   10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.
   11. Support cast iron drainage piping at every joint.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe valves for throttling, bypass, or manual flow control services.

E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

F. Provide spring loaded check valves on discharge of water pumps.

G. Provide plug valves in natural gas systems for shut-off service.

H. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 33 1300.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
   2. Provide 18 gage, 0.0478 inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

C. Ground equipment
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.08 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:

a. Pipe size: 1/2 inches to 1-1/4 inches:
   1) Maximum hanger spacing: 6.5 ft.
   2) Hanger rod diameter: 3/8 inches.
b. Pipe size: 1-1/2 inches to 2 inches:
   1) Maximum hanger spacing: 10 ft.
   2) Hanger rod diameter: 3/8 inch.
c. Pipe size: 2-1/2 inches to 3 inches:
   1) Maximum hanger spacing: 10 ft.
   2) Hanger rod diameter: 1/2 inch.

2. Plastic Piping:
   a. All Sizes:
      1) Maximum hanger spacing: 6 ft.
      2) Hanger rod diameter: 3/8 inch.

3.09 FIELD QUALITY CONTROL

A. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Report test results promptly and in writing to Architect

END OF SECTION

SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Back water valves.
E. Backflow preventers.
F. Water hammer arrestors.
G. Mixing valves.
H. Thermostatic mixing valves.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: Procedures for Owner-supplied products.
B. Section 22 1005 - Plumbing Piping.
C. Section 22 4000 - Plumbing Fixtures.
D. Section 22 3000 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ASSE 1011 - Hose Connection Vacuum Breakers; 2004.
C. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
D. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
E. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
F. NSF 372 - Drinking Water System Components - Lead Content; 2011.
G. PDI-WH 201 - Water Hammer Arresters; 2010.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Josam Company; _____: www.josam.com.
   2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   3. Zurn Industries, LLC; _____: www.zurn.com.
   4. Or Equal

2.03 CLEANOUTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____: www.jayrsmith.com.
   2. Josam Company; _____: www.josam.com.
   3. Zurn Industries, LLC; _____: www.zurn.com.
   4. Or Equal

B. Cleanouts at Exterior Surfaced Areas (CO-1):
   1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas (CO-2):
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas (CO-3):
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E. Cleanouts at Interior Finished Wall Areas (CO-4):
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

F. Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____: www.jayrsmith.com.
   2. Watts Regulator Company; _____: www.wattsregulator.com.
   3. Zurn Industries, LLC; _____: www.zurn.com.
   4. Or Equal

B. Interior Hose Bibbs:
   1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in conformance with ASSE 1011.

2.05 BACK WATER VALVES

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company; _____: www.jayrsmith.com.
   2. Zurn Industries, LLC; _____: www.zurn.com.

B. Plastic Back Water Valves: ABS body and valve, extension sleeve, and access cover.

2.06 BACKFLOW PREVENTERS

A. Manufacturers:

1. Watts Regulator Company, a part of Watts Water Technologies; _____: www.wattsregulator.com.
2. Zurn Industries, LLC; _____: www.zurn.com.
3. Or Equal

B. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.07 WATER HAMMER ARRESTORS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company; _____: www.jayrsmith.com.
2. Watts Regulator Company, a part of Watts Water Technologies; _____: www.wattsregulator.com.
3. Zurn Industries, LLC; _____: www.zurn.com.

B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.08 MIXING VALVES

A. Thermostatic Mixing Valves:
1. Manufacturers:
a. Leonard Valve Company: www.leonardvalve.com.
b. Lawler Manufacturing Company: www.temperedwater.com
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
a. Check valve on inlets.
b. Stem thermometer on outlet.
c. Strainer stop checks on inlets.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, washing machine outlets, or _____.

END OF SECTION

SECTION 22 3000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pumps.
   1. Circulators.

1.02 RELATED REQUIREMENTS

A. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

B. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ICC (IPC) - International Plumbing Code; 2012.

B. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Product Data:
   1. Indicate pump type, capacity, power requirements.
   2. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   3. Provide electrical characteristics and connection requirements.

C. Project Record Documents: Record actual locations of components.

D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 CERTIFICATIONS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 CERTIFICATIONS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 IN-LINE CIRCULATOR PUMPS

A. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

B. Impeller: Bronze.

C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

E. Drive: Flexible coupling.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Pumps:
   1. Provide air cock and drain connection on horizontal pump casings.
   2. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
   3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
   4. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
   5. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

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 plumbing fixtures and related components.

B. Related Sections include the following:
   1. Division 15 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

1.03 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.04 SUBMITTALS

A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

C. Submittals
   1. Documentation indicating flow and water consumption requirements

1.05 DRAWING INTERPRETATION

A. The project drawings are schematic in nature and indicate general arrangement of equipment. It is not the intent of the drawings to substitute for shop drawings. In many instances, equipment and devices are sized on one manufacturers product. In the event of a field verification or coordination issue, report issue to Owners construction supervisor.

B. Piping and air duct plans are intended to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement.

C. Do not install equipment, duct work or piping in a non code compliant fashion due to drawing interpretation. Provide modification of illustrated work in order to accommodate job conditions at no cost to Owner.

D. Generally, layout pipelines requiring drainage first, followed by large pipe mains, air duct and electrical conduit. Follow this procedure for an orderly installation but not to establish precedence of one trade over another.

E. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Consult Design Professional before making changes which effect the function or appearance of systems.

F. In some cases, drawings are based on products of one or several manufacturers, as listed on the contract documents. The contractor shall be held responsible for modifications made necessary by substitution of products or other manufacturers

G. Architectural drawings take precedence for equipment layout and locations.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.

E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

F. Regulatory Requirements: Complete potable water installation shall have a maximum weighted average lead content to 0.25 percent. This shall apply to pipes, fittings, fixtures, valves and other products that come in contact with drinking water.

G. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

H. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

I. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Hand Sinks: NSF 2 construction.
   3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   4. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
   5. Vitreous-China Fixtures: ASME A112.19.2M.
   6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

J. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
   4. Faucet Hose: ASTM D 3901.
   5. Faucets: ASME A112.18.1M.
   6. Hose-Connection Vacuum Breakers: ASSE 1011.
   7. Hose-Coupling Threads: ASME B1.20.7.
   8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   9. NSF Materials: NSF 61.
   10. Pipe Threads: ASME B1.20.1.
   11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   12. Supply and Drain Fittings: ASME A112.18.1M.

K. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   1. Atmospheric Vacuum Breakers: ASSE 1001.
   2. Brass and Copper Supplies: ASME A112.18.1M.

3. Plastic Tubular Fittings and Piping: ASTM F 409.
4. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.

L. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Grab Bars: ASTM F 446.
2. Hose-Coupling Threads: ASME B1.20.7.
3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Toilet Seats: ANSI Z124.5.
6. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.07 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Faucet, Laminar-Flow Fittings: Equal to 10 percent of amount of each type and size installed, but not less than 2 of each type and size.
4. Faucet, Flow-Control Fittings: Equal to 10 percent of amount of each type and size installed.
5. Supply, Flow-Control Fittings: Equal to 5 percent of amount of each type and size installed.
6. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
7. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
8. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Shall be as scheduled on the drawings

2.02 WATER CLOSETS

A. Description Accessible, floor mounted, floor-outlet, vitreous-china fixture designed for dual flush tank operation. .
1. Seat: See Plumbing Schedule on drawing P5.01
2. Style: One piece
3. Design Consumption: 1.28 gal./flush / 0.9 gal./flush
4. Water Hammer Arrestor: Furnish and install Zurn Shoktrol water hammer arrestor for each individual flush valve and water closet.

2.03 FLUSHOMETERS

A. Description: Flushometer for water-closet-type fixture. Dual-flush, push-button type. Include brass body with corrosion-resistant internal components, push-button non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
1. Consumption: 0.9 gal./flush for liquids and 1.28 gal./flush for solids

2.04 LAVATORIES

A. Lavatories: Vitreous china, cast iron wall hangers with lag screw through anchor holes.
   1. Supply Pipes: 3/8" flexible tube risers, loose key stops, escutcheons
   2. Waste: 1 ½" tail piece, adjustable p-trap, 17 gauge tubing waste to wall and escutcheon.
   3. Carrier System: Concealed arms. See Plumbing Schedule on drawing P5.01

B. Lavatories: Solid surface type (see Architectural Plans and Specifications).
   1. Supply Pipes: 3/8" flexible tube risers, loose key stops, escutcheons
   2. Waste: 1 ½" tail piece, adjustable p-trap, 17 gauge tubing waste to wall and escutcheon.

2.05 LAVATORY FAUCETS

A. Description: Single-control mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   1. Maximum Flow Rate: 1.0 GPM

2.06 KITCHEN SINKS

A. Service Sinks: Stainless Steel, sizes as specified on the drawings
   1. Supply Pipes: ½" loose key stops, escutcheons
   2. Waste: 1 ½" tail piece, adjustable p-trap, 17 gauge tubing waste to wall and escutcheon

2.07 KITCHEN SINK FAUCETS

A. Description: Kitchen faucet without spray. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   1. Maximum Flow Rate: 2.2 GPM

2.08 SERVICE SINKS

A. Service Sinks: Cast Iron or Stainless Steel, sizes as specified on the drawings
   1. Supply Pipes: ½" loose key stops, escutcheons
   2. Waste: 1 ½" tail piece, adjustable p-trap, 17 gauge tubing waste to wall and escutcheon
   3. Fixtures: All laboratory fixtures shall include a vacuum breaker
   4. Water Hammer Arrestor: Furnish and install Zurn Shoktrol water hammer arrestor on DCW and DHW for each service sink with knee valve control.

2.09 FIXTURE CARRIERS

A. Lavatories: provide concealed arms carrier suited for fixture, location wall thickness, and material.

B. Service Sinks: Short foot or block supports to support fixture independent of wall. With fixture bolts, bearing plates, steel pipe uprights, and chrome plated trim.

C. Flushing Rim Sinks: Support system with connection fitting, adjustable faceplate and upper support plate. Height to suit fixture.

2.10 PLUMBING FIXTURE TRIM:

A. Water Fittings - General: Water fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral slow compression volume control device and all faucets shall be capable of being readily converted from compression to self-closing, without disturbing the faucet or fitting body proper. Provide 4-arm forged brass handles containing plastic screw-on type colored service index buttons.

B. Tank Nipples: Tank nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those

indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-hanging fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

I. 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 valve if stops are not specified with fixture. Refer to Division 23 Section "Valves" for general-duty valves.

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install toilet seats on water closets.

N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

P. 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.

Q. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

R. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

S. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Mechanical General Provisions“ for escutcheons.

U. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

F. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 0500
MECHANICAL GENERAL PROVISIONS

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 Contract requirements and the following basic mechanical materials and methods to complement other Division 21, 22 and 23 Sections.
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Concrete base construction requirements.
   4. Escutcheons.
   5. Dielectric fittings.
   6. Flexible connectors.
   7. Mechanical sleeve seals.
   8. Equipment nameplate data requirements.
   9. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section "Mechanical Identification."
   10. Nonshrink grout for equipment installations.
   11. Field-fabricated metal and wood equipment supports.
   12. Installation requirements common to equipment specification sections.
   13. Mechanical demolition.
   14. Cutting and patching.
   15. Touchup painting and finishing.

B. Pipe and pipe fitting materials are specified in Division 21, 22, and 23 piping system Sections.

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, crawl spaces, 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 use of the word “Provide”: Whenever the word “Provide” is used in the specifications and/or on the drawings, it shall mean “furnish and install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated.

G. The use of the word “Piping”: “Piping” shall include but not be limited to, in addition to piping or mains, all fittings, flanges, unions, valves, strainers, drains, traps, insulation, vents, hangers and other accessories relative to such piping.

H. The use of the word “Material”: Whenever the word material is used in the specifications and/or on the drawings, it shall mean any “product”, “equipment”, “device”, “assembly”, or “item”

required under the contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

I. The term "Mechanical Contractor", "HVAC Contractor", "Plumbing Contractor" or "Contractor" refer to the Sub Contractor or his Sub Contractors responsible for the furnishing and installation of all work indicated on the Mechanical, HVAC, and/or Plumbing drawings and in the Mechanical, HVAC, and/or Plumbing Specifications.

J. The term "Accessible" indicates ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, conduit, etc to gain access. "accessible ceiling" indicates acoustical tile type hung ceilings. Concealed spline or sheetrock ceilings with access panes shall not be considered accessible ceilings.

K. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

L. The following are industry abbreviations for rubber materials:
   1. CR: Chlorosulfonated polyethylene synthetic rubber.
   2. EPDM: Ethylene propylene diene terpolymer rubber.

1.04 CODES, STANDARDS, REFERENCES, AND PERMITS

A. All material and workmanship shall comply with all the latest editions of all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations.

B. In case of differences between the Building Codes, State Law, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the contractor shall promptly notify the Engineer in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary and bid purposes. However, no work will proceed until the Engineer determines the correct method of installation.

D. Should the contractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, the contractor shall bear all costs arising in correcting the deficiencies, as approved by the Engineer.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

C. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

D. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.06 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.07 SYSTEM DESCRIPTION

A. Furnish and install all materials in order to provide functioning systems, upon completion, in compliance with all applicable codes, authorities having jurisdiction, manufacturer's requirements, performance requirements specified, and any modifications resulting from reviewed shop drawings and the field coordination drawings.

1.08 SCOPE OF WORK

A. The contractor is responsible for furnishing and installing all the devices and equipment shown indicated the Mechanical Drawings including materials and equipment required to create fully operational systems.

B. The contractor shall be responsible for reviewing the Architectural, Electrical, and Fire Protection Plans. In addition to all mechanical equipment, plumbing fixtures, and mechanical devices indicated on the Mechanical Plans, the contractor is responsible for mechanical installation of all the equipment and devices shown on the Architectural Plans and the Electrical Plans.

C. The contractor shall be responsible for reviewing the Architectural, Electrical, and Fire Protection Plans. Prior to bid, the contractor shall notify the Engineer of any discrepancies between the Architectural, Electrical, Mechanical, and Fire Protection Plans regarding equipment locations, equipment quantities, piping and duct work routing, device locations, light locations, chase locations, etc. otherwise it will be assumed the contractor is responsible for mechanical installation of all the equipment and devices shown on the Architectural Plans, Mechanical Plans, Plumbing Plans, Fire Protection Plans and the Electrical Plans regardless of whether they are indicated on the Mechanical Plans.

1.09 DRAWING INTERPRETATION

A. The project drawings are schematic in nature and indicate general arrangement of equipment. It is not the intent of the drawings to substitute for shop drawings. In many instances, equipment and devices are sized on one manufacturer's product. In the event of a field verification or coordination issue, report issue to Owners construction supervisor.

B. Piping and air duct plans are intended to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement. The drawings do not necessarily indicate all required offsets, details and accessories and equipment to be connected or encountered in the way of new work.

C. Generally, layout pipelines requiring drainage first, followed by large pipe mains, air duct and electrical conduit. Follow this procedure for an orderly installation but not to establish precedence of one trade over another. It must be understood that pipe and duct hanger installations must comply with seismic bracing requirements. Minimizing hanger lengths (structure to equipment and crossbars) to 12" and under minimizes the requirement for seismic bracing.

D. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines, to avoid existing field conditions as well as to maintain clearances to equipment whether or not indicated on the drawings. The contractor shall provide all drains, traps and accessories as required for his work to effect these offsets, transitions and changes in direction. Consult Design Professional before making changes that effect the function or appearance of systems.

E. Do not install equipment, air ducting or piping in a non-code compliant fashion due to drawing interpretation. Provide modification of illustrated work in order to accommodate job conditions at no cost to Owner.

F. In some cases, drawings are based on products of one or several manufacturers, as listed on the contract documents. The contractor shall be held responsible for modifications made necessary by substitution of products or other manufacturers.

1.10 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.11 COORDINATION

A. Do not install any part of a system until all critical components of the systems and related systems have been approved. Coordinate individual parts of systems.

B. Coordinate contract work with other work specified in other sections. Relocate work if required for proper installation and functioning of other systems, at no extra cost to the Owner.

C. Install products in accordance with manufacturer's instructions. Notify Design Professional if Contract Documents conflict with manufacturer's instructions. Comply with Design Professional's interpretations,

D. In general, air duct, heating and sprinkler piping, and drainage lines take precedence over water, gas, and electrical conduits. The design professional will final decisions regarding the arrangement of work, which cannot be agreed upon by the contractors.

1.12 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.13 "AS-BUILT" RECORD DRAWINGS

A. Record daily progress on one set of construction documents. Utilize a permanent black or blue marking media. All progress of record drawings shall be provided in a neat and accurate fashion.

B. As-built drawing reviews will be completed on a monthly basis by the engineer of record. Release of requisitions will be based on the regular progress of As-built drawings. The latest As-built drawings shall be submitted for review with each requisition for payment.

C. Formal As-built drawings shall be submitted for review at the completion of each phase of the work. The as-built drawings shall be ¼" scale and created in electronic format utilizing both AUTOCAD Release 2004. At the completion of each phase of work, the mechanical contractor shall submit to the Engineer the original field progress as-built drawings, the electronic files of the formal as-built drawings, and four sets of final as-built drawings plotted on 24" x 36" 'D' sized sheets. Final payment for the phase of work and the start of the next phase shall be dependant of approval of the as-built drawings.

1.14 GUARANTEE

A. Provide written guarantee of all completed/installed work. Materials, equipment and workmanship shall be guaranteed for a minimum period of one year after Owners acceptance of work. Any failure due to defective material, equipment or workmanship shall be corrected at no additional cost to owner. This shall include damage completed to other areas of construction or facility resulting from this failure. Provide correction of any failure within an acceptable/reasonable time period.

B. Provide all equipment and material manufacturers guarantees and/or warranties to owner after acceptance of installation.

1.15 OPERATING AND MAINTENANCE MANUALS

A. Provide operating and maintenance information for all equipment, devices, systems, and materials. This shall include all maintenance and operations procedures, recommendations, and service requirements. All submitted data must include minimum equipment/device operations and maintenance requirements to fulfill manufacturers warrantees.

B. Submit all engineering selection and specification documentation with operating and maintenance information for all equipment, devices, systems, and materials.

C. Submit all data media in a detailed, organized, and complete manner. Provide a minimum of three copies to Owners construction supervisor for engineer/architect review. Submit in 3 ring bound enclosure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dielectric Flanges:
      a. Capitol Manufacturing Co.
      b. Central Plastics Co.
      c. Epco Sales Inc.
      d. Watts Industries, Inc.; Water Products Div.
   2. Dielectric-Flange Insulating Kits:
      a. Calpico, Inc.
      b. Central Plastics Co.
   3. Dielectric Couplings:
      a. Calpico, Inc.
      b. Lochinvar Corp.

4. Dielectric Nipples:
   a. Grinnell Corp.; Grinnell Supply Sales Co.
   b. Perfection Corp.
   c. Victaulic Co. of America.
5. Metal, Flexible Connectors:
   a. ANAMET Industrial, Inc.
   b. Flexicraft Industries.
   c. Mercer Rubber Co.
   d. Uniflex, Inc.
6. Rubber, Flexible Connectors:
   a. General Rubber Corp.
   b. Mercer Rubber Co.
   c. Proco Products, Inc.
   d. Uniflex, Inc.
7. Mechanical Sleeve Seals:
   a. Calpico, Inc.
   b. Metraflex Co.
   c. Thunderline/Link-Seal.

2.02 PIPE AND PIPE FITTINGS

A. Refer to individual Division 21, 22, and 23 piping Sections for pipe and fitting materials and joining methods.

2.03 JOINING MATERIALS

A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch 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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

G. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.

2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Fernco, Inc.
      c. Mission Rubber Company.
      d. Plastic Oddities, Inc.

2.05 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Dielectric unions: Dielectric unions are not acceptable.

C. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

D. Insulating Material: Suitable for system fluid, pressure, and temperature.

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

H. 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 .

2.06 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 250-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
   1. 2-Inch NPS and Smaller: Threaded.
   2. 2-1/2-Inch NPS and Larger: Flanged.

3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.

B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

E. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig minimum working-pressure rating at 220 deg F. Units may be straight or elbow type, unless otherwise indicated.

2.07 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.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 MECHANICAL SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.09 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
   1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
   3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
   1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
   2. OD: Completely cover opening.
   3. Cast Brass: Split casting, with concealed hinge and set screw.
      a. Finish: Rough brass.
      b. Finish: Polished chrome-plate.

2.10 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psig, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 MECHANICAL DEMOLITION

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

D. Disconnect, demolish, and remove Work specified in Division 21, 22, and 23 Drawings and Sections.

E. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

F. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

G. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

H. Removal: Remove indicated equipment from Project site.

I. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
   2. Existing Piping: Use the following:
      a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
      b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes with smooth concrete bore.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
   d. 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.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 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.

E. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

F. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

G. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.06 PAINTING AND FINISHING

A. Apply paint to exposed piping according to the following, unless otherwise indicated:
1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.

3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.

B. Do not paint piping specialties with factory-applied finish.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Provide 2" chamfered edges on top of concrete pads. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete." Provide broom finish.

B. The mechanical contractor shall fill each air handling unit fan inertia base with cast-in-place concrete. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

C. Mechanical Contractor shall be responsible for any patching of existing partitions after removal of duct work and HVAC piping.

D. The Plumbing Contractor Shall be responsible for any patching of existing partitions after removal of plumbing piping.

3.11 GROUTING

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

3.12 FIRESTOPPING

A. The mechanical contractor is responsible for providing proper U.L. Listed firestopping and smokestopping for all duct, pipe, controls conduit, and related electrical conduit installed by the mechanical contractor.

B. The mechanical contractor shall utilize the latest fire and smoke protection materials and installation methods. The mechanical contractor shall guarantee that all materials installed are fire and smoke stopped per U.L. Listing, NFPA, building code requirements.

C. The mechanical contractor shall utilize Architectural Life Safety Drawings to identify partition ratings. If the mechanical contractor is unsure of partition rating then he or she must inquire to Construction Manager.

END OF SECTION

SECTION 23 0516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 2300 - Refrigerant Piping.

1.03 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.

B. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

E. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

F. Maintenance Data: Include adjustment instructions.

1.05 REGULATORY REQUIREMENTS

A. Conform to UL requirements.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:
   1. Mercer Rubber Company; _____: www.mercer-rubber.com.
   2. Metraflex Company; _____: www.metraflex.com.
   3. Or Equal

B. Inner Hose: Carbon Steel.

C. Exterior Sleeve: Single braided, stainless steel.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Manufacturer:
   1. Mercer Rubber Company; _____: www.mercer-rubber.com.
   2. Metraflex Company; _____: www.metraflex.com.
   3. Or Equal

B. Inner Hose: Bronze.

C. Exterior Sleeve: Braided bronze.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

H. Application: Copper piping.

2.03 ACCESSORIES

A. Stainless Steel Pipe: ASTM A269/A269M.

B. Pipe Alignment Guides:
   1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

C. Swivel Joints:
   1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 23 0519
METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Positive displacement meters.

B. Flow meters.

C. Pressure gages and pressure gage taps.

D. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 25 00 00 - HVAC Instrumentation and Controls

1.03 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014.

D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2015.

E. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2012.

F. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold Water Meters; American Water Works Association; 2010 (ANSI/AWWA C706).

G. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012.

H. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

I. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Project Record Documents: Record actual locations of components and instrumentation.

1.05 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

A. AWWA C700, positive displacement disc type suitable for fluid with metal alloy main case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.

B. Meter: Brass body turbine meter with magnetic drive register.
   1. Service: Cold water, 122 degrees F.
   2. Accuracy: 1-1/2 percent.

2.02 PRESSURE GAGES

A. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi.

2.03 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.04 STEM TYPE THERMOMETERS

A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
   1. Size: 9 inch scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

2.05 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.06 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 0943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

J. Locate test plugs adjacent thermometers and thermometer sockets.

3.02 SCHEDULE

A. Positive Displacement Meters, Location:

B. Pressure Gages, Location and Scale Range:
   1. Pumps, 0 to 100 psi.
   2. Expansion tanks, 0 to 100 psi.

C. Pressure Gage Tappings, Location:
   1. Control valves 3/4 inch & larger - inlets and outlets.
   2. Major coils - inlets and outlets.
   3. Heat exchangers - inlets and outlets.
   4. Boiler - inlets and outlets.

D. Stem Type Thermometers, Location and Scale Range:
   1. Headers to central equipment, 0 to 250 degrees F.
   2. Coil banks - inlets and outlets, 0 to 250 degrees F.
   3. Boilers - inlets and outlets, 0 to 250 degrees F.
   4. After major coils, 0 to 250 degrees F.
   5. Domestic hot water supply and recirculation, 0 to 250 degrees F.

E. Thermometer Sockets, Location:
   1. Control valves 1 inch & larger - inlets and outlets.
   2. Reheat coils - inlets and outlets.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Dampers: Ceiling tacks, where located above lay-in ceiling.

C. Ductwork: Nameplates.

D. Heat Transfer Equipment: Nameplates.

E. Instrumentation: Tags.

F. Piping: Pipe markers.

G. Pumps: Nameplates.

H. Small-sized Equipment: Tags.

I. Thermostats: Nameplates.

J. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 NAMEPLATES

A. Manufacturers:
   1. Advanced Graphic Engraving, LLC; _____: www.advancedgraphicengraving.com.
   2. Kolbi Pipe Marker Co.; _____: www.kolbipipemarkers.com.
   3. Seton Identification Products, a Tricor Direct Company; _____: www.seton.com.
   4. _____.
   5. Letter Color: White.
   6. Letter Height: 1/4 inch.
   7. Background Color: Black.

8. Plastic: Conform to ASTM D709.

2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving; _____: www.advancedgraphicengraving.com.
   2. Brady Corporation; _____: www.bradycorp.com.
   3. Kolbi Pipe Marker Co.; _____: www.kolbipipemarkers.com.
   4. Seton Identification Products, a Tricor Company; _____: www.seton.com.
   5. _____.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation; _____: www.bradycorp.com.
   2. Kolbi Pipe Marker Co.; _____: www.kolbipipemarkers.com.
   3. MIFAB, Inc.; _____: www.mifab.com.
   4. Seton Identification Products, a Tricor Company; _____: www.seton.com.
   5. _____.

B. Color: Conform to ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. Color code as follows:
   1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
   2. Toxic and Corrosive Fluids: Orange with black letters.
   3. Compressed Air: Blue with white letters.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic and refrigerating systems.

C. Measurement of final operating condition of HVAC systems.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Employment of testing agency and payment for services.

1.03 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; 2002.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   4. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      d. Final test report forms to be used.
      e. Detailed step-by-step procedures for TAB work for each system and issue, including:
         1) Terminal flow calibration (for each terminal type).
         2) Diffuser proportioning.
         3) Branch/submain proportioning.
         4) Total flow calculations.
         5) Rechecking.
         6) Diversity issues.
      f. Expected problems and solutions, etc.
      g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.

h. Details of how TOTAL flow will be determined; for example:
   1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
   2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
k. Method of checking building static and exhaust fan and/or relief damper capacity.
l. Time schedule for TAB work to be done in phases (by floor, etc.).
m. Time schedule for deferred or seasonal TAB work, if specified.
n. False loading of systems to complete TAB work, if specified.
o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
p. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
q. Procedures for formal progress reports, including scope and frequency.
r. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least twice a week to the Commissioning Authority.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Progress Reports.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit under provisions of Section 01 4000.
   2. Revise TAB plan to reflect actual procedures and submit as part of final report.
   3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
   4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   6. Units of Measure: Report data in I-P (inch-pound) units only.

H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC MN-1, AABC National Standards for Total System Balance.
   2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
   3. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
      c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 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. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify 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. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.09 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

3.10 SCOPE

A. Test, adjust, and balance the following:
   1. HVAC Pumps.
   2. Air Cooled Refrigerant Condensers.
   3. Packaged Terminal Air Conditioning Units.
   4. Air Coils.

5. Terminal Heat Transfer Units.
6. Air Handling Units.
7. Fans.
8. Air Filters.
9. Air Inlets and Outlets.

3.11 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.

B. V-Belt Drives:
   1. Identification/location.
   2. Required driven RPM.
   3. Driven sheave, diameter and RPM.
   4. Belt, size and quantity.
   5. Motor sheave diameter and RPM.
   6. Center to center distance, maximum, minimum, and actual.

C. Pumps:
   1. Identification/number.
   2. Manufacturer.
   3. Size/model.
   4. Impeller.
   5. Service.
   6. Design flow rate, pressure drop, BHP.
   7. Actual flow rate, pressure drop, BHP.
   8. Discharge pressure.
   9. Suction pressure.
   10. Total operating head pressure.
   11. Shut off, discharge and suction pressures.
   12. Shut off, total head pressure.

D. Air Cooled Condensers:
   1. Identification/number.
   2. Location.
   3. Manufacturer.
   4. Model number.
   5. Serial number.
   6. Entering DB air temperature, design and actual.
   7. Leaving DB air temperature, design and actual.
   8. Number of compressors.

E. Cooling Coils:
   1. Identification/number.
   2. Location.
   3. Service.
   4. Manufacturer.
   5. Air flow, design and actual.

6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Entering water temperature, design and actual.
13. Leaving water temperature, design and actual.
14. Saturated suction temperature, design and actual.
15. Air pressure drop, design and actual.

F. Heating Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

G. Electric Duct Heaters:
1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Design kW.
6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

H. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

I. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

J. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

K. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

L. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
    a. Blower.
    b. Orifice, tube size.
    c. Orifice size.
    d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

M. Air Distribution Tests:
   1. Air terminal number.
   2. Room number/location.
   3. Terminal type.
   4. Terminal size.
   5. Area factor.
   6. Design velocity.
   7. Design air flow.
   8. Test (final) velocity.
   9. Test (final) air flow.
   10. Percent of design air flow.

N. Sound Level Reports:
   1. Location.
   2. Octave bands - equipment off.
   3. Octave bands - equipment on.

END OF SECTION

SECTION 23 0713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Insulation jackets.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 07 52 53 - EPDM Roofing

C. Section 23 0553 - Identification for HVAC Piping and Equipment.

D. Section 23 3100 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.

E. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.

F. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2008.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum _____ years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Knauf Insulation; _____: www.knaufinsulation.com.
   2. Johns Manville; _____: www.jm.com.
   3. Owens Corning Corporation; _____: www.ocbuildingspec.com.
   4. Or Equal

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' value: 0.17 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Density: 1.5 lb/cu. ft.
   3. Maximum Service Temperature: 1200 degrees F.
   4. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
   1. Knauf Insulation; _____: www.knaufinsulation.com.
   2. Johns Manville; _____: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. Or Equal

B. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. 'K' Value: 0.17 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 450 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent.
   4. Minimum Density: 6.0 lb/cu ft.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive:
a. Compatible with insulation.

B. EPDM Membrane (Outdoor) Jacket: ASTM D 4637, Type I, non-reinforced uniform, flexible EPDM sheet.
1. Thickness: 90 mils
2. Exposed Face Color: White on black.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:
1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with outdoor jacket finished as specified in Section _____.

G. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 SCHEDULES

Service	Location	Size	Insulation Type	Insulation Thickness	Insulation Jacket
Round Outdoor Air Ductwork	Interior, Concealed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Round Outdoor Air Ductwork	Interior, Exposed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Rectangular Outdoor Air Ductwork	Interior, Concealed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Rectangular Outdoor Air Ductwork	Interior, Exposed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Round ERV Exhaust Air Ductwork	Interior, Concealed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Round ERV Exhaust Air Ductwork	Interior, Exposed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Rectangular ERV Exhaust Air Ductwork	Interior, Concealed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Rectangular ERV Exhaust Air Ductwork	Interior, Exposed	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Round Supply Air Ductwork	Interior, Exposed	All Sizes	Flexible Glass Fiber	1-1/2"	Vapor Barrier Jacket
Round Supply Air Ductwork	Interior, Concealed	All Sizes	Flexible Glass Fiber	1-1/2"	Vapor Barrier Jacket

Rectangular Supply Air Ductwork	Interior, Concealed	Smaller than 24"	Flexible Glass Fiber	1-1/2"	Vapor Barrier Jacket
Rectangular Supply Air Ductwork	Interior, Concealed	24" and Larger	Rigid Glass Fiber	2"	Vapor Barrier Jacket
Rectangular Supply Air Ductwork	Interior, Exposed	Smaller than 24"	Rigid Glass Fiber	1-1/2"	Vapor Barrier Jacket
Rectangular Supply Air Ductwork	Interior, Exposed	24" and Larger	Rigid Glass Fiber	2"	Vapor Barrier Jacket
Rectangular Ductwork (Supply, Exhaust, Return, and Outdoor Air) in Unconditioned Space	Interior	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket
Round Ductwork (Supply, Exhaust, Return, and Outdoor Air) in Unconditioned Space	Interior	All Sizes	Rigid Glass Fiber	3"	Vapor Barrier Jacket

END OF SECTION

SECTION 23 0716
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 23 0553 - Identification for HVAC Piping and Equipment.

C. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 2114 - Hydronic Specialties.

E. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.

H. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2015.

I. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

J. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2013.

K. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

M. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible.
   1. 'K' Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 450 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

B. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   2. Secure with self-sealing longitudinal laps and butt strips.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.
   1. Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
   1. ASTM C195; hydraulic setting on mineral wool.

2.03 GLASS FIBER, RIGID

A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
   1. 'K' Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.
   4. Maximum Density: 8.0 lb/cu ft.

B. Vapor Barrier Jacket:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with self-sealing longitudinal laps and butt strips.

4. Secure with outward clinch expanding staples and vapor barrier mastic.

C. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.
1. Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
1. ASTM C195; hydraulic setting on mineral wool.

2.04 CELLULAR GLASS

A. Insulation: ASTM C552, Type I.
1. Apparent Thermal Conductivity; 'K' Value: Grade 6, 0.35 at 100 degrees F.
2. Service Temperature: Up to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch.
4. Water Absorption: 0.5 percent by volume, maximum.
5. Density: Minimum 6.12 lb/cu ft, Grade 6.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.06 JACKETS

A. PVC Plastic:
1. Jacket: Sheet material, off-white color.
a. Minimum Service Temperature: Minus 40 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.
2. Covering Adhesive Mastic: Compatible with insulation.
a. Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

C. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature; insulate entire system.

G. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

J. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K. Inserts and Shields:
   1. Application: Equipment 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between hangers and inserts.
   3. Insert Location: Between support shield and equipment and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

L. Finish insulation at supports, protrusions, and interruptions.

M. Exterior Applications:
   1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
   2. Cover with aluminum, stainless steel, or _____.

N. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

A. Heating Systems:
   1. Pump Bodies:
   2. Air Separators:
   3. Expansion Tanks:
   4. Hot Thermal Storage Tanks:

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 07 8400 - Firestopping.

C. Section 09 9123 - Interior Painting: Painting insulation jacket.

D. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

E. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

F. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.

I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.

J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010.

K. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

L. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

N. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

O. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. Knauf Insulation; _____: www.knaufinsulation.com.
   2. Johns Manville; _____: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. Or Equal

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. 'K' Value: ASTM C177, 0.25 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. 'K' Value: ASTM C177, 0.25 at 75 degrees F.
   2. Maximum Service Temperature: 650 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive: Compatible with insulation.
   1. Compatible with insulation.

G. Indoor Vapor Barrier Finish:
   1. Vinyl emulsion type acrylic, compatible with insulation, black color.

H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; _____: www.aeroflexusa.com.
   2. Armacell LLC; _____: www.armacell.us.
   3. Or Equal

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Note: The insulation product shall comply with the maximum service temperature of the VRF system. COordinate maximum service temperature with the manufacturer's product data of the selected system. If the system exceeds 220 degrees F, the insulation shall be substituted for EPDM closed cell pipe insulation comparable to Aerocel by Aeroflex. The same insulation valvues shall apply, but the insulation shall be installed to comply with the maximum service temperature of the VRF system.

2.04 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation; _____: www.jm.com.
      b. Or Equal
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.
   3. Covering Adhesive Mastic: Compatible with insulation.
      a. Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 110 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 110 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature.
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
   1. Application: Piping 1 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

3.03 SCHEDULE

A. Heating Systems:

Service	Size	Insulation Thickness	Insulation Type
Hot Water Heating Supply & Return (to 200 degrees F)	1-1/2" and Smaller	1-1/2"	Glass Fiber
Hot Water Heating Supply & Return (to 200 degrees F)	1-1/2" and Larger	2"	Glass Fiber

Refrigerant Piping (Low Pressure)	All Sizes	1-1/2"	Flexible Elastomeric Cellular Insulation
Refrigerant Piping (High Pressure)	All Sizes	1-1/2"	Flexible Elastomeric Cellular Insulation
Refrigerant Piping (Liquid)	All Sizes	1-1/2"	Flexible Elastomeric Cellular Insulation
Condensate Drainage Piping	All Sizes and Smaller	1"	Glass Fiber

END OF SECTION

SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water and glycol piping, above grade.

C. Radiant heating piping system.

D. Pipe and pipe fittings for:
   1. Heating water piping system.
   2. Glycol water piping system.
   3. Equipment drains and overflows.
   4. Pipe hangers and supports.
   5. Unions, flanges, mechanical couplings, and dielectric connections.

E. Valves:
   1. Ball valves.
   2. Plug valves.
   3. Check valves.

F. Flow controls.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 08 3100 - Access Doors and Panels.

C. Section 09 9123 - Interior Painting.

D. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

E. Section 22 0553 - Identification for Plumbing Piping and Equipment.

F. Section 22 0719 - Plumbing Piping Insulation.

G. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

H. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.

I. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

J. Section 23 0553 - Identification for HVAC Piping and Equipment.

K. Section 23 0719 - HVAC Piping Insulation.

L. Section 23 2114 - Hydronic Specialties.

M. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.

B. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.

F. ASME B31.9 - Building Services Piping; 2014.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers; 2006.

I. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.

K. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.

N. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).

O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

P. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2013a.

Q. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011.

R. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; 2011 and errata.

S. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2004 and errata.

T. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

U. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

V. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

W. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of valves.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 3 years of experience.

C. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical joints are not permitted in any location.
      a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
      b. Use rigid joints unless otherwise indicated.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
   5. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
   2. On discharge of Hot Water Heating pumps, use spring loaded check valves.
   3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
   4. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
   5. In heating water systems, butterfly valves may be used interchangeably with gate and globe valves.
   6. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.
   7. For throttling service, use plug cocks. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

E. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

A. PEX-a: ASTM F714/ASTM D3350, cross linked Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

B. Performance Requirements: PEX-a piping and fittings shall meet the following pressure and temperature ratings:
   1. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
   2. 180 degrees F (82 degrees C) at 100 psi (689 kPa).
   3. 73.4 degrees F (23 degrees C) at 160 psi (1,102 kPa).

C. Plastic Pipe and Fittings:
   1. PEX-a (Engle-method Crosslinked Polyethylene) Piping: Uponor Wirsbo hePEX , ASTM 876 with oxygen-diffusion barrier that meets DIN 4726.
   2. PEX-a Fittings, Elbows and Tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
      a. UNS No. C69300 Lead-free (LF) Brass.
      b. 20 percent glass-filled polysulfone as specified in ASTM D6394.
      c. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D6394.
      d. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D6394
      e. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D6394.
      f. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

D. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: AWS A5.8/A5.8M BCuP copper/silver alloy.

2.03 RADIANT HEATING PIPING

A. Polyethylene Pipe (PEX): ASTM F876, ASTM F877, and ASTM F1960 cross-linked polyethylene, PEX-a,100 psig operating pressure at 180 degrees F.
   1. Fittings for PEX Tubing: ASTM F 1960, cold expansion fittings matching PEX tube dimensions with PEX-a reinforcing rings, Lead Free Brass.
   2. Joints: ASTM F 1960 cold expansion fittings.

B. Composite Polyethylene Pipe: Aluminum tube laminated between two layers of high density polyethylene.
   1. Fittings: Brass flared compression.
   2. Joints: Fittings adapt to copper tubing or copper tube fittings, threaded pipe and fittings, and copper compression fittings.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877 and with plastic or corrosion-resistant-metal valve for each outlet.

2.04 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.05 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

D. Vertical Support: Steel riser clamp.

E. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

F. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

G. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

H. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

I. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Less:
   1. Ferrous Piping: 150 psig malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Dielectric Connections:
   1. Waterways:
      a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      b. Dry insulation barrier able to withstand 600 volt breakdown test.
      c. Construct of galvanized steel with threaded end connections to match connecting piping.
      d. Suitable for the required operating pressures and temperatures.
   2. Flanges:
      a. Dielectric flanges with same pressure ratings as standard flanges.
      b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      c. Dry insulation barrier able to withstand 600 volt breakdown test.
      d. Construct of galvanized steel with threaded end connections to match connecting piping.
      e. Suitable for the required operating pressures and temperatures.

C. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.

2.07 GLOBE OR ANGLE VALVES

A. Up To and Including 2 Inches:
   1. Bronze body, bronze trim, screwed bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder ends.

B. Over 2 Inches:
   1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.08 BALL VALVES

A. Up To and Including 2 Inches:
   1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
   2. Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends , and full size port.

2.09 PLUG VALVES

A. Up To and Including 2 Inches:
   1. Bronze body, bronze tapered plug, 40 percent port opening, non-lubricated, teflon packing, threaded ends.

2. Operator: One plug valve wrench for every ten plug valves minimum of one.

2.10 SWING CHECK VALVES

A. Up To and Including 2 Inches:
   1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

2.11 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.12 FLOW CONTROLS

A. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements. Install chilled water piping to ASME B31.5 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls and floors.

H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

I. Slope piping and arrange to drain at low points.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.

K. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

L. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
3. Place hangers within 12 inches of each horizontal elbow.
4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
8. Prime coat exposed steel hangers and supports. Refer to Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 0719.

N. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100.

O. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

A. Piping Systems.

Service	Size	Piping Material
Heating Water Piping, Above Ground	3" and Smaller	Copper

B. Hanger Spacing for Copper Tubing.
1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

C. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.

D. Hanger Spacing for Plastic Piping.
1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.

END OF SECTION

SECTION 23 2114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Strainers.

B. Combination flow controls.

C. Pump suction fittings.

D. Combination fittings.

E. Flow indicators, controls, meters.

F. Radiator valves.

G. Relief valves.

H. Pressure reducing valves.

1.02 RELATED REQUIREMENTS

A. Section 22 1006 - Plumbing Piping Specialties: Backflow Preventers.

B. Section 23 2113 - Hydronic Piping.

C. Section 23 2500 - HVAC Water Treatment: Pipe Cleaning .

1.03 REFERENCE STANDARDS

A. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of flow controls.

F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 STRAINERS

A. Size 2 inch and Under:
   1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:
   1. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.02 BALANCING VALVES

A. Size 2 inch and Smaller:
   1. Provide globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded connections.
   2. Metal construction materials consist of bronze or brass.
   3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.

B. Size 2.5 inch and Larger:
   1. Provide globe or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged connections.
   2. Valve body construction materials consist of cast iron or carbon steel.
   3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, or EPDM.

2.03 COMBINATION FLOW CONTROLS

A. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

C. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

2.04 RADIATOR VALVES

A. Angle or straight pattern, rising stem, inside screw globe valve for 125 psi working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

2.05 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.06 PRESSURE REDUCING VALVES

A. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 2113.

B. Materials of Construction:
   1. Valve Body: Constructed of bronze or cast iron.
   2. Internal Components: Construct of stainless steel and engineered plastics.

C. Connections:
   1. NPT threaded: 0.50 inch, 0.75 inch, or ____ inch.

D. Provide integral check valve and strainer.

E. Maximum Inlet Pressure: 100 psi.

F. Maximum Fluid Temperature: 180 degrees F.

G. Operating Pressure Range: Between 10 psi and 25 psi.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

D. Support pump fittings with floor mounted pipe and flange supports.

E. Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.

F. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

3.02 MAINTENANCE

A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.

B. Explain corrective actions to Owner's maintenance personnel in person.

END OF SECTION

SECTION 23 2123
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vertical in-line pumps.

1.02 RELATED REQUIREMENTS

A. Section 22 0513 - Common Motor Requirements for Plumbing Equipment.
B. Section 22 0716 - Plumbing Equipment Insulation.
C. Section 22 0719 - Plumbing Piping Insulation.
D. Section 22 0716 - Plumbing Equipment Insulation.
E. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
F. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
G. Section 23 0716 - HVAC Equipment Insulation.
H. Section 23 0719 - HVAC Piping Insulation.
I. Section 23 2113 - Hydronic Piping.
J. Section 23 2114 - Hydronic Specialties.
K. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; 2014.
B. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Armstrong Pumps Inc; _____: www.armstrongpumps.com.
B. Bell & Gossett, a Xylem Inc. brand; _____: www.bellgossett.com.
C. Taco: www.taco-HVAC.com.
D. Wilo SE: www.wilo-usa.com.

E. Grundfos Pumps: us.grundfos.com

F. Or Equal

2.02 HVAC PUMPS - GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Minimum Quality Standard: UL 778.

C. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.

D. Pumps shall be installed with suction diffusers. Diffusers to have integral strainers unless a separate strainer is being installed on the inlet to the pumps.

2.03 IN-LINE CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psi maximum working pressure.

B. Casing: Cast iron, with flanged pump connections.

C. Impeller: Bronze keyed to shaft.

D. Bearings: Permanently-lubricated ball bearings.

E. Shaft: Stainless steel with bronze sleeve, integral thrust collar.

F. Seal: Mechanical seal , 275 degrees F maximum continuous operating temperature.

G. Electrical Characteristics:
   1. Refer to Section 26 2717.
   2. Motor: 1750 rpm unless indicated otherwise; refer to Section 23 0513.
   3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.04 VERTICAL IN-LINE PUMPS

A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psi working pressure.

B. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.

E. Seal: Mechanical seal, 275 degrees F maximum continuous operating temperature.

F. Electrical Characteristics:
   1. Refer to Section 26 2717.
   2. Motor: 1750 rpm unless specified otherwise; refer to Section 23 0513.
   3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Refer to Section 22 0548.

D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 3000.

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Valves.
E. Strainers.
F. Check valves.
G. Filter-driers.
H. Flexible connections.

1.02 RELATED REQUIREMENTS

A. Section 08 3100 - Access Doors and Panels.
B. Section 09 9123 - Interior Painting.
C. Section 22 0719 - Plumbing Piping Insulation.
D. Section 22 0716 - Plumbing Equipment Insulation.
E. Section 23 0716 - HVAC Equipment Insulation.
F. Section 23 0719 - HVAC Piping Insulation.
G. Section 23 6213 - Packaged Air-Cooled Refrigerant Compressor and Condenser Units.
H. Section 23 81 29 - Varriable Refrigerant Volume (VRV) HVAC Systems
I. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.
B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
C. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2013.
D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.
E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
G. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.
I. ASME B31.9 - Building Services Piping; 2014.
J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.
K. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).
L. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

N. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

O. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

1.04 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

C. Filter-Driers:
   1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Submit welders certification of compliance with ASME BPVC-IX.

H. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

I. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.07 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME BPVC-IX.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 PIPING

A. Copper Tube: ASTM B 280, 1/2H hard drawn Type O annealed copper pipe.
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.

B. Pipe Supports and Anchors:
   1. Conform to ASME B31.5.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
   3. Vertical Support: Steel riser clamp.
   4. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   5. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
   6. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 REFRIGERANT

A. Refrigerant: R-410a as defined in ASHRAE Std 34.

2.03 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.04 VALVES

A. Diaphragm Packless Valves:
   1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

B. Packed Angle Valves:
   1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Ball Valves:
   1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:
   1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.05 STRAINERS

A. Straight Line or Angle Line Type:
   1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.06 CHECK VALVES

A. Globe Type:

1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

B. Straight Through Type:
1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.07 FILTER-DRIERS

A. Performance:
1. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
2. Design Working Pressure: 350 psi, minimum.

B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.
1. Connections: As specified for applicable pipe type.

2.08 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.5.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.

G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 3100.

J. Flood piping system with nitrogen when brazing.

K. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 9123.

L. Insulate piping and equipment; refer to Section and Section 23 0716.

M. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

N. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

O. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

P. Fully charge completed system with refrigerant after testing.

Q. Provide electrical connection to solenoid valves. Refer to Section 26 2717.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Test refrigeration system in accordance with ASME B31.5.

C. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Casing and plenums.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 09 9113 - Exterior Painting: Weld priming, weather resistant, paint or coating.

C. Section 23 0713 - Duct Insulation: External insulation and duct liner.

D. Section 23 3300 - Air Duct Accessories.

E. Section 23 3700 - Air Outlets and Inlets.

F. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

E. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.

F. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.

G. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2013.

H. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2013.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

J. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

K. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2014.

L. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

N. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.

O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012, 2nd Edition.

P. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum ___ years of documented experience.

1.06 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.07 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to NFPA 90A standards.

B. All Ducts: Galvanized steel, unless otherwise indicated.

C. Ventilation Air Supply: 4 inch w.g. pressure class, galvanized steel.

D. Ventilation Air Return: 4 inch w.g. pressure class, galvanized steel.

E. Ventilation Air Exhaust: 4 inch w.g. pressure class, galvanized steel.

F. Ventilation Air Outdoor Air: 4 inch w.g. pressure class, galvanized steel.

G. Terminal Unit Supply: 2 inch w.g. pressure class, galvanized steel.

H. Terminal Unit Return: 2 inch w.g. pressure class, galvanized steel.

I. Attic Ventilation Exhaust: 4 inch w.g. pressure class, galvanized steel.

J. Outside Air Intake: 1/2 inch w.g. pressure class, galvanized steel.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.
   3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
   4. For Use With Flexible Ducts: UL labeled.

C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Other Types: As required.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

G. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.
   1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
   3. Maximum Velocity: 4000 fpm.
   4. Temperature Range: Minus 10 degrees F to 160 degrees F.

B. Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
   1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
   3. Maximum Velocity: 4000 fpm.
   4. Temperature Range: Minus 20 degrees F to 210 degrees F.

2.05 CASINGS

A. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.

B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gage, 0.0478 inch expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

2.06 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with ductwork manufacturer's installation instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Flexible Ducts: Connect to metal ducts with adhesive.

E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

I. Use double nuts and lock washers on threaded rod supports.

J. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

K. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

L. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

END OF SECTION

SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.
B. Backdraft dampers - metal.
C. Combination fire and smoke dampers.
D. Duct access doors.
E. Duct test holes.
F. Fire dampers.
G. Flexible duct connections.
H. Smoke dampers.
I. Volume control dampers.

1.02 RELATED REQUIREMENTS

A. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
B. Section 23 3100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
B. NFPA 92 - Standard for Smoke Control Systems; 2015.
C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2014.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
E. Project Record Drawings: Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

2.04 DUCT ACCESS DOORS

A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
   1. Less Than 12 inches Square: Secure with sash locks.
   2. Up to 18 inches Square: Provide two hinges and two sash locks.
   3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.

B. Access doors with sheet metal screw fasteners are not acceptable.

2.05 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.06 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Ceiling Dampers: Galvanized steel, 22 gage, 0.0299 inch frame and 16 gage, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.

C. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

E. Multiple Blade Dampers: 16 gage, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.07 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.

2.08 SMOKE DAMPERS

2.09 VOLUME CONTROL DAMPERS

A. Splitter Dampers:
   1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
   2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .

B. Single Blade Dampers: Fabricate for duct sizes up to 6 by 30 inch.
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gage, 0.0239 inch, minimum.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch, minimum.

D. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

K. Use splitter dampers only where indicated.

L. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

C. Louvers.

1.02 RELATED REQUIREMENTS

A. Section 23 41 00 - Air Filters

1.03 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.

B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. American Louver Company; ALC Grilles and Registers: www.americanlouver.com.

B. Hart & Cooley, Inc.; _____: www.hartandcooley.com.

2.02 ROUND CEILING DIFFUSERS

A. Type: Round, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sectorizing baffles where indicated. Diffuser collar shall project not more than 1 inch above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.

B. Fabrication: Steel with baked enamel finish.

C. Color: As selected by Architect from manufacturer's standard range.

2.03 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square, stamped, multi-core, square, adjustable pattern,stamped, multi-core, square and rectangular, multi-louvered, square and rectangular, adjustable pattern, multi-louvered, and _____ diffuser to discharge air in 360 degree, one way, two way, three way, four way, and _____ pattern with sectorizing baffles where indicated.

B. Type: Square, stamped, multi-core diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.

C. Frame: Surface mount type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Fabrication: Steel with baked enamel finish.

E. Color: As selected by Architect from manufacturer's standard range.

2.04 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille with one-way deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions with factory clear lacquer finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.05 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.06 LINEAR WALL REGISTERS/GRILLES

A. Type: Streamlined blades with 0 degree deflection, 1/8 x 3/4 inch on 1/4 inch centers.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.07 LINEAR FLOOR SUPPLY REGISTERS/GRILLES

A. Type: Streamlined blades with 0 degree deflection, 1/8 x 3/4 inch on 1/2 inch centers, assembled on expanded tubes mandrel construction.

B. Frame: 1-1/4 inchheavy margin frame with countersunk screw mounting, and mounting frame.

C. Fabrication: Aluminum extrusions with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.08 DUCT MOUNTED EXHAUST GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.

B. Filter: Filter clips capable of accommodating 2" deep filter.

C. Grille Attachement: Grill is attached to frame with full lenght piano hinge.

D. Material: Formed Aluminum.

E. Finish: Electrocoat acrylic baked enamel.

F. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.09 DUCT MOUNTED SUPPLY DIFFUSER

A. Type: Duct Diffuser, performated holes with mitered, offset, aluminum frame for easy installation on a round, flat oval, or rectangular duct assembly or fitting body using sheet metal screws.

1. Provide units with Integral Balance Damper.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

END OF SECTION

SECTION 23 4100
AIR FILTERS

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 factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.03 DEFINITIONS

A. HEPA: High-efficiency particulate air.

1.04 SUBMITTALS

A. Product Data: Include dimensions; shipping, installed, and operating weights; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.
   1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
   2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
   3. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For each type of filter and rack to include in maintenance manuals specified in Division 1.

1.05 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated. Other manufacturers systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

B. Electronic Air Cleaners and Electrical Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100 by a testing agency acceptable to authorities having jurisdiction.

C. Comply with NFPA 90A and NFPA 90B.

D. ASHRAE Compliance: Comply with provisions of ASHRAE 52.1 and 52.2 for method of testing and rating air-filter units.

E. Comply with NFPA 70 for installing electrical components.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.07 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. Provide one complete set of filters for each filter bank. If system includes prefilters, provide one sets of prefilters.
   2. Provide two complete sets of filters for each fan coil unit.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Air Filters, Electrostatic Air Cleaners, and Filter-Holding Systems:
      a. AAF International.
      b. Farr Co.
      c. Flanders Filters, Inc.
   2. Filter Gages:
      a. Airguard Industries, Inc.
      b. Dwyer Instruments Inc.

2.02 FILTER GAUGE REQUIREMENTS

A. Furnish and install an air filter gauge to indicate the pressure drop across each filter section. Each gauge shall be installed in an easily accessible and readable location. Locate the static pressure tips at least 1'-0" upstream and 1'-0" down stream from the filters. The static heads shall be placed in a zone of minimum turbulance. Properly level inclined manometers and calibrate all filter gauges.

B. Provide Magnehelic differential pressure gauges complete with static pressure tips, aluminum tubing and vent valves for filters mounted above the ceiling. Remote mount gauge for filters installed above ceiling system. Coordinate gauge location with FAHC Facilities prior to installation.

2.03 FIELD INSTALLED CARTRIDGE TYPE PREFILTER

A. Disposable media type with field erected filter bank holding frames. Frames to be galvanized steel construction with positive type filter retainers. Cartridges to be supported by a heavy steel wire retainer attached to a filter holding frame. The retainers shall be coated with baked polyvinyl chloride resin.

B. Filter will be fabricated from a series of reinforced non-woven fabric filtration media pockets that have been treated with a non flammable odorless filter adhesive. The ends of the pockets shall be bonded by the manufacturer, and the entire filter cartridge shall be flame proofed and listed by the Underwriter's Laboratories as Class 2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Arrestance (ASHRAE 52.1): 90.
   2. MERV (ASHRAE 52.2): 7.

2.04 FACTORY ASSEMBLED CARTRIDGE TYPE PREFILTER

A. Filter will be fabricated from a series of reinforced non-woven fabric filtration media pockets that have been treated with a non flammable odorless filter adhesive. The ends of the pockets shall be bonded by the manufacturer, and the entire filter cartridge shall be flame proofed and listed by the Underwriter's Laboratories as Class 2.
   1. Arrestance (ASHRAE 52.1): 90.
   2. MERV (ASHRAE 52.2): 7.

B. Filter housing shall be fabricated from 16 gauge galvanized steel composed of one or more modules for field assembly. Access doors on each housing end, flanges for attachment to ductwork, prefilter rack and gasketed final filter rack shall be provided for final assembly into a complete unit. Access doors shall be gasketed around perimeter and for compression against filter cells to prevent leakage.

C. All access doors shall be hinged and held closed by spring catches

D. Provide positive filter locking mechanism using force to seal perimeter gasketing around each filter.

2.05 CARTRIDGE TYPE AIR FILTERS

A. Disposable cell type suitable for variable air volume. Components to consist of glass media, crimped aluminum separators, glass pack-ing sealant and fire retardant, and water resistant hard board cell sides. Cells to be UL 900 Class 1 construction. Flanges and gasket-ing to permit installation in holding frames providing a non-leaking seal. Initial resistance not greater than 0.65" of W.G. at 500 feet per minute face velocity. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Arrestance (ASHRAE 52.1): 95.
   2. MERV (ASHRAE 52.2): 13.

B. Field Erected Filter - Bank Holding Frames: Holding frames to be T cross section roll formed No. 16 gauge galvanized steel minimum complete with four stainless steel latches and oval punched for assembly by riveting or bolting into the required filter bank.

C. Factory Assembled Filter Housing: Housing constructed from not less than 16 gauge galvanized metal and leak free at filter sealing edges, doors and joints when pres-sure tested at 4" of W.G. A suitable frame for holding the filter cells to be provided and a crank or lever operated spring-loaded filter clamping mechanism to seal all filter edges. Provide tight sealing access doors on each end with gasketing, hinges and locking devices. Gaskets for filter seals to be provided as required.

2.06 DISPOSABLE PLEATED AIR FILTERS

A. Disposable pleated filter, cotton polyester media with wire back-ing. Filter bonded to heavy paperboard or internal metal frame on front, back and sides. Average filter efficiency of 25-30% as measured by ASHRAE 52-76. Provide permanent holding frame of sizes scheduled on drawings. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Arrestance (ASHRAE 52.1): 90.
   2. MERV (ASHRAE 52.2): 7.

2.07 95% EFFICIENT DRY FILTERS

A. 95%-efficiency filters shall be factory constructed disposable pleated filters. Filter media shall be made of microglass paper with a water repellent binder. Rigid media pack shall consist of media pleats structurally bonded one to the other. Frame to be foil laminated fiber board to provide strength and moisture resistance. Pack shall be bonded inside the double wall frame on all four edges. The filter shall have an average atmospheric dust spot efficiency of 90-95% as determined by the ASHRAE 52-76 test method. Provide prefilters and permanent holding frame of sizes scheduled on drawings. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Arrestance (ASHRAE 52.1): 95.
   2. MERV (ASHRAE 52.2): 13.

2.08 HEPA FILTERS

A. Filter shall be factory constructed by pleating on continuous sheet of medium into closely spaced pleats with aluminum separators. Adhesive sealer shall be rubber base. Filter medium shall be glass paper. Filter frame shall be assembled in a rigid manner. Overall dimensions shall be correct to within +/- 1/16" and squareness shall be within 1/8". Filter shall have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphthalate smoke. The clean filter static pressure drop shall be no greater than 1.00" w.g. when operating at rated capacity. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. MERV (ASHRAE 52.2): 20.

2.09 FILTER GAGES

A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
   1. Diameter: 4-1/2 inches
   2. Range: 0- to 3.0-inch wg.

B. Manometer-Type Filter Gage: Molded plastic with epoxy-coated aluminum scale, logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg, and accurate within 3 percent of full scale range.

C. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install filter frames according to manufacturer's written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

F. Coordinate filter installations with duct and air-handling unit installations.

G. Electrical wiring and connections are specified in Division 26 Sections.

H. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components, filter and filter-frame installation, and electrical wiring. Report results in writing.

B. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter for air leaks according to ASME N510 pressure-decay method.

3.03 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 23 7227
AIR TO AIR HEAT RECOVERY UNITS

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 RELATED REQUIREMENTS

A. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.

C. Section 23 3416 - Centrifugal HVAC Fans: Supply Fans and Exhaust Fans.

D. Section 23 41 00 - Air Filters

E. Section 23 82 16 - Air Coils

F. Section 23 62 13 - Packaged Air-Cooled Refrigerant Compressor and Condenser Units

G. Section 25 00 00 - HVAC Instrumentation and Controls.

H. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 SUMMARY

A. This Section includes Packaged Air to Air Heat (Energy) Recovery Units.

1.04 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. AHRI 270 - Sound Rating of Outdoor Unitary Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute; 2004.

D. ASHRAE Std 23 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2005.

E. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2007, Including All Addenda (ANSI/ASHRAE/

F. ASHRAE Std 90.2 - Energy Efficient Design of New Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2007.

G. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2009, Revision 1 - 2010.

H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2009.

J. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping,

installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

C. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

D. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.

E. Maintenance Data: Maintenance manuals specified in Division 1.

F. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
   1. The air handling unit(s) shall be certified in accordance with UL Standard 1995 and CSA-C22.2 No. 236
   2. The air handling unit(s) shall be safety certified by an accredited testing laboratory and the nameplate shall carry the label of the certification agency.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver air handling units as factory-assembled (ship unassembled) as recommended by the manufacturer.

B. Coordinate delivery of units in sufficient time to allow movement into building.

C. Handle air handling units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.08 COORDINATION

A. Coordinate installation of air handling units including, but not limited to, structural support of unit, piping size and connection location, and electrical power and control wiring.

1.09 REGULATORY REQUIREMENTS

A. Conform to NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.10 WARRANTY

A. General Warranty

B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to strict compliance with the requirements of this specification, provide products by one of the following:
   1. Air Handling Units:
      a. Zhender
      b. Or Equal

2.02 AIR HANDLING UNITS

A. Description: Factory assembled air handling units designed to the performance scheduled and including components as shown on the drawings.
   1. Total energy recovery core
   2. Integrated electric preheat
   3. Counterflow heat exchanger with efficiencies up to 95%

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 90A.

C. Mount units on pressure treated sleepers.

3.03 SYSTEM STARTUP

A. Prepare and start equipment. Adjust for proper operation.

3.04 CLOSEOUT ACTIVITIES

A. Demonstrate operation to Owner's maintenance personnel.

END OF SECTION

SECTION 23 8200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finned tube radiation.

B. Cabinet unit heaters.

1.02 RELATED REQUIREMENTS

A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.

B. Section 23 0716 - HVAC Equipment Insulation.

C. Section 23 0719 - HVAC Piping Insulation.

D. Section 23 2113 - Hydronic Piping.

E. Section 23 2114 - Hydronic Specialties.

F. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.03 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.

B. AHRI 350 - Sound Performance Rating of Non-Ducted Indoor Air-Conditioning Equipment; 2008.

C. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).

D. AHRI 840 - Unit Ventilators; 1998.

E. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:
   1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
   2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
   3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
   4. Submit the following for blower-coil units indicating:
      a. Overall dimensions including installation, operation, and service clearances.
      b. Lift points, recommendations, and center of gravity.
      c. Unit shopping, installation, and operating weights including dimensions.
      d. Fan curves with specified operating point clearly plotted.
      e. Safety and start-up instructions.

D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

E. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide 5 year manufacturer's warranty for _____.

PART 2 PRODUCTS

2.01 HYDRONIC FINNED TUBE RADIATION

A. Required Directory Listing: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.

B. Heating Elements: 3/4 inch ID seamless copper tubing, mechanically expanded into evenly spaced aluminum fins sized 4 x 4 inches, suitable for soldered fittings.

C. Heating Elements: 1 inch ID seamless copper tubing, mechanically expanded into evenly spaced aluminum fins sized 4 x 4 inches, suitable for soldered fittings.

D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

E. Enclosures: 18 gage, 0.0478 inch sheet steel up to 18 inches in height, 16 gage, 0.0598 inch sheet steel over 18 inches in height or aluminum as detailed, with easily jointed components for wall to wall installation.
   1. Support rigidly, on wall or floor mounted brackets.

F. Finish: Factory applied baked primer coat.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 x 7 inch minimum size, integral with cabinet.

2.02 HYDRONIC CABINET UNIT HEATERS

A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

B. Coils:
   1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
   2. Heating Hot Water: Suitable for working temperatures up to a maximum not less than 200 degrees F.

C. Cabinet: Minimum 16 gage, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.

D. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

G. Control: DDC.

H. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Finned Tube Radiation:
   1. Install wall angles and end caps where units butt against walls.
   2. Align cabinet joints with window mullions.
   3. Install wall angles where units butt against walls and align cabinet joints with window mullions.

E. Cabinet Unit Heaters:
   1. Install as indicated.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

3.03 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Vacuum clean coils and inside of units.

C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

D. Install new filters.

3.04 PROTECTION

A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION

SECTION 26 0500
ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

PART 1 - GENERAL

2.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions elsewhere in project specifications, apply to this Section.

2.02 SUMMARY

A. This Section includes the following: .
   1. Supporting devices for electrical components.
   2. Electrical demolition.
   3. Cutting and patching for electrical construction.
   4. Touchup painting.

2.03 DEFINITIONS

A. The use of the word “Provide”: Whenever the word “Provide” is used in the specifications and/or on the drawings, it shall mean “furnish and install”, “connect”, “apply”, “erect”, “construct”, or similar terms, unless otherwise indicated.

B. The use of the word “Piping”: “Piping” shall include but not be limited to, in addition to piping or mains, all fittings, flanges, unions, valves, strainers, drains, traps, insulation, vents, hangers and other accessories relative to such piping.

C. The use of the word “Material”: Whenever the word material is used in the specifications and/or on the drawings, it shall mean any “product”, “equipment”, “device”, “assembly”, or “item” required under the contract, as indicated by trade or brand name, manufacturer’s name, standard specification reference or other description.

D. The term “Electrical Contractor” or “Contractor” refer to the Sub Contractor or his Sub Contractors responsible for the furnishing and installation of all work indicated on the Electrical drawings and in the Electrical Specifications.

E. The term “Accessible” indicates ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, conduit, etc to gain access. “accessible ceiling” indicates acoustical tile type hung ceilings. Concealed spline or sheetrock ceilings with access panes shall not be considered accessible ceilings.

2.04 CODES, STANDARDS, REFERENCES, AND PERMITS

A. All material and workmanship shall comply with all the latest editions of all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations.

B. In case of differences between the Building Codes, State Law, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the contractor shall promptly notify the Engineer in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary and bid purposes. However, no work will proceed until the Engineer determines the correct method of installation.

D. Should the contractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, the contractor shall bear all costs arising in correcting the deficiencies, as approved by the Engineer.

2.05 SUBMITTALS

A. Shop Drawings: Dimensioned plans and sections or elevation layouts of electrical equipment and devices. All clearance requirements for electrical equipment shall be included.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Provide factory representation for supervision of equipment installation and commissioning (start-up) where requested by drawings and/or specifications. The factory representative shall provide approval of adequate installation completion.

C. Provide documentation that structural supports for stacking transformers is adequate to accommodate weights.

2.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

2.07 SYSTEM DESCRIPTION

A. Furnish and install all materials in order to provide functioning systems, upon completion, in compliance with all applicable codes, authorities having jurisdiction, manufacturer's requirements, performance requirements specified, and any modifications resulting from reviewed shop drawings and the field coordination drawings.

2.08 SCOPE OF WORK

A. The contractor is responsible for furnishing and installing all the devices and equipment shown indicated the Electrical Drawings including materials and equipment required to create fully operational systems.

B. The contractor shall be responsible for reviewing the Architectural, Mechanical, Fire Protection and other relevant plans. In addition to all mechanical equipment, light fixtures fixtures, and devices indicated on the Electrical Plans, the contractor is responsible for electrical installation of all the equipment and devices shown on the Architectural Plans, Mechanical Plans, Fire Protection and other plans associated with this project.

C. The contractor shall be responsible for reviewing the Architectural, Mechanical, Fire Protection and other relevant plans. Prior to bid, the contractor shall notify the Engineer of any discrepancies between the Architectural, Kitchen, Electrical, Mechanical, and Fire Protection Plans regarding equipment locations, equipment quantities, conduit routing, device locations, light locations, chase locations, etc. otherwise it will be assumed the contractor is responsible for the electrical installation of all the equipment and devices shown on Architectural Plans, Mechanical Plans, Plumbing Plans, Fire Protection and other plans associated with this project regardless of whether they are indicated on the Electrical Plans.

2.09 DRAWING INTERPRETATION

A. The project drawings are schematic in nature and indicate general arrangement of equipment. It is not the intent of the drawings to substitute for shop drawings. In many instances, equipment and devices are sized on one manufacturer's product. In the event of a field verification or coordination issue, report issue to Owners construction supervisor.

B. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines, to avoid existing field conditions as well as to maintain clearances to equipment whether or not indicated on the drawings. The contractor shall provide all pull boxes and accessories as required for his work to effect these offsets, transitions and changes in direction. Consult Design Professional before making changes that affect the function or appearance of systems.

C. Do not install equipment, devices or conduit in a non-code compliant fashion due to drawing interpretation. Provide modification of illustrated work in order to accommodate job conditions at no cost to Owner.

2.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver conduit with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored conduit and equipment from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect electrical specialties from moisture and dirt.

D. Store plastic conduit protected from direct sunlight. Support to prevent sagging and bending.

2.11 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

G. Coordinate supporting electrical equipment and devices with all other divisions.

H. Coordinate mounting heights of all devices with architectural details and shop drawings.

2.12 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for conduit spaces, chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if electrical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

2.13 "AS-BUILT" RECORD DRAWINGS

A. Record daily progress on one set of construction documents. Utilize a permanent black or blue marking media. All progress of record drawings shall be provided in a neat and accurate fashion.

B. As-built drawing reviews will be completed on a monthly basis by the engineer of record. Release of requisitions will be based on the regular progress of As-built drawings. The latest As-built drawings shall be submitted for review with each requisition for payment.

C. Formal As-built drawings shall be submitted for review at the completion of each phase of the work. The as-built drawings shall be ¼" scale and created in electronic format utilizing AUTOCAD 2005. At the completion of each phase of work, the electrical contractor shall submit to the Engineer the original field progress as-built drawings, the electronic files of the formal as-built drawings, and four sets of final as-built drawings plotted on 30" x 42" 'E' sized sheets. Final payment for the phase of work and the start of the next phase shall be dependant of approval of the as-built drawings.

2.14 GUARANTEE

A. Provide written guarantee of all completed/installed work. Materials, equipment and workmanship shall be guaranteed for a minimum period of one year after Owners acceptance of work. Any failure due to defective material, equipment or workmanship shall be corrected at no additional cost to owner. This shall include damage completed to other areas of construction or facility resulting from this failure. Provide correction of any failure within an acceptable/reasonable time period.

B. Provide all equipment and material manufacturers guarantees and/or warranties to owner after acceptance of installation.

2.15 OPERATING AND MAINTENANCE MANUALS

A. Provide operating and maintenance information for all equipment, devices, systems, and materials. This shall include all maintenance and operations procedures, recommendations, and service requirements. All submitted data must include minimum equipment/device operations and maintenance requirements to fulfill manufacturers warrantees.

B. Submit all engineering selection and specification documentation with operating and maintenance information for all equipment, devices, systems, and materials.

C. Submit all data media in a detailed, organized, and complete manner. Provide a minimum of three copies to Owners construction supervisor for engineer/architect review. Submit in 3 ring bound enclosure.

PART 2 - PRODUCTS

3.01 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Select one of two paragraphs below if slotted-steel channel supports are used.

D. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.

E. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.
   1. Retain two subparagraphs below with either paragraph selected above. Coordinate with Drawings.
   2. Channel Thickness: Selected to suit structural loading.
   3. Fittings and Accessories: Products of the same manufacturer as channel supports.

F. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.
   1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
   2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

G. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

H. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

I. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

J. Expansion Anchors: Carbon-steel wedge or sleeve type.

K. Toggle Bolts: All-steel springhead type.

L. Verify that devices in paragraph below are permissible in Project.

M. Powder-Driven Threaded Studs: Heat-treated steel.

3.02 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

4.01 ELECTRICAL EQUIPMENT INSTALLATION

A. Coordinate requirements below with Drawings.

B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

C. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

F. Provide ¾” exterior grade, group 3, fire resistive plywood for surface mounted equipment installation. Paint plywood with battleship grey finish which meets fire resistive building requirements. Provide where indicated on drawings or where equipment is to be mounted on masonry or concrete walls.

G. Mounting heights indicated on drawings are to be measured from the center of the device to the finished floor elevation. Submit a request for unidentified mounting heights of equipment to Owners construction supervisor.

H. Coordinate all device mounting heights with Architectural documents and ADA requirements. If discrepancy is detected, contact design professional so as to limit delay to construction.

I. The mounting heights indicated on architectural details and shop drawings take precedence over mounting heights indicated on drawings. In the event of a mounting issue, consult Owners construction supervisor.

4.02 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Galvanized Steel materials.

C. Selection of Supports: Comply with manufacturer's written instructions.

D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

4.03 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Coordinate paragraph below with Drawings.

G. Install 3/8”-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.

H. Delete paragraph below or revise for restrictions on spring-steel fasteners for light-commercial projects.

I. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

J. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

K. Simultaneously install vertical conductor supports with conductors.

L. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

M. Install metal channel racks or equipment backboards for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

N. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

O. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
   1. Wood: Fasten with wood screws or screw-type nails.

2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Delete subparagraph below if powder-actuated devices are prohibited.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
   a. Field Welding: Comply with AWS D1.1.
7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

4.04 DEMOLITION

A. Retain Article below only for renovation projects. Coordinate with Division 2 Section "Selective Demolition." Coordinate with Drawings.

B. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality at no cost to Owner.

C. Coordinate all electrical shutdowns with facility and local utility for demolition and revision to existing electrical circuits, panel feeds, and high voltage rework. The emergency power system shall be kept online during all shutdowns and switchovers.

D. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety. Remove electrical conduit and conductor back to source (ie, circuit breaker, panelboard) for equipment or devices indicated to be demolished or removed.

E. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

F. Remove demolished material from Project site and dispose of in a legal manner.

G. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

4.05 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

4.06 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Delete inapplicable subparagraphs below.
   2. Raceways.
   3. Building wire and connectors.
   4. Supporting devices for electrical components.
   5. Electricity-metering components.
   6. Concrete bases.
   7. Electrical demolition.
   8. Cutting and patching for electrical construction.
   9. Touchup painting.

4.07 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division "Painting."
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

4.08 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

4.09 SECTION INCLUDES

A. Electrical demolition.

4.10 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Additional requirements for alterations work.

PART 3 EXECUTION

5.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Architect before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

5.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

5.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

5.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

SECTION 26 0501
MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Architect before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner at least 24 hours before partially or completely disabling system.
   2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
   3. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Nonmetallic-sheathed cable.
C. Metal-clad cable.
D. Wiring connectors.
E. Electrical tape.
F. Heat shrink tubing.
G. Oxide inhibiting compound.
H. Wire pulling lubricant.
I. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 26 0501 - Minor Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 28 3100 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2011).
F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2007 (Reapproved 2012).
G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.
I. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; Revision A, 2008.
J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
K. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.
L. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.

M. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.

N. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.

O. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

P. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

R. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

S. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

T. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

U. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

W. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.

X. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For branch circuit wiring in dry locations within building less than 3 floors above grade..
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to view except mechanical spaces, attics and other similar areas.
      b. Where exposed to damage.
      c. For damp, wet, or corrosive locations.

D. Metal-clad cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
   2. In addition to other applicable restrictions, may not be used:
      a. Where not approved for use by the authority having jurisdiction.
      b. Where exposed to view.
      c. Where exposed to damage.
      d. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
      e. For patient care areas of health care facilities requiring redundant grounding unless hospital grade rated.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Comply with FS A-A-59544 where applicable.

G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

I. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

J. Conductor Material:

1. Provide copper conductors except where aluminum conductors are specifically indicated. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
    a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
        1) Services: Copper conductors size 1/0 AWG and larger.
        2) Feeders: Copper conductors size 1/0 AWG and larger.
    b. Where aluminum conductors are substituted for copper, comply with the following:
        1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
        2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
        3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
        4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

K. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
    a. Exceptions:
        1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
        2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
2. Control Circuits: 14 AWG.

L. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
    a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
    a. 240/120 V, 1 Phase, 3 Wire System:
        1) Phase A: Black.
        2) Phase B: Red.
        3) Neutral/Grounded: White.
    b. Equipment Ground, All Systems: Green.
    c. Isolated Ground, All Systems: Green with yellow stripe.
    d. Travelers for 3-Way and 4-Way Switching: Pink.
    e. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor Stranding:
1. Feeders and Branch Circuits:
    a. Size 10 AWG and Smaller: Solid.
    b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.
      c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
   2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 NONMETALLIC-SHEATHED CABLE

A. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.

B. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

2.05 METAL-CLAD CABLE

A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

E. Provide oversized neutral conductors where indicated or required.

F. Provide dedicated neutral conductor for each phase conductor where indicated or required.

G. Grounding: Full-size integral equipment grounding conductor.
   1. Provide additional isolated/insulated grounding conductor where indicated or required.

H. Armor: Steel, interlocked tape.

I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.06 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use compression connectors.
   3. Connectors for Aluminum Conductors: Use compression connectors.

C. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Aluminum Conductors: Use compression connectors for all connections.
7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
8. Conductors for Control Circuits: Use crimped terminals for all connections.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.07 WIRING ACCESSORIES

A. Electrical Tape:
1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

E. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as shown on the drawings.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated and routing is not shown, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location shown.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
   7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install aluminum conductors in accordance with NECA 104.

E. Install nonmetallic-sheathed cable (Type NM-B) in accordance with NECA 121.

F. Install metal-clad cable (Type MC) in accordance with NECA 120.

G. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

H. Exposed Cable Installation (only where specifically permitted):
   1. Route cables parallel or perpendicular to building structural members and surfaces.
   2. Protect cables from physical damage.

I. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

J. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

K. Terminate cables using suitable fittings.
1. Metal-Clad Cable (Type MC):
   a. Use listed fittings.
   b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

L. Install conductors with a minimum of 12 inches of slack at each outlet.

M. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

N. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

O. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

P. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
   a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
   b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
   a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
   b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
3. Wet Locations: Use heat shrink tubing.

Q. Insulate ends of spare conductors using vinyl insulating electrical tape.

R. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

S. Identify conductors and cables in accordance with Section 26 0553.

T. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

U. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

V. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

E. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Existing metal underground water pipe.
   2. Metal frame of the building.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.03 PERFORMANCE REQUIREMENTS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

2.03 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.

B. Wire: Stranded copper.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 0553.

E. Provide bonding to meet requirements described in Quality Assurance.

F. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use 2 AWG bare copper conductor.

G. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.13.

E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.

F. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006

G. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010

H. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.

I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer’s catalog data for fastening systems.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.

4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION

SECTION 26 0534
CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Flexible metal conduit (FMC).
D. Liquidtight flexible metal conduit (LFMC).
E. Electrical metallic tubing (EMT).
F. Rigid polyvinyl chloride (PVC) conduit.
G. Electrical nonmetallic tubing (ENT).
H. Liquidtight flexible nonmetallic conduit (LFNC).
I. Conduit fittings.
J. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 26 0519 - Low-Voltage Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
D. Section 26 0529 - Hangers and Supports for Electrical Systems.
E. Section 26 0553 - Identification for Electrical Systems.
F. Section 26 0537 - Boxes.
G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
K. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

N. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

O. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

P. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

S. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

T. UL 886 - Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

U. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.

V. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. In locations where non-metallic sheathed (NM) cable not permitted.

B. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

C. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

D. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use rigid PVC conduit.

E. Embedded Within Concrete:
   1. Within Slab on Grade: Not permitted.
   2. Within Slab Above Ground: Not permitted.

F. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).

G. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).

H. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).

I. Interior, Damp or Wet Locations: Use electrical metallic tubing (EMT).

J. Exposed, Interior, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).

K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use electrical metallic tubing (EMT).

L. Corrosive Locations Above Ground: Use aluminum rigid metal conduit.

M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.

N. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

O. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

A. Electrical Service Conduits: Also comply with Section 26 2100.

B. Communications Systems Conduits: Also comply with Section 27 00 00.

C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2 inch (16 mm) trade size.
   2. Control Circuits: 1/2 inch (16 mm) trade size.
   3. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
   4. Underground, Interior: 3/4 inch (21 mm) trade size.
   5. Underground, Exterior: 1 inch (27 mm) trade size.

F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

B. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use aluminum.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction.

D. Fittings: NEMA FB 1.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction with PVC jacket.

2.07 ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use set-screw type.
      a. Do not use indenter type connectors and couplings.
   4. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ELECTRICAL NONMETALLIC TUBING (ENT)

A. Description: NFPA 70, Type ENT electrical nonmetallic tubing complying with NEMA TC 13 and listed and labeled as complying with UL 1653. For use only for communications systems.

B. Fittings:
   1. Manufacturer: Same as manufacturer of ENT to be connected.
   2. Use solvent-welded type fittings.
   3. Solvent-Welded Fittings: Rigid PVC fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; suitable for use with ENT.

2.10 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

B. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.11 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 500 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

G. Description: NEMA TC 2.

H. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

F. Install electrical nonmetallic tubing (ENT) in accordance with NECA 111.

G. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

H. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated and routing is not shown, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
   5. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across top of parapet walls.
      c. Across building exterior surfaces.
   6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   7. Arrange conduit to maintain adequate headroom, clearances, and access.
   8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   9. Route conduits above water and drain piping where possible.
   10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   12. Maintain minimum clearance of 12 inches between conduits and hot surfaces.

I. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   7. Use of wire for support of conduits is not permitted.

J. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

L. Underground Installation:
1. Provide trenching and backfilling in accordance with other sections of these specifications..
2. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length for service entrance where not concrete-encased.

M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

N. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify conduits in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 INSTALLATION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

B. Do not cross conduits in slab.

C. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

D. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

E. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations.

F. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Do not install horizontal raceway runs above or below water and steam piping.

G. Complete raceway installation before starting conductor installation

H. Install raceways a maximum of 10’0” above finished floor, unless indicated otherwise or to meet seismic installation requirements. Any raceway above 10’0” above finished floor shall be approved by owner and engineer.

I. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

J. Install temporary closures to prevent foreign matter from entering raceways.

K. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

L. 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.

M. Prefabricated bends are only permitted for RMC and IMC conduits 3” and above.

N. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
   1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

O. Raceways 1¼” and smaller, penetrating concrete slabs, shall be installed with a bituminous coating. The bituminous coating shall be applied around the entire perimeter of the raceway and along the full depth of the slab.

P. Raceways 1½” and larger, penetrating concrete slabs, shall be installed within a Schedule 40 PVC sleeve.

Q. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit or rigid steel conduit before rising above the floor.

R. 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.

S. Individual construe hangers shall be designed for the purpose, and have pre-assembled closure bolts and nuts, and provisions for receiving hanger rod

T. Multiple conduit trapeze hangers shall not be less than 1-1/2" by 1-1/2", 12 gage steel, cold formed, lipped channels. Hanger rods shall be not less than 3/8" diameter steel.

U. Join raceways with fittings designed and approved for that purpose and make joints tight
   1. Use insulating bushings to protect conductors

V. Tighten set screws of threadless fittings with suitable tools.

W. 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.

X. 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.

Y. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements

Z. 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. Install raceway sealing fittings at the following points:

AA. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

AB. Where otherwise required by NFPA 70.

AC. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor, where approved by engineer. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

AD. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures. Lighting fixtures shall not be "daisy chained." For equipment subject to vibration, noise transmission, or movement; and for all motors use LFMC. Install separate ground conductor across flexible connections.

AE. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Where noted for wall mounted raceway, provide junction boxes or stubs through wall to delete need for surface raceway from floor or ceiling.

AF. Set floor boxes level and flush with finished floor surface

AG. Set floor boxes level. Trim after installation to fit flush with finished floor surface.

AH. Anchors shall be self drilling expansion shields, or machine bole expansion hangers.

AI. Solid Masonry and Concrete Anchors: Fed. Spec. FF-S-325

AJ. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

AK. Wall Outlets in Stud Walls: Boxes shall be 4" square with plaster ring, with number of gangs as required.

AL. Surface Exposed Wall or Ceiling Outlets: 4" square or multi-gang boxes with matching raised covers. Boxes in finished areas and where indicated shall be cast FS type with covers similar to those specified for finished plates.

AM. Ground and bond conduit under provisions of Section 26 0526.

AN. Identify conduit under provisions of Section 26 0553.

3.06 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.

3.07 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

END OF SECTION

SECTION 26 0537
BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Underground boxes/enclosures.

D. Wall and ceiling outlet boxes.

E. Floor boxes.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0534 - Conduit:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 2726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.

G. Section 26 2726 - Wiring Devices: Wall plates in finished areas.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

C. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes or where approved non-metallic boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes, cast aluminum boxes, or where approved non-metallic boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use nonmetallic boxes where exposed rigid PVC conduit is used.
4. Use suitable concrete type boxes where flush-mounted in concrete.
5. Use suitable masonry type boxes where flush-mounted in masonry walls.
6. Use raised covers suitable for the type of wall construction and device configuration where required.
7. Use shallow boxes where required by the type of wall construction.
8. Do not use "through-wall" boxes designed for access from both sides of wall.
9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
11. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
14. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   3. Junction and Pull Boxes Larger Than 100 cubic inches:
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

D. Floor Boxes:
   1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
   2. Use cast iron or nonmetallic floor boxes within slab on grade.
   3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
   4. Manufacturer: Same as manufacturer of floor box service fittings.

E. Underground Boxes/Enclosures:
   1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
   2. Size: As indicated on drawings.
   3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
   4. Provide logo on cover to indicate type of service.
   5. Applications:
      a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 8 load rating.
      b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
   6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.

a. Manufacturers:
   1) Highline Products, a subsidiary of MacLean Power Systems; _____: www.highlineproducts.com.
   2) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com.
b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
   9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0534.

E. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

F. Install boxes plumb and level.

G. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

H. Install boxes as required to preserve insulation integrity.

I. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

J. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

K. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify boxes in accordance with Section 26 0553.

R. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

S. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

T. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.

U. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

V. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

W. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

X. Maintain headroom and present neat mechanical appearance.

Y. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

Z. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

AA. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

AB. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

AC. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

AD. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

AE. Use flush mounting outlet box in finished areas.

AF. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

AG. Provide separate boxes for emergency power and normal power systems.

AH. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

AI. Locate outlet boxes so that wall plates do not span different building finishes.

AJ. Locate outlet boxes so that wall plates do not cross masonry joints.

AK. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation.
1. Provide minimum 24 inches separation in fire rated walls.

AL. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

AM. Use stamped steel bridges to fasten flush mounting outlet box between studs.

AN. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

AO. Use adjustable steel channel fasteners for hung ceiling outlet box.

AP. Do not fasten boxes to ceiling support wires.

AQ. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

AR. Use gang box with plaster ring for single device outlets.

AS. Use cast outlet box in exterior locations exposed to the weather and wet locations.

AT. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

AU. Set floor boxes level.

AV. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

AW. Identify boxes in accordance with Section 26 0553.

3.03 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.04 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

B. Clean exposed surfaces and restore finish.

3.05 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting.

B. Section 09 9123 - Interior Painting.

C. Section 26 0519 - Low-Voltage Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

D. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

E. Section 27 1005 - Structured Cabling for Voice and Data - Inside-Plant: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Enclosed switches, circuit breakers, and motor controllers:
         1) Identify voltage and phase.
         2) Identify power source and circuit number. Include location when not within sight of equipment.
         3) Identify load(s) served. Include location when not within sight of equipment.
   2. Service Equipment:
      a. Use identification nameplate to identify each service disconnecting means.
   3. Emergency System Equipment:
      a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
      b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
   4. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
   5. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
      a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
   6. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.

C. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
   3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
      a. At each source and load connection.
      b. Within boxes when more than one circuit is present.

c. Within equipment enclosures when conductors and cables enter or leave the enclosure.

D. Identification for Raceways:
1. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
1) Color Code:
(a) Fire Alarm System: Red.
2) Field-Painting: Comply with Section 09 9123 and 09 9113.
3) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.
2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
4. Use underground warning tape to identify underground raceways.

E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
a. Color-Coded Boxes: Field-painted in accordance with Section 09 9123 and 09 9113 per the same color code used for raceways.
b. For exposed boxes in public areas, do not color code.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
a. For exposed boxes in public areas, use only identification labels.

F. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 00 00.
2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
3. Factory Pre-Marked Wallplates: Comply with Section 26 2726.
4. Use identification label to identify fire alarm system devices.
a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

G. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.

b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
a. System designation where applicable:
1) Emergency Power System: Identify with text "EMERGENCY".
2) Fire Alarm System: Identify with text "FIRE ALARM".
b. Equipment designation or other approved description.
c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
a. System Designation: 1 inch.
b. Equipment Designation: 1/2 inch.
c. Other Information: 1/4 inch.
5. Color:
a. Normal Power System: White text on black background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background for normal power.

G. Format for Fire Alarm Device Identification:
   1. Minimum Size: 3/8 inch by 1.5 inches.
   2. Legend: Designation indicated and device zone or address.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height: 3/16 inch.
   5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

C. Minimum Size:
   1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

D. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
   2. Markers for System Identification:
      a. Emergency Power System: Text "EMERGENCY".

E. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
   2. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.
   10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
   1. Do not use adhesives on exterior surfaces except where substrate can not be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.

B. Time switches.

C. Outdoor photo controls.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0537 - Boxes.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0919 - Enclosed Contactors: Lighting contactors.

E. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

F. Section 26 5100 - Interior Lighting.

G. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.

B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2011.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

I. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

J. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.

4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Fluorescent Ballasts: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
   1. Hubbell Building Automation, Inc; _____: www.hubbellautomation.com
   2. Sensor Switch Inc; _____: www.sensorswitch.com.
   3. WattStopper; _____: www.wattstopper.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.
   5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
   6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
   7. Sensitivity: Field adjustable.
   8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
   9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
   10. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on the drawings.
   11. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
   12. Occupancy Sensors on Emergency Power Circuits: Code compliant OSP20-RDH/RHN for life safety.

C. Wall Switch Occupancy Sensors:
   1. All Wall Switch Occupancy Sensors:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
      b. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
      c. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
      d. Finish: Color to be selected.

D. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:

a. Description: Low profile occupancy sensors designed for ceiling installation.
b. Unless otherwise indicated or required to control the load indicated on the drawings, provide low voltage units, for use with separate compatible accessory power packs.
c. Provide field selectable setting for disabling LED motion detector visual indicator.
d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
e. Finish: See 26 2726..

2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.

E. Directional Occupancy Sensors:
1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.

F. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on the drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on the drawings.

2.03 TIME SWITCHES

A. Digital Electronic Time Switches:
1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
a. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
a. Indoor clean, dry locations: Type 1.
b. Outdoor locations: Type 3R.

2.04 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
1. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Stem-Mounted Outdoor Photo Controls:
1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
2. Housing: Weatherproof, impact resistant polycarbonate.

3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Button Type Outdoor Photo Controls
1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.

2.05 DAYLIGHTING CONTROLS

A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

B. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
a. Indoor Photo Sensors: 5 to 100 footcandles.
3. Finish: White unless otherwise indicated.

C. Power Packs for Low Voltage Daylighting Control Modules:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on the drawings.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Ratings: As required to control the load indicated on the drawings.

D. Accessories:
1. Where indicated, provide compatible accessory wall switches for manual override control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
      b. In-Wall Time Switches: 48 inches above finished floor.
      c. In-Wall Interval Timers: 48 inches above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.

G. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

H. Identify lighting control devices in accordance with Section 26 0553.

I. Install identification label for wall switch occupancy sensors, in-wall time switches, in-wall interval timers, and accessory manual wall switches in accordance with Section 26 0526 indicating load served where indicated, when controlling loads that are not visible from the control location, or when multiple control devices are installed at one location.

J. Occupancy Sensor Locations:
   1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
   2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Outdoor Photo Control Locations:

1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

M. Daylighting Control Photo Sensor Locations:
1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

N. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

O. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

P. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

Q. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

R. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 2716 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

A. See Section 01 9113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

SECTION 26 2716

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hinged cover enclosures.

B. Cabinets.

C. Terminal blocks.

D. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

C. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks; National Electrical Manufacturers Association; 2005.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Cabinet Keys: Deliver to Owner in accordance with Section 01 6000 for maintenance materials.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 HINGED COVER ENCLOSURES

A. Construction: NEMA 250, Type 1 steel enclosure.

B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.

C. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.

D. Enclosure Finish: Manufacturer's standard enamel.

2.02 CABINETS

A. Boxes: Galvanized steel.

B. Backboard: Provide 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.

C. Fronts: Steel, flush type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.

D. Provide metal barriers to form separate compartments wiring of different systems and voltages.

E. Keys: Provide two of each different key.

2.03 TERMINAL BLOCKS

A. Terminal Blocks: NEMA ICS 4.

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

D. Provide ground bus terminal block, with each connector bonded to enclosure.

2.04 ACCESSORIES

A. Plastic Raceway: Plastic channel with hinged or snap-on cover.

B. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 26 0529.

C. Install cabinet fronts plumb.

3.02 CLEANING

A. Clean electrical parts to remove conductive and harmful materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 2717
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Conductors and Cables.

B. Section 26 0534 - Conduit.

C. Section 26 0519 - Low-Voltage Conductors and Cables (600 V and Less).

D. Section 26 0537 - Boxes.

E. Section 26 2726 - Wiring Devices.

F. Section 26 2818 - Enclosed Switches.

G. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disconnect Switches: As specified in Section 26 2818 and in individual equipment sections.

B. Wiring Devices: As specified in Section 26 2726.

C. Flexible Conduit: As specified in Section 26 0534.

D. Wire and Cable: As specified in Section 26 0519.

E. Boxes: As specified in Section 26 0537.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Wall plates.

E. Floor box service fittings.

F. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0537 - Boxes.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

E. Section 27 1005 - Structured Cabling for Voice and Data - Inside-Plant: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).

E. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
   1. Wall Dimmers: Include derating information for ganged multiple devices.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data:
   1. Wall Dimmers: Include information on operation and setting of presets.
   2. GFCI Receptacles: Include information on status indicators.
   3. Surge Protection Receptacles: Include information on status indicators.

E. Project Record Documents: Record actual installed locations of wiring devices.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Keys for Locking Switches: Two of each type.
   3. Extra Wall Plates: One of each style, size, and finish.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hubbell Incorporated; _____: www.hubbell-wiring.com.

B. Leviton Manufacturing Company, Inc; _____: www.leviton.com.

C. Lutron Electronics Company, Inc; _____: www.lutron.com.

D. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us

E. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

2.02 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Provide GFCI protection for receptacles installed within 6 feet of sinks.

E. Provide GFCI protection for receptacles installed in kitchens.

F. Provide GFCI protection for receptacles serving electric drinking fountains.

G. Unless noted otherwise, do not use combination switch/receptacle devices.

H. For flush floor service fittings, use tile rings for installations in tile floors.

I. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.03 ALL WIRING DEVICES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

B. Finishes:
   1. All Wiring Devices: Ivory with nylon wall plate unless otherwise indicated.
   2. Flush Floor Box Service Fittings: Ivory wiring devices with brass cover and ring/flange.

2.04 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

2.05 WALL DIMMERS

A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

2.06 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

B. Convenience Receptacles:
   1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
   2. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
   3. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

C. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.

a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

2.07 WALL PLATES

A. Manufacturers:
1. Hubbell Incorporated; _____: www.hubbell-wiring.com.

B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard; _____.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.08 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:
1. Hubbell Incorporated; _____: www.hubbell-wiring.com.
2. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Service fittings compatible with floor boxes provided under Section 26 0537 with components, adapters, and trims required for complete installation.

C. Above-Floor Service Fittings:
1. Dual Service Pedestal Combination Outlets:
a. Configuration:
1) Power: Number as shown on drawings _____ _____.
2) Communications: One 1 inch bushed opening; verify exact size in field.
3) Voice and Data Jacks: As specified in Section 27 1005.
b. Provide barrier to separate line and low voltage compartments.

D. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
a. Cover: Rectangular.
b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Dual Service Flush Combination Outlets:
a. Cover: Rectangular.
b. Configuration:
1) Power: Number as shown on drawings _____ duplex receptacle(s) with duplex flap opening(s).
2) Communications: One 1 inch bushed opening; verify exact size in field..
3) Voice and Data Jacks: As specified in Section 27 1005.
3. Dual Service Flush Furniture Feed:
a. Cover: Rectangular.
b. Configuration:
1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
4. Accessories:
a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.

b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

2.09 POKE-THROUGH ASSEMBLIES

A. Manufacturers:
1. Hubbell Incorporated; _____: www.hubbell-wiring.com.
2. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

C. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Single Service Flush Communications Outlets:
a. Configuration: _____.
b. Voice and Data Jacks: As specified in Section 27 1005.
3. Dual Service Flush Combination Outlets:
a. Cover: Hinged door(s).
b. Configuration:
1) Power: One standard convenience duplex receptacle(s).
2) Communications: _____.
3) Voice and Data Jacks: As specified in Section 27 1005.
4. Dual Service Flush Furniture Feed:
a. Configuration:
1) Power: One 3/4 inch threaded opening(s).
2) Communications: Two 1/2 inch threaded opening(s).
5. Accessories:
a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 48 inches above finished floor.
      b. Wall Dimmers: 48 inches above finished floor.
      c. Fan Speed Controllers: 48 inches above finished floor.
      d. Receptacles: 18 inches above finished floor or 6 inches above counter.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

J. Install wiring devices plumb and level with mounting yoke held rigidly in place.

K. Install wall switches with OFF position down.

L. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

M. Do not share neutral conductor on branch circuits utilizing wall dimmers.

N. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

O. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

Q. Identify wiring devices in accordance with Section 26 0553.

R. Provide wiring device label in accordance with Section 26 0553 for wall-mounted controls controlling loads that are not visible from the control location or multiple wall-mounted controls installed at one location identifying load controlled.

S. Provide wiring device label in accordance with Section 26 0553 for all receptacles identifying serving branch circuit.

T. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.

C. Inspect each wiring device for damage and defects.

D. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

E. Test each receptacle to verify operation and proper polarity.

F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 2818 - Enclosed Switches: Fusible switches.

C. Section 26 2913 - Enclosed Controllers: Fusible switches.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
      a. Fusible Enclosed Switches: See Section 26 2818.
      b. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
   1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Fuses: One set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.

4. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Service Entrance:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits: Class RK1, time-delay.

D. Individual Motor Branch Circuits: Class RK1, time-delay.

E. Primary Protection for Control Transformers: Class CC, time-delay.

2.02 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

I. Class CC Fuses: Comply with UL 248-4.

2.03 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

END OF SECTION

SECTION 26 2818
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2813 - Fuses.

E. Section 26 2913 - Enclosed Controllers: Manual motor controllers.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
2. Include wiring diagrams showing all factory and field connections.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; _____: www.eaton.com.

B. Substitutions: See Section 01 6000 - Product Requirements.

C. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

J. Conductor Terminations: Suitable for use with the conductors to be installed.

K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

M. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

O. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Provide compression lugs.
      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Identify enclosed switches in accordance with Section 26 0553.

J. Provide identification nameplate for each enclosed switch in accordance with Section 26 0553.

K. Provide identification label on inside door of each fused switch indicating NEMA fuse class and size installed in accordance with Section 26 0553.

L. Provide arc flash warning labels in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed NEMA motor controllers for low-voltage (600 V and less) applications:

B. Overcurrent protective devices for motor controllers, including overload relays.

C. Manual motor controllers.

D. Magnetic motor controllers.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2813 - Fuses: Fuses for fusible switches.

1.03 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.

E. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2000 (R2010).

F. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (R2011).

G. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

K. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contractors and Motor-starters - Electromechanical Contractors and Motor-starters; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Maintenance Data: Replacement parts list for controllers.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; _____: www.eaton.com.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ENCLOSED MOTOR CONTROLLERS

A. Provide enclosed motor controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed motor controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
   1. Provide motor controllers and associated components suitable for operation under the following service conditions without derating:
      a. Altitude:
         1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
         2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide motor controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:
   1. Comply with NEMA ICS 6.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   3. Finish: Manufacturer's standard unless otherwise indicated.

H. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
   1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
   2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
   3. Trip-free operation.
   4. Visible trip indication.

5. Resettable.
   a. Employ manual reset unless otherwise indicated.
   b. Do not employ automatic reset with two-wire control.

2.04 MANUAL CONTROLLERS

A. Manual Motor Controllers: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, NO auxiliary contact, and push button operator.

B. Fractional Horsepower Manual Controllers: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and key operator.

C. Motor Starting Switches: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red pilot light and key operator.

D. Enclosures: NEMA ICS 6, Type 1.

2.05 AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Coil Operating Voltage: 120 volts, 60 Hertz.

C. Overload Relays: NEMA ICS 2; bimetal.

D. Enclosures: NEMA ICS 6, Type 1.

2.06 ACCESSORIES

A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.

B. Cover Mounted Pilot Devices: NEMA ICS 5, standard duty oiltight type.

C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

D. Pushbuttons: Unguarded type.

E. Indicating Lights: Transformer, LED type.

F. Selector Switches: Rotary type.

G. Relays: NEMA ICS 2, _____.

H. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each motor starter. Provide fused primary, secondary, and bond unfused leg of secondary to enclosure.

2.07 DISCONNECTS

A. Combination Controllers: Combine motor controllers with disconnects in common enclosure. Obtain IEC Class 2 coordinated component protection.

B. Thermal Magnetic Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole; UL listed.

C. Motor Circuit Protector: Circuit breakers with integral instantaneous magnetic trip in each pole; UL listed.

D. Nonfusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle.

E. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class R fuses.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install motor controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment components in accordance with Section 26 0529.

E. Install enclosed motor controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed devices, components, and accessories.

H. Height: 5 ft to operating handle.

I. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

L. Select and install overload heater elements in motor controllers to match installed motor characteristics.

M. Identify enclosed motor controllers in accordance with Section 26 0553.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Motor Starters: Perform inspections and tes913ts listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

E. Correct deficiencies and replace damaged or defective enclosed motor controllers or associated components.

F. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Lamps.

F. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0537 - Boxes.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.

D. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS

A. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.

B. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).

C. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).

D. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society; 2008.

E. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

G. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.

H. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

I. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2011.

J. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. NFPA 101 - Life Safety Code; 2015.

M. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

N. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.

O. UL 1598 - Luminaires; Current Edition, Including All Revisions.

P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
      b. Include IES LM-79 test report upon request.
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
   3. Drivers: Include wiring diagrams and list of compatible lamp configurations.
   4. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.

E. Field Quality Control Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
   3. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide two year manufacturer warranty for all linear fluorescent ballasts.

C. Provide five year pro-rata warranty for batteries for emergency lighting units.

D. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

E. Provide three year full warranty for fluorescent emergency power supply units.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See Section 01 6000 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Provide products complying with Federal Energy Management Program (FEMP) requirements.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

J. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Sealed maintenance-free lead calcium unless otherwise indicated.
   2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

G. Accessories:
   1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2.04 EXIT SIGNS

A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single or double as indicated or as required for the installed location.
   2. Directional Arrows: As indicated or as required for the installed location.

B. Self-Powered Exit Signs:
   1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
   2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
   3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
   4. Provide low-voltage disconnect to prevent battery damage from deep discharge.

5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

2.05 BALLASTS AND DRIVERS

A. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to 10 percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.
      a. Wall Dimmers: See Section 26 2726.
      b. Daylighting Controls: See Section 26 0923.

2.06 LAMPS

A. Lamps - General Requirements:
   1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
   2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
   3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
   4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.07 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

D. Provide all accessories for supporting and connecting fixtures in grid ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
   7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

F. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
   4. Install canopies tight to mounting surface.
   5. Unless otherwise indicated, support pendants from swivel hangers.

H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

I. Install accessories furnished with each luminaire.

J. Bond products and metal accessories to branch circuit equipment grounding conductor.

K. Emergency Lighting Units:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
   2. Install lock-on device on branch circuit breaker serving units.

L. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
   2. Install lock-on device on branch circuit breaker serving units.

M. Remote Drivers: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

N. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 5600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Lamps.

C. Poles and accessories.

D. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0537 - Boxes.

C. Section 26 0919 - Enclosed Contactors: Lighting contactors.

D. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.

E. Section 26 2726 - Wiring Devices: Receptacles for installation in poles.

F. Section 26 2813 - Fuses.

G. Section 26 5100 - Interior Lighting.

1.03 REFERENCE STANDARDS

A. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.

B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.

C. ANSI O5.1 - American National Standard for Wood Poles -- Specifications and Dimensions; 2015.

D. IEEE C2 - National Electrical Safety Code; 2012.

E. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).

F. IESNA LM-5 - Photometric Measurements of Area and Sports Lighting Installations; 2004 (Reaffirmed 2007).

G. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).

H. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.

I. IESNA LM-64 - Photometric Measurements of Parking Areas; 2001 (Reaffirmed 2007).

J. IES RP-8 - Roadway Lighting; 2014.

K. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

L. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.

M. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2011.

N. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

P. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.

Q. UL 1598 - Luminaires; Current Edition, Including All Revisions.

R. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
   2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
   3. Lamps: Include rated life and initial and mean lumen output.
   4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

E. Field Quality Control Reports.
   1. Include test report indicating measured illumination levels.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.
   3. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.

I. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. LED Luminaires: Listed and labeled as complying with UL 8750.

2.03 LAMPS

A. Lamps - General Requirements:
   1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
   2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
   3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
   4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.04 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

F. Install accessories furnished with each luminaire.

G. Bond products and metal accessories to branch circuit equipment grounding conductor.

H. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.
   1. Test according to IESNA LM-5 (area and sports lighting installations).

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 27 1005
STRUCTURED CABLING FOR VOICE AND DATA - INSIDE-PLANT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Communications pathways.
B. Copper cable and terminations.
C. Communications equipment room fittings.
D. Communications outlets.
E. Communications grounding and bonding.
F. Communications identification.
G. Cabling and pathways inside building(s).
H. Distribution frames, cross-connection equipment, enclosures, and outlets.
I. Grounding and bonding the telecommunications distribution system.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
C. Section 26 0534 - Conduit.
D. Section 26 0537 - Boxes.
E. Section 26 0553 - Identification for Electrical Systems: Identification products.
F. Section 26 2726 - Wiring Devices.

1.03 REFERENCE STANDARDS

A. ICEA S-83-596 - Indoor Optical Fiber Cables; Insulated Cable Engineers Association; 2011 (ANSI/ICEA S-83-596).
B. ICEA S-90-661 - Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables (With or Without An Overall Shield) For Use in General Purpose and LAN Communications Wiring Systems Technical Requirements; Insulated Cable Engineers Association; 2012. (ANSI/ICEA S-90-661)
C. NECA/BICSI 568 - Standard for Installing Building Telecommunications Cabling; National Electrical Contractors Association; 2006. (ANSI/NECA/BICSI 568)
D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. TIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Rev C, 2015.
F. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; Telecommunications Industry Association; 2015.
G. TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard; Telecommunications Industry Association; Rev C, 2009 (with Addenda; 2012).
H. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; Rev C, 2009 (with Addenda; 2014).
I. TIA-569-C - Telecommunications Pathways and Spaces; Telecommunications Industry Association; Rev C, 2012 (with Addenda; 2013).
J. TIA-606-B - Administration Standard for the Telecommunications Infrastructure; Telecommunications Industry Association; Rev B, 2012.

K. TIA-607-B - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; Telecommunications Industry Association; Rev B, 2012 (with Addenda; 2013).

L. ANSI/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications; Rev A, 2002.

M. UL 444 - Communications Cables; Current Edition, Including All Revisions.

N. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

O. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
   3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Arrange for Communications Service Provider to provide service.

C. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Communications Service Provider representative.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
   1. Storage and handling requirements and recommendations.
   2. Installation methods.

C. Evidence of qualifications for installer.

D. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 60 days prior to intended test date.

E. Field Test Reports.

F. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
   1. Record actual locations of outlet boxes and distribution frames.
   2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
   3. Identify distribution frames and equipment rooms by room number on contract drawings.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: At least 3 years experience manufacturing products of the type specified.

B. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
   1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
   2. Supervisors and installers factory certified by manufacturers of products to be installed.

3. Employing BICSI Registered Cabling Installation Technicians (RCIT) for supervision of all work.
4. Employing experienced technicians for all work; show at least 3 years experience in the installation of the type of system specified, with evidence from at least 2 projects that have been in use for at least 18 months; submit project name, address, and written certification by user.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Keep stored products clean and dry.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
1. Comply with TIA-568 (cabling) and TIA-569 (pathways), latest editions (commercial standards).
2. Comply with Communications Service Provider requirements.
3. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
4. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
5. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

B. System Description:
1. Building Entrance: By others.
2. Horizontal Cabling: Copper.

C. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.

D. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.02 PATHWAYS

A. Conduit: As specified in Section 26 0534; provide pull cords in all conduit.

2.03 COPPER CABLE AND TERMINATIONS

A. Copper Horizontal Cable: TIA/EIA-568 Category 6 solid conductor unshielded twisted pair (UTP), 24 AWG, 100 ohm; 4 individually twisted pairs; covered with blue jacket and complying with all relevant parts of and addenda to latest edition of TIA/EIA-568 and UL 444.
1. In locations other than in plenums, provide NFPA 70 type CMG general purpose, CMR riser-rated, or type CMP plenum-rated cable.
2. In plenums, provide NFPA 70 type CMP plenum-rated cable.

B. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.

C. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
   1. Performance: 500 mating cycles.
   2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.

2.04 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

A. Copper Cross-Connection Equipment:
   1. Connector Blocks for Category 5e and Up Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.

B. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.
   1. Do not paint over UL label.

2.05 COMMUNICATIONS OUTLETS

A. Outlet Boxes: Comply with Section 26 0537.
   1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.

B. Wall Plates:
   1. Comply with system design standards and UL 514C.
   2. Accepts modular jacks/inserts.
   3. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 26 2726.

2.06 GROUNDING AND BONDING COMPONENTS

A. Comply with TIA-607.

B. Comply with Section 26 0526.

2.07 IDENTIFICATION PRODUCTS

A. Comply with TIA-606.

B. Comply with Section 26 0553.

2.08 CROSS-CONNECTION EQUIPMENT

A. Connector Blocks for Category 5e and Up Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.

B. Patch Panels for Copper Cabling: Sized to fit EIA standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
   1. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
   2. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
   3. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.
   4. Provide incoming cable strain relief and routing guides on back of panel.

2.09 ENCLOSURES

A. Outlet Boxes: For flush mounting in walls; depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
   1. Size, Unless Otherwise Indicated: 4 inches square by 2-1/8 inches deep.

2. Wall Plates: Material and finish to match wiring device and wall plate finishes specified in Section 26 2726, complying with system design standards and UL 514C.
3. Labels: Comply with TIA/EIA-606 using encoded identifiers; label each jack on the face plate as to its function with a unique numerical identifier.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Comply with latest editions and addenda of TIA-568 (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), NECA/BICSI 568, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

B. Comply with Communication Service Provider requirements.

C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

3.02 INSTALLATION OF PATHWAYS

A. Install pathways with the following minimum clearances:
   1. 12 inches from power conduits and cables and panelboards.
   2. 5 inches from fluorescent and high frequency lighting fixtures.
   3. 6 inches from flues, hot water pipes, and steam pipes.

B. Conduit, in Addition to Requirements of Section 26 0534:
   1. Arrange conduit to provide no more than the equivalent of two 90 degree bend(s) between pull points.
   2. Conduit Bends: Inside radius not less than 10 times conduit internal diameter.
   3. Arrange conduit to provide no more than 100 feet between pull points.
   4. Do not use conduit bodies.
   5. Minimum Cover - Underground Service Entrance: Comply with NFPA 70 and Communications Service Provider requirements.

C. Outlet Boxes:
   1. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of telecommunications outlets provided under this section.
      a. Mounting Heights: Unless otherwise indicated, as follows:
         1) Telephone and Data Outlets: 18 inches above finished floor.
         2) Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches above finished floor to top of telephone.
         3) Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches above finished floor to top of telephone.
      b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
      c. Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
      d. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
      e. Locate outlet boxes so that wall plate does not span different building finishes.
      f. Locate outlet boxes so that wall plate does not cross masonry joints.

D. Grounding and Bonding: Perform in accordance with ANSI/J-STD-607 and NFPA 70.

E. Firestopping: Seal openings around pathway penetrations through fire-rated walls, partitions, floors, and ceilings in accordance with Section 07 8400.

3.03 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:

1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
2. Do not over-cinch or crush cables.
3. Do not exceed manufacturer's recommended cable pull tension.
4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
1. At Distribution Frames: 120 inches.
2. At Outlets - Copper: 12 inches.

C. Copper Cabling:
1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
3. Use T568B wiring configuration.
4. Copper Cabling Not in Conduit: Use only type CMP plenum-rated cable as specified.

D. Identification:
1. Use wire and cable markers to identify cables at each end.
2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

E. Field-Installed Labels: Comply with TIA/EIA-606 using encoded identifiers.
1. Cables: Install color coded labels on both ends.
2. Outlets: Label each jack on its face plate as to its type and function, with a unique numerical identifier.
3. Patch Panels: Label each jack as to its type and function, with a unique numerical identifier.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Comply with inspection and testing requirements of specified installation standards.

C. Visual Inspection:
1. Inspect cable jackets for certification markings.
2. Inspect cable terminations for color coded labels of proper type.
3. Inspect outlet plates and patch panels for complete labels.

D. Testing - Copper Cabling and Associated Equipment:
1. Test operation of shorting bars in connection blocks.
2. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION

SECTION 28 3100
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NFPA 72 - National Fire Alarm and Signaling Code; 2016.

C. NFPA 101 - Life Safety Code; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Proposal Documents: Submit the following with cost/time proposal:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
   3. Certification by Contractor that the system design will comply with the contract documents.
   4. Proposed maintenance contract.

C. Drawings must be prepared using AutoCAD Release 2014.
   1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.

D. Evidence of designer qualifications.

E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by Contractor that the system design complies with the contract documents.
   11. Do not show existing components to be removed.

F. Evidence of installer qualifications.

G. Evidence of instructor qualifications; training lesson plan outline.

H. Evidence of maintenance contractor qualifications, if different from installer.

I. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.

J. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Original copy of NFPA 72 with portions that are not relevant to this project neatly crossed out by hand; label with project name and date.
   2. Complete set of specified design documents, as approved by authority having jurisdiction.
   3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
   4. Contact information for firm that will be providing contract maintenance and trouble call-back service.
   5. List of recommended spare parts, tools, and instruments for testing.
   6. Replacement parts list with current prices, and source of supply.
   7. Detailed troubleshooting guide and large scale input/output matrix.
   8. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
   9. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

K. Project Record Documents: See Section 01 7800 for additional requirements; have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
   2. "As installed" wiring and schematic diagrams, with final terminal identifications.
   3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

L. Closeout Documents:
   1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
   2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
   3. Certificate of Occupancy.
   4. Maintenance contract.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.

3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
4. Contract maintenance office located within 50 miles of project site.
5. Certified in the State in which the Project is located as fire alarm installer.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.06 WARRANTY

A. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units: Existing Fire-Lite MS-4 System.

B. Initiating Devices, and Notification Appliances:
1. Match existing system..
2. Provide all initiating devices and notification appliances made by the same manufacturer.

2.02 EXISTING COMPONENTS

A. Remove unused existing components and materials from site and dispose of properly.

2.03 FIRE SAFETY SYSTEMS INTERFACES

A. HVAC:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

B. Doors:
1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor.
2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from.

2.04 COMPONENTS

A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Conventional or addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Initiating Devices:
1. Manual Pull Stations: _____.
   a. Provide 1 extra.
2. Smoke Detectors: _____.
   a. Provide 1 extra.
3. Duct Smoke Detectors: _____.
   a. Provide 1 extra.
4. Heat Detectors: _____.
   a. Provide 1 extra.

D. Notification Appliances:
1. Horns: _____.

a. Provide 1 extra.

2. Strobes: _____.
   a. Provide 1 extra.

E. Circuit Conductors: Copper; provide 200 feet extra; color code and label.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
   4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion.

C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
   1. Specified diagnostic period without malfunction has been completed.

2. Approved operating and maintenance data has been delivered.
3. All aspects of operation have been demonstrated to Owner.
4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
5. Occupancy permit has been granted.
6. Specified pre-closeout instruction is complete.

3.04 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

C. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

F. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 312000 – Earthwork

1. SUMMARY

This section addresses surface earthwork procedures for the installation of exterior concrete pad and exit path connecting egress stairs to north parking.

Related Sections:

Structural — See structural drawings for detailed earth work and concrete specifications relating to excavation and backfill for building foundations and slabs.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets		
Product Samples		
Mock-ups		
Closeout submittals		

3. PRODUCTS

A. NOT USED.

4. EXECUTION & QUALITY CONTROL

A. GENERAL
   i. Remove and stockpile topsoil for re-use.
   ii. Bed buried utilities in sand-filled trench during backfill.
   iii. Remove and stockpile topsoil for re-use.
   iv. Existing grading around east end of building to be reinstated at end of project. All final grading adjacent to building shall maintain a positive slope away from building.
   v. At all disturbed locations, replace topsoil , re-seed and mulch

B. EXCAVATION
   i. Use of explosives not allowed.
   ii. Disposal of surplus and waste materials – surplus satisfactory soil to be stored on site in a designated area on the Owner's property. Waste materials and unsatisfactory soils to be trucked off site and disposed of.

C. EXTERIOR CONCRETE PAD AT EAST DOORS
   i. Concrete for pad to be 3500 psi ultimate strength, reinforced with fibermesh.
   ii. Concrete to be a minimum of 5" thick.

iii. Concrete pad to be installed over compacted sub-base of 12" crushed gravel, isolated from soil layers below with polypropylene geotextile fabric (Mirafi 500x or equal).
iv. Subgrade below crushed gravel to be compacted if it was disturbed as part of other construction activities.
v. Pad to slope away from building at 2% slope.
vi. Pad to be pinned to the concrete foundation wall with #5 dowels at 18" spacing. Note that these pins will be installed through foundation insulation.
vii. Concrete to be broom-finished.

D. SURE_PACK WALKWAY
i. Subgrade below crushed gravel to be compacted if it was disturbed as part of other construction activities.
ii. Sure-Pack to be installed over compacted sub-base of 8" crushed gravel, isolated from soil layers below with polypropylene geotextile fabric (Mirafi 500x or equal).
iii. Crushed gravel sub-base to extend 8" laterally beyond extents of Sure-Pack walk.
iv. Final walk surface to be formed with 4" compacted Sure-Pack. Walk should have a small sideslope (less than 2%) to drain.