C. Respirators shall not be removed while in the work area.

D. Only NIOSH-approved respirators shall be used.

E. Additional respiratory protection such as organic vapor cartridges, may be needed when handling some solvents, coatings, or stripping products. Consult the MSDS, manufacturer, or industrial hygienist, and obtain the proper cartridges and usages as necessary.

3.5 HYGIENE PRACTICES

A. Eating, drinking, smoking, chewing gum or tobacco, and applying of cosmetics are not allowed in the work area.

B. All persons entering the work area are required to wear appropriate PPE, and follow the entry and exit procedures posted in the Personnel Decontamination Enclosure System.

C. PPE shall include, at a minimum:

1. Full body disposable suits, hard hat, eye protection, respirator, and proper footwear.
2. Gloves.
3. Non-disposable footwear and clothing shall remain in the work area and shall be disposed of as contaminated waste when the job is completed.
4. Authorized visitors shall be provided with suitable PPE.

3.6 PROHIBITED ACTIVITIES.

A. Dry removal or dry sweeping.

B. Use of compressed air for cleaning.

C. Use of high speed power tools not equipped with a HEPA-filtered local exhaust system.

3.7 WORK AREA ISOLATION AND PREPARATION

A. General Preparation. Contractor shall:

1. Post:

a. OSHA asbestos warning signs at every entrance to the work area.
b. Decontamination and work procedures in equipment rooms and clean rooms.
c. EPA NESHAP asbestos rules (40 CFR Part 61, subparts A & M) in the clean room.
d. OSHA Asbestos Construction Standards (29 CFR 1926.1101) in the clean room.
e. Entry and Exit Log
f. List of telephone numbers in the clean room for:

(1) local hospital and/or local emergency squad.
(2) owner security office (if applicable).
(3) owner representative reachable 24 hours per day.
(4) contractor's headquarters.
(5) architects or consultants directly involved in the project.

2. Secure the work area from entry by unauthorized persons using black polyethylene sheeting as a construction area barrier and post construction warning signs.
3. Separate work areas from occupied areas.

   a. Seal off all doorways and corridors which will not be used for passage during work.
   b. Install isolation barriers in all openings larger than 4' x 8', consisting of double-layer 6-mil poly to prevent access to the contained areas.
4. Have an approved fire extinguisher in the equipment room.
5. Install and maintain walk-off mats to the general work entrance.

B. Interior Preparation

1. Install negative air machine in the work area. The equipment shall exhaust through a HEPA filter to the outside of the building or the exhaust will be double filtered. The equipment shall remain in operation twenty-four hours a day until decontamination of the work area and final air sampling and analysis is completed. Seal openings around exhaust ducts. Exhaust from the negative air movement equipment shall not be allowed to be released within the buildings unless unfeasible as determined by the EC. All HEPA filtered air movement equipment shall be maintained according to this specification or regulations.
2. Coordinate with the Facility or Mechanical Contractor for the shut down and isolation of heating, ventilating, air conditioning (HVAC) systems which are within the work area.
3. Seal off all windows, corridors, doorways, bathrooms, closets, skylights, ducts, grilles, diffusers, and other penetrations or openings with 6-mil poly and tape.
4. Protect and cover floors, in those areas in which no abatement is to be performed with 6-mil poly with seams staggered and taped, and extending 12" up walls. Maintain for the duration of the project.
5. Protect and cover the walls in the work area.
6. Protect and cover non-movable fixed objects from which no abatement will be conducted (e.g. fixed cabinets, shelves, etc.). Pipe insulation on steam / condensate piping will be removed along with the pipe itself.
7. Asbestos materials shall not be disturbed during the preparation phase.
8. Maintain emergency and fire exits.
9. In abatement work areas install a three chamber Worker Decontamination Enclosure System, consisting of clean room, shower room, and equipment room separated by air locks, all with curtained doorways, of sufficient size to serve the size of the crew. If appropriate, apply for a waiver for an offsite decontamination area for buildings / areas where a full decontamination unit cannot be installed.

a. Where an adjacent decon unit is not feasible (i.e., for multiple tented glovebag operations), the AC shall (only with an approved variance from the EC):

(1) set up the decon unit within the work area barriers
(2) establish a negative pressure of at least 0.02" water column (wc) between the equipment room and adjacent spaces, including the clean room
(3) provide at least 4 air changes per hour within the decon unit

10. Once operational, the system shall be inspected daily. Damages and defects will be repaired immediately upon discovery.

C. Exterior Preparation (for areas that interface with interior work)

1. 6 mil poly sheeting shall be placed over the ground, foundation, or other surfaces below the abatement area.
2. Unauthorized entry shall be prevented by using appropriate barriers, such as warning tape, fencing, or other suitable barriers.
3. Nearby air intakes, grilles, and other openings into the building interior shall be sealed off with 6 mil poly and tape.

3.8 ABATEMENT PROCEDURES

A. Removal:

1. Asbestos materials shall be wetted and kept wet during removal.
2. ACM waste shall be bagged or containerized as it is removed.
3. Work areas shall be kept wet until visible material is cleaned up.
4. Asbestos waste shall be removed from the work area daily.

a. The waste shall be placed and sealed in a properly labeled 6-mil poly bag.
b. The bag shall be cleaned and placed in a second properly labeled 6-mil poly bag. This bag shall be sealed by securing with duct tape, folding over taped area and goose necking with duct tape.

3.9 CLEANING AND DECONTAMINATION

A. All visible accumulations of ACM, debris, tools, and unnecessary equipment shall be removed from the work area.

B. First clean:

1. Wet clean all surfaces and remove excess water.
2. Remove outer layer of poly and dispose as ACM waste (splash guards and poly protecting the underlying surfaces).
3. Critical barriers on windows, doors, penetrations, and other openings shall remain in place and negative air system shall remain in continuous operation until final clearance tests have passed.

C. Visual inspection: EC and contractor jointly inspect the work area for visible residue and excess water and, if observed, repeat the clean/ wait cycle until residues are not detected and work area is dry.

D. Remove all tools, cleaning materials, remaining wastes from the work area.

E. Apply lock-down encapsulants where specified in the Documents.

F. Notify EC that work area is ready for final clearance testing.

3.10 FINAL CLEARANCE

A. Final clearance testing shall be performed after the final cleaning and visual inspection has been completed and where no visible water or condensation remains.

B. All work areas shall be tested and analyzed by either PCM or Transmission Electron Microscopy (TEM) methodologies.

C. If final clearance test(s) fail, the AC shall be responsible for repeating the cleaning sequence as necessary until final clearance tests are successful, at no additional cost to the owner. The AC shall also be responsible for paying for the additional time and expenses incurred by the EC for conducting the repeat clearance sampling, analysis and project oversight.

D. Upon completion of a successful visual inspection and test, a “punch list” walkthrough shall be conducted for each area that contained special wastes, non-hazardous special waste or hazardous waste within five working days (per building) of completion of the work by the Contractor. The Contractor, Environmental Consultant and the Owner will participate in the walkthrough. All punch list items shall be completed within five working days of walkthrough. The items will include all deficiencies found in the inspections of the AC’s work which is to be corrected. When the deficiencies have been removed, the AC shall request a re-inspection by the EC.

3.11 SPECIAL PROCEDURES

A. **Glovebag Procedure**. Glovebags may be used to remove small sections of ACM pipe insulation encountered.

1. Typical preparation/notification requirements apply.
2. Glovebag removal will require a single layer, 6 mil poly tent containment with negative pressure air filtration.
3. Monitoring will be performed by the EC.
4. Glovebag construction shall be 6 mil poly with seamless bottom, suitable for the intended use (straight runs, fittings, elbows, vertical pipes, etc.) without modification.
5. At least two licensed workers shall perform glovebag operations.
6. Workers shall wear full body PPE and at least a ½ mask APR equipped with a P-100 cartridge. Note here, too, that OSHA still requires an

exposure assessment and respirators that are appropriate for the expected airborne fiber concentrations.

7. Prior to use, all loose or damaged material adjacent to the operation shall be wrapped in two layers of 6 mil poly or otherwise be rendered intact.
8. Work Practices shall include:

    a. Install to completely cover the circumference of pipe or other structure. Pipe insulation diameter shall not exceed ½ the bag working length above the glove sleeves.
    b. Smoke test for leaks and seal any leaks prior to use.
    c. Single use and not moved.
    d. Wet removal methods on the materials to be removed and wet cleaning to remove all visible ACM from the pipe or structure surfaces.
    e. Not to be used on surfaces greater than 150^0F.
    f. Spray down the interior surfaces of the bag, substrate, and removed ACM.
    g. Wet down remaining ACM surfaces or seal with encapsulant.
    h. Seal off the lower portion of the bag containing the ACM waste by twisting several times and sealing with tape.
    i. Collapse glovebag with a HEPA vacuum.
    j. Place the detached glovebag directly into a 6 mil poly waste disposal bag and gooseneck-seal it in the waste disposal bag for disposal.
    k. Dispose in accordance with this specification.

3.12 WASTE DISPOSAL AND EQUIPMENT LOAD-OUT

A. Preparing equipment for load-out

1. Remove gross debris from equipment and wet-wipe all surfaces.
2. Seal openings to prevent escape of internal contamination; or open up equipment, remove filters, and make equipment interiors accessible for cleaning and decontamination.

B. Packaging asbestos wastes:

1. All asbestos-containing wastes, including removed ACM and debris, containment poly, critical barrier materials, suits, respirator cartridges, vacuums and negative air machine HEPA filters, water filters, and other asbestos-containing items shall be properly packaged in 6 mil poly for disposal.
2. Use double 6 mil poly bags with “gooseneck” seal, or other impermeable containers.
3. Wrap large or irregular items in 2 layers of 6 mil poly sheeting and seal with tape.
4. Sharp, jagged, or other items that may puncture poly shall be packaged in rigid impermeable containers such as drums or boxes, or wrapped in burlap or other protective covering before sealing in double bags or double layers of 6 mil poly.
5. Label containers:

a. OSHA warning label.
b. DOT performance-oriented hazardous material label.
c. Name and address of generator and abatement location.

C. Removing items from the work area:

1. Packaged asbestos wastes, non-porous debris (such as doors, hardware, and other items that can be decontaminated), and equipment shall be wet cleaned, moved into the equipment decontamination enclosure system, cleaned a second time, and moved into the holding area.
2. Containers and equipment shall be removed from the holding area by workers in clean PPE and respirators who enter from the uncontaminated side (outside). The equipment decontamination enclosure system shall not be used to enter or exit the work area.

D. Storage of packaged asbestos wastes shall be in a completely enclosed dumpster or other suitable container that can be secured. The secured area shall be kept locked at all times to prevent unauthorized access.

E. Shipment of items from the project.

1. Decontaminated tools and equipment may be shipped by normal carrier to warehouse, another jobsite, or other destination.
2. For asbestos wastes:

a. Line shipping container with 6 mil poly prior to loading packaged asbestos wastes.
b. Post NESHAP placards during loading.
c. Persons performing loading operations shall wear PPE including respirators.
d. Containers and packages shall be tightly packed together to prevent shifting during transport. Large components or heavy items shall be secured to prevent shifting, and shall not be stacked on top of bags.
e. Execute the NESHAP-required Waste Shipment Record (WSR) to be signed by the generator, transporter, and landfill. All WSRs shall be returned to the EC within 30 days of shipment.

F. Disposal of packaged asbestos wastes.

1. Only landfills approved and permitted by the State of Iowa for accepting asbestos wastes may be used for disposal.

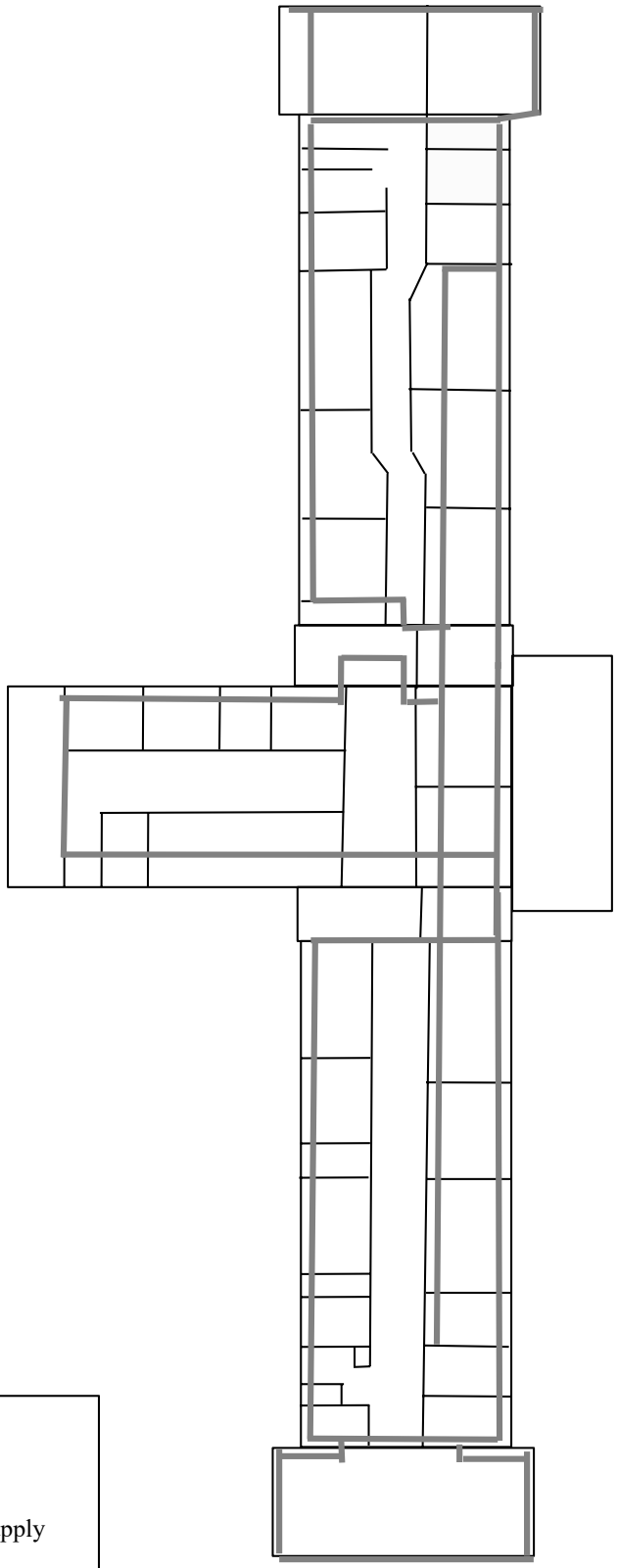
3.13 DEMOBILIZATION

A. EC shall visually inspect the work area for evidence of visible debris prior to releasing the area for tear-down. Detection of contamination will require additional cleaning and re-testing of the work area.

B. Remove critical barriers and seals.

END OF SECTION 02081

Drawings – Medical Center Building



Legend

Asbestos on steam and condensate piping

TSI on domestic water supply connections

ATLAS

4503 E 50th Street, Suite 800
Des Moines, IA 50317

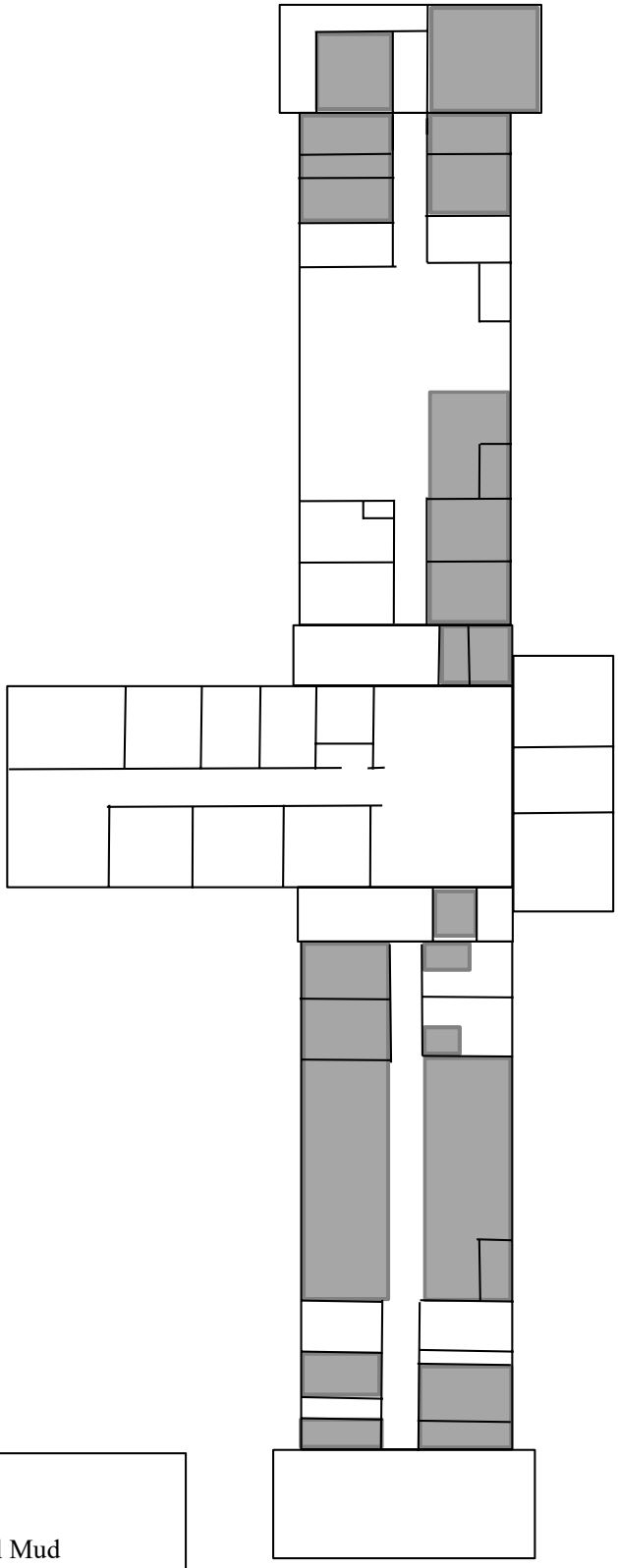
ASBESTOS MATERIALS DRAWING

Medical Building
Basement

1251 224th St.
Woodward, IA 50276

Tim Jacobsen¶
Atlas Technical Consultants¶
Iowa Asbestos Project Designer #23-9651

PROJECT NO: 204BS06333		
DESIGNED BY: Atlas	SCALE: NTS	REVIEWED BY: EM
DRAWN BY: EM	DATE: 12/7/2023	FILE: SiteMap.PPT



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Asbestos Drywall Mud

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4503 E 50th Street, Suite 800
Des Moines, IA 50317

ASBESTOS MATERIALS DRAWING

PROJECT NO: 204BS06333

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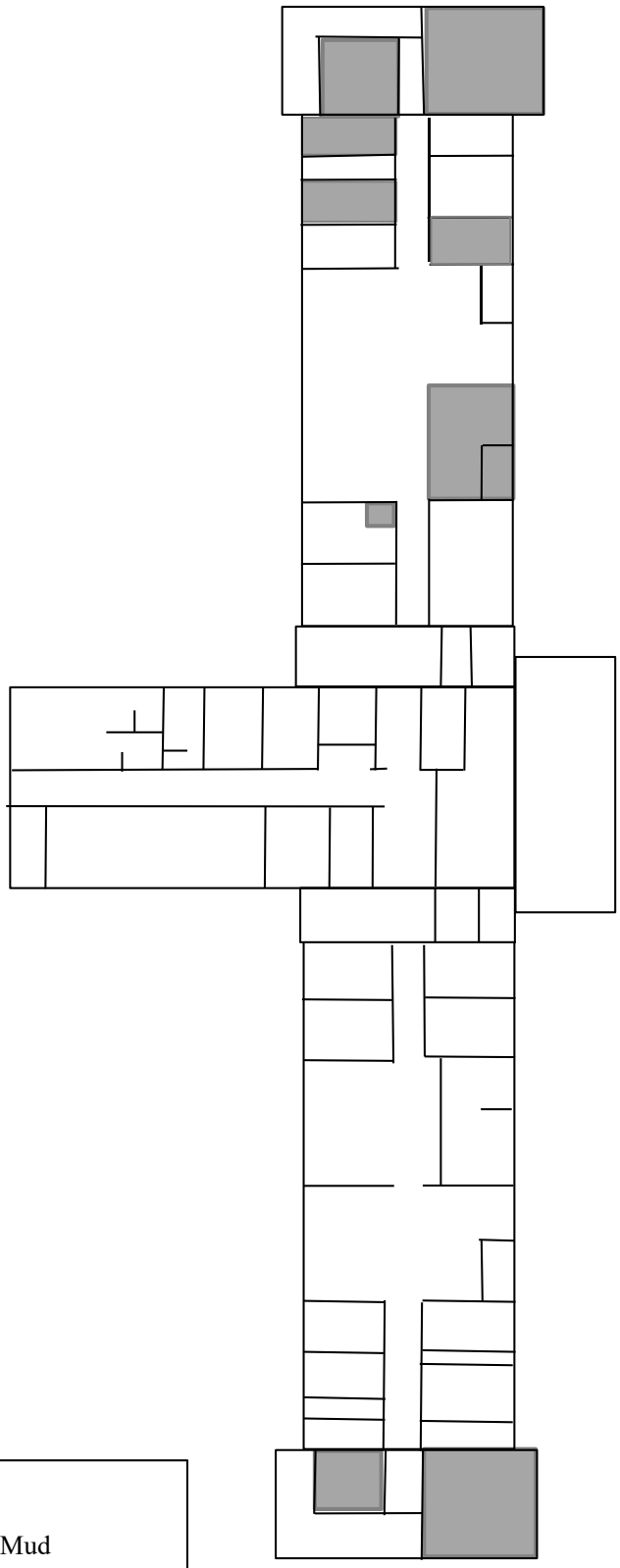
Medical Building
First Floor

1251 224th St.
Woodward, IA 50276

Tim Jacobsen
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651



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Asbestos Drywall Mud

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ASBESTOS MATERIALS DRAWING

PROJECT NO: 204BS06333		
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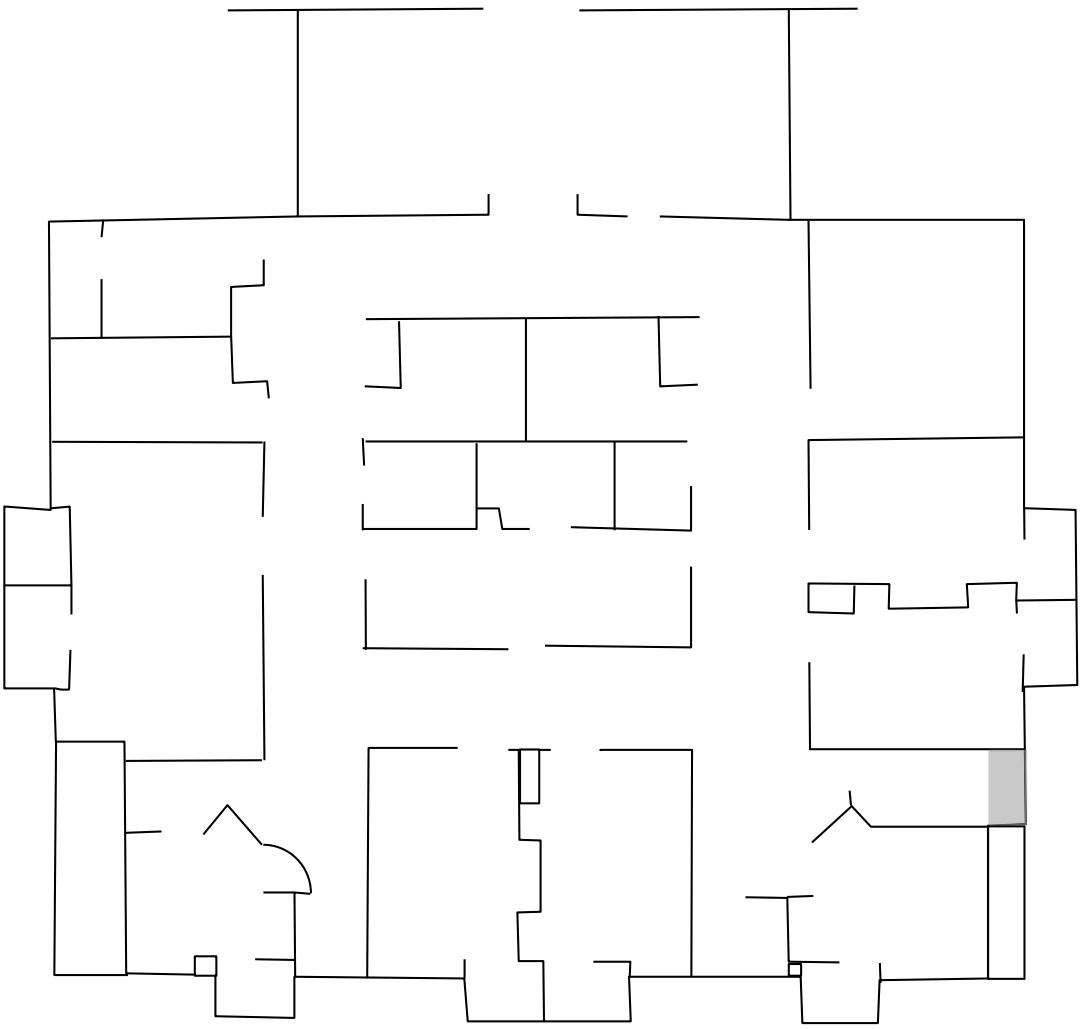
Medical Building
Second Floor

1251 224th St.
Woodward, IA 50276

Tim Jacobsen
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651



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Asbestos Blue Vinyl Flooring

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ASBESTOS MATERIALS DRAWING

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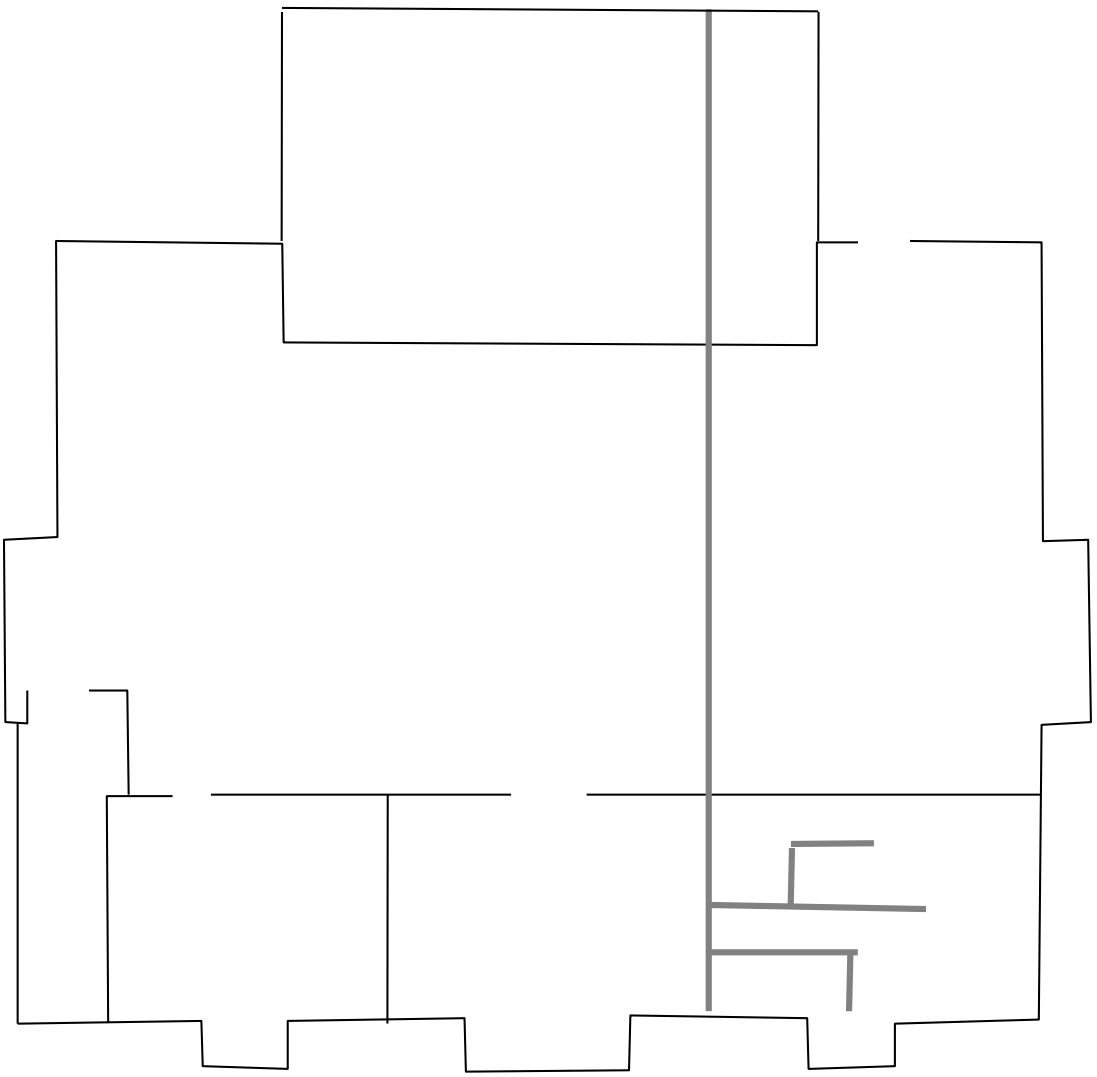
Medical Building
South Wing First Floor

1251 224th St.
Woodward, IA 50276

Tim Jacobsen
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651



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Asbestos on steam and condensate piping

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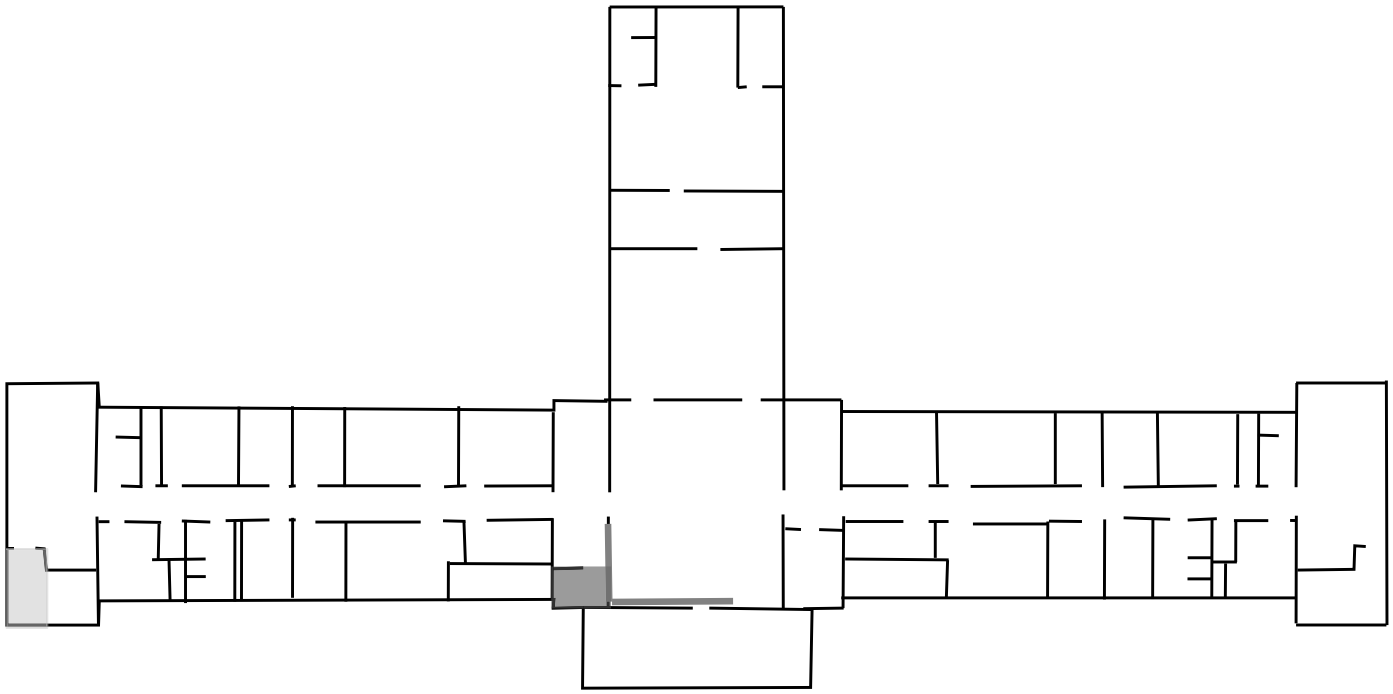
Medical Building
South Wing - Basement

1251 224th St.
Woodward, IA 50276

Tim Jacobsen
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651

Drawings – Elmcrest Building



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- Asbestos Mastic Black/Yellow
- Asbestos Light Brown Flooring
- Asbestos on steam and condensate piping

N

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ASBESTOS MATERIALS DRAWING

PROJECT NO: 204BS06333

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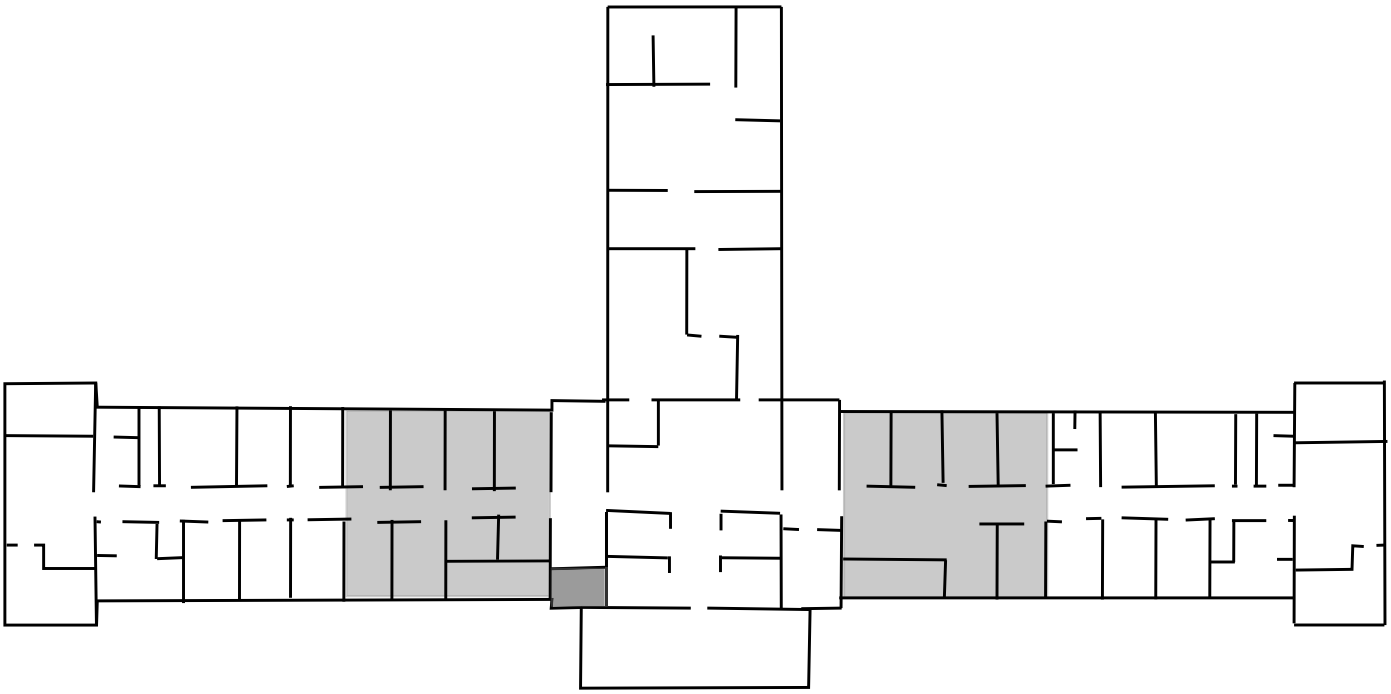
Elmcrest
Second Floor

1251 224th St.
Woodward, IA 50276

Tim Jacobsen
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651



Legend

- Blue Vinyl Flooring
- Asbestos Mastic Black/Yellow

N

ATLAS

4503 E 50th Street, Suite 800
Des Moines, IA 50317

ASBESTOS MATERIALS DRAWING

Elmcrest
First Floor
1251 224th St.
Woodward, IA 50276

Tim Jacobsen
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651

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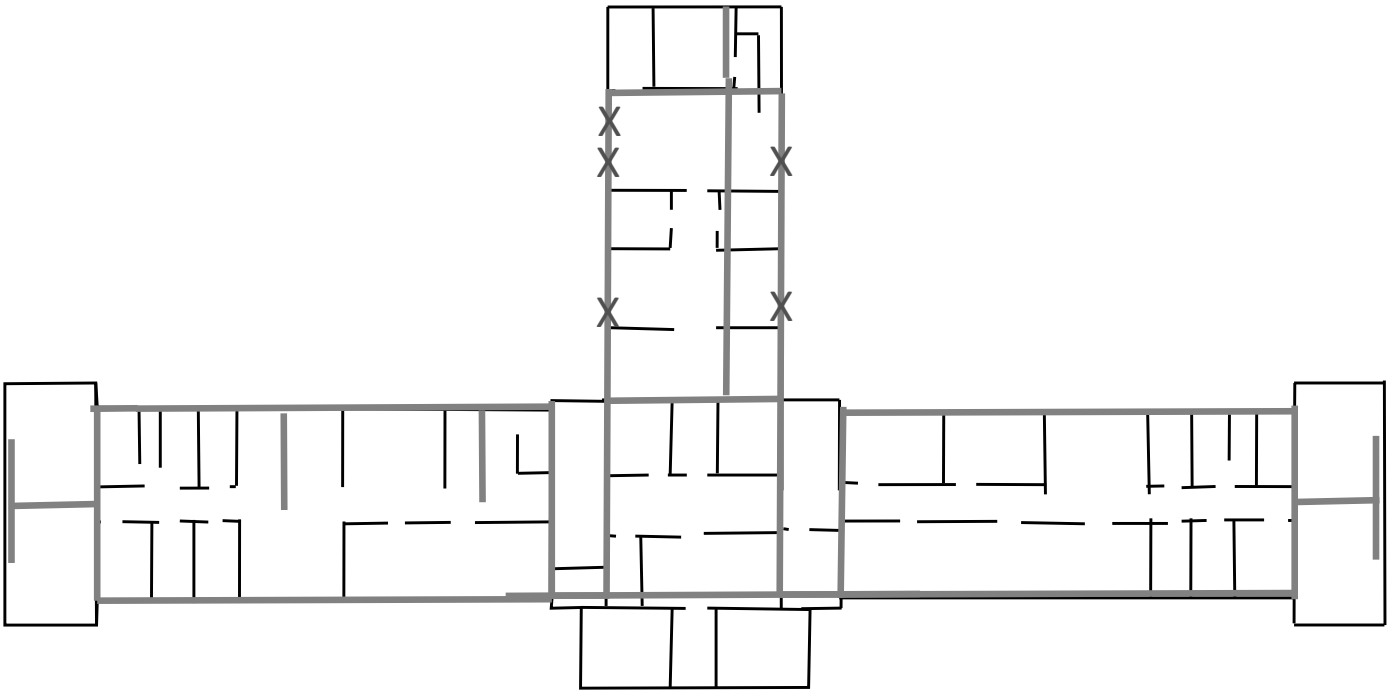

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— Asbestos on steam and condensate piping

XXX Asbestos Window Glazing

N

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4503 E 50th Street, Suite 800
Des Moines, IA 50317

ASBESTOS MATERIALS DRAWING

PROJECT NO: 204BS06333

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Elmcrest
Basement
1251 224th St.
Woodward, IA 50276

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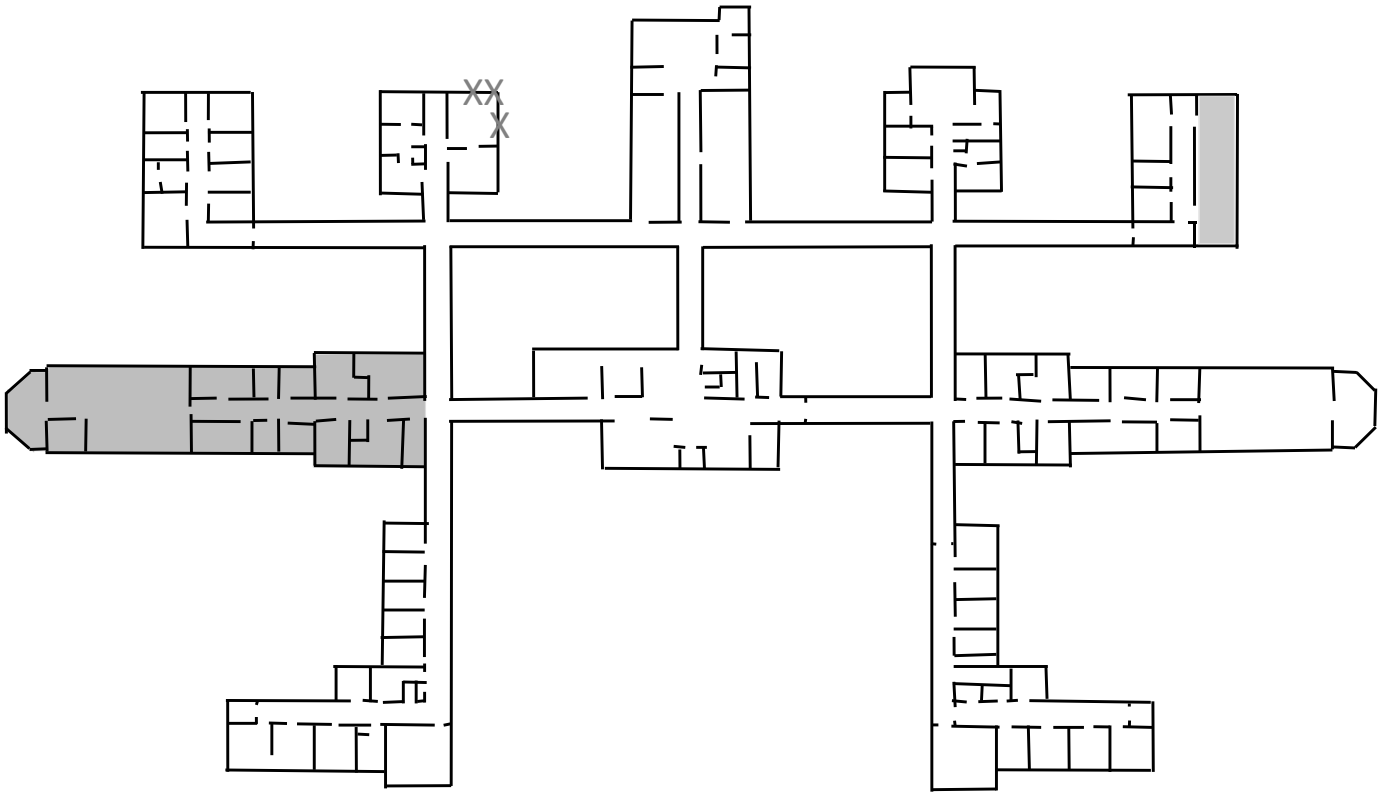
Atlas Technical Consultants
Iowa Asbestos Project Designer #23-9651

Drawings – Administration Building



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XXX Asbestos Window Glazing

Asbestos Containing Drywall Mud (<1%)

Asbestos Laminate Flooring

N

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4503 E 50th Street, Suite 800
Des Moines, IA 50317

ASBESTOS MATERIALS DRAWING

Admin Building
First Floor

1251 224th St.
Woodward, IA 50276

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Iowa Asbestos Project Designer #23-9651

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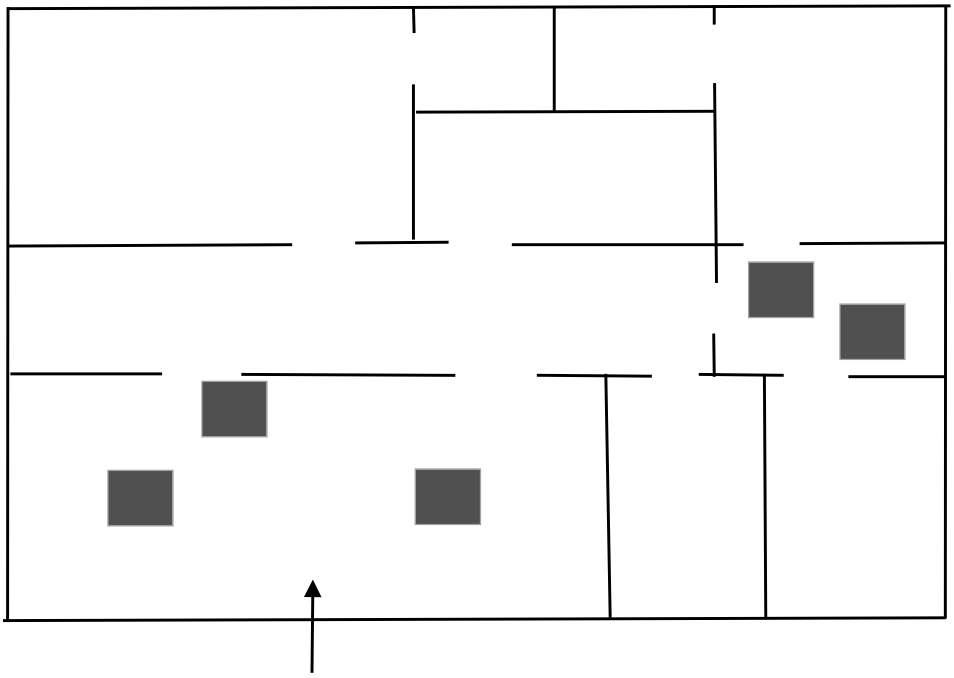

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Asbestos Ceiling Tile Pucks

N

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ASBESTOS MATERIALS DRAWING

Admin Building
Second Floor

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SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

B. Abandonment and removal of existing utilities and utility structures.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. See Division 01 for submittal procedures, quality requirements, alterations of work, and closeout requirements.

B. Division 01 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

C. Division 01 - Product Requirements

D. Division 01 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.3 DEFINITIONS

A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

1.5 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements for submittal procedures.

B. Demolition Plan: Submit demolition plan as required by OSHA and AHJs.

1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.

2. Demolition firm qualifications.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

D. The Contractor shall submit utility service termination certificates, copies of demolition notices, and permits to the Architect/Engineer prior to removal.

E. The Contractor shall submit demolition procedures and operational sequence for review and acceptance by the Architect/Engineer if a portion of the existing facility is to remain in operation during construction and phasing is not specified in the plans or specifications.

F. Schedule indicating proposed sequence of operations for selective demolition work to Architect/Engineer for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 DEMOLITION

A. Remove other items indicated, for salvage and relocation.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with requirements in Division 01.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Obtain required permits.
2. Comply with applicable requirements of NFPA 241.
3. Use of explosives is not permitted.
4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
5. Provide, erect, and maintain temporary barriers and security devices.
6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Protect existing structures and other elements to remain in place and not removed.

1. Stop work immediately if adjacent structures appear to be in danger.

E. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

F. Hazardous Materials:

1. If hazardous materials are discovered during removal operations, stop work and notify Architect/Engineer and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

2. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

G. Perform demolition in a manner that maximizes salvage and recycling of materials.

1. Dismantle existing construction and separate materials.

2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

H. Accurately record locations of capped utilities and subsurface obstructions on the Contractor's record drawing set.

3.3 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

I. Contractor is responsible for the adjustment of all gas vents, manholes, castings, and water valves to match the new surface. Adjustments shall be coordinated with the utility companies and the cost for all adjustments shall be incidental to construction. Any damage to said structures and appurtenances, that occurs during construction, shall be repaired by the Contractor at no additional cost to the Owner.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.

1. Verify construction and utility arrangements are as indicated.
2. Report discrepancies to Architect/Engineer before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and required to accomplish new work.

1. Remove items indicated on drawings.

C. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.

1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.

1. Prevent movement of structure. Provide shoring and bracing as required.
2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch to match new work.

3.5 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove materials not to be reused on site; do not burn or bury.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 05 5213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

F. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing 2020a.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2020.

I. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.

K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements 2022.

L. ASTM F1941 - Standard Specification for Electrodeposited Coatings on Threaded Fasteners 2010.

M. ASTM F2329/F2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners 2015.

N. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).

P. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals 2016.

Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

R. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer licensed in the State in which the Project is located to design railings.

B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lb/ft applied in any direction.

b. Concentrated load of 200 lb applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lb applied horizontally on an area of 1 sq. ft..

b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Comply with ICC (IBC) and ADA Standards for all railings.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.

2. Railing brackets.

3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1 1/2 inch clearance from inside face of handrail to finished wall surface.

2.2 STEEL AND IRON

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

2.3 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5 for zinc coating.

2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.

3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Division 9 Painting Sections.

E. Intermediate Coats and Topcoats: Provide products that comply with Division 9 Painting Sections.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide steel sleeves not less than 6 inch long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

Q. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Division 9 Painting Sections.

1. Color: As indicated by manufacturer's designations.

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As indicated by manufacturer's designations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inch beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inch of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inch deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

D. Leave anchorage joint exposed with 1/8 inch buildup, sloped away from post.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0 mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Sheathing.

C. Fire retardant treated wood materials.

D. Communications and electrical room mounting boards.

E. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

C. AWPA U1 - Use Category System: User Specification for Treated Wood 2022.

D. PS 1 - Structural Plywood 2009 (Revised 2019).

E. PS 2 - Performance Standard for Wood Structural Panels 2018.

F. PS 20 - American Softwood Lumber Standard 2021.

G. SPIB (GR) - Standard Grading Rules 2021.

1.3 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide technical data on fire-retardant treatment materials.

1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.

2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2 or Standard Grade.

2. Boards: Standard or No. 3.

3. Fire Retardant Treated.

2.3 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

1. Fire Retardant Treated.

2.4 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.5 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:

1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.

a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

b. Interior rough carpentry items are to be fire retardant treated.

c. Treat rough carpentry items as indicated.

d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Provide the following specific nonstructural framing and blocking:

1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Wall-mounted door stops.
6. Chalkboards and marker boards.
7. Wall paneling and trim.
8. Joints of rigid wall coverings that occur between studs.
9. Blocking at wall openings..

3.3 INSTALLATION OF CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

3.4 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.5 CLEANING

A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.

1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 07 4243
METAL WINDOW PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal Window Infill Panels for exterior

1.2 REFERENCE STANDARDS

A. ASTM E330-84: Structural Performance of Exterior Windows, Curtain Walls and Doors under the influence of wind loads.

B. ASTM D1781-76: Climbing Drum Peel Test for Adhesives.

C. ASTM D3363-74: Method for Film Hardness by Pencil Test.

D. ASTM D2794-90: Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

E. ASTM D3359-90: Method for Measuring Adhesion by the tape test.

1.3 SUBMITTALS

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

B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

C. Shop Drawings: Indicate thickness, dimension and components of parts. Detail glazing methods, framing and tolerances to accommodate thermal movement.

D. Samples: Submit manufacturer’s standard range of physical samples illustrating available coating colors and textures.

E. Samples: Submit (2) samples of 10” x 10” of each color and finish texture.

F. Affidavit certifying materials meet all requirements as specified.

G. Warranty: Submit Manufacturer’s warranty and ensure that forms have been completed in the Owner’s name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Panel manufacturer shall have a minimum of 10 years’ experience.

B. Field measurements shall be taken prior to completion of manufacturing and cutting.

C. Maximum deviation from vertical and horizontal alignment of installed panels is 1/8" (3mm) in 20' (6m) non-commutative.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect finish and edge in accordance with panel manufacturer's recommendations.

B. Store materials in accordance with panel manufacturer's recommendations.

1.6 WARRANTY

A. See Section 01 7700 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Standard Warranty.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

A. Laminated metal faced Mapes-R Infill panels as manufactured by Mapes Industries, Inc.

B. Architect pre-approved equivalent.

2.2 PRODUCTS

A. Mapes-R Panels

1. Panel Thickness: 1"
2. Exterior: Smooth Standard Kynar Finish
3. Exterior Substrate: 0.125" Solid Plastic
4. Insulating Core: Polyisocyanurate
5. Interior Substrate: 0.125" Solid Plastic
6. Interior: Smooth Primed Aluminum
7. Color: Selected by Architect.

2.3 ACCESSORIES

A. Recommended for use as an infill panel component in window systems. Related trim/frame material to complete installation as recommended by the manufacturer.

B. Seals against moisture intrusion as recommended by the manufacturer. Polyurethane and silicone-based sealant with a 20 year life are recommended.

C. Molding Profiles: As shown on drawings & as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Panel surfaces shall be free from defects prior to installation.

3.2 EXECUTION

A. Erect panels plumb, level and true.

B. Glaze panels securely and in accordance with approved shop drawings and manufacturer's instructions to allow for necessary thermal movement and structural support.

C. Do not install panels that are observed to be defective including warped, bowed, dented, scratched and delaminating components.

D. Weatherseal all joints as required using methods and materials as previously specified.

E. Separate dissimilar metals using gasketed fasteners and blocking to eliminate the possibility of electrolytic reaction.

3.3 ADJUSTING AND CLEANING

A. Remove masking film as soon as possible after installation. Masking intentionally left in place after panel installation will be the responsibility of the contractor.

B. Weep holes and drainage channels must be unobstructed and free from dirt and sealant.

END OF SECTION

SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).

C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2020.

D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

F. ITS (DIR) - Directory of Listed Products current edition.

G. FM (AG) - FM Approval Guide current edition.

H. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

I. UL (FRD) - Fire Resistance Directory Current Edition.

1.3 SUBMITTALS

A. See Section 01 3300 for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

1.4 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

1.5 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firestopping Manufacturers:

1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
2. Hilti, Inc: www.us.hilti.com/#sle.
3. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
4. Architect pre-approved equivalent.

2.2 MATERIALS

A. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

C. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

B. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

END OF SECTION

SECTION 07 9000
JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior and interior sealants.
2. Joint accessories.

1.2 REFERENCES

A. ASTM International Inc.

1. ASTM C 510 - Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
2. ASTM C 719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
3. ASTM C 794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
4. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.
5. ASTM C 1193 - Standard Guide for Use of Joint Sealants.
6. ASTM C 1247 - Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
7. ASTM C 1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
8. ASTM C 1311 - Standard Specification for Solvent Release Sealants.
9. ASTM D 2203 - Standard Test Method for Staining from Sealants.

1.3 SUBMITTALS

A. Product Data:

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

B. Samples:

1. Submit standard cured color samples for each sealant type illustrating selected colors.
2. Include instructions for removing existing sealants and preparing joints for new sealant.

C. Manufacturer's Certificate:

1. Certify products are suitable for intended use and products meet or exceed specified requirements.
2. Certify applicator is approved by manufacturer.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with the following:

1. Building Joints: ASTM C 1193.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications:

1. Company approved by manufacturer.

2. Designate one individual as project foreman who shall be on site at all times during installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in manufacturers unopened original packaging. Inspect for damage.

B. Store primers and sealants in cool dry location with ambient temperature range of 60 to 80 degrees F (15 to 27 degrees C).

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install primers or sealants when atmospheric temperatures or joint surface temperatures are less than 40 degrees F (4 degrees C).

1.8 SCHEDULING

A. Ensure sealants are cured before covering with any other materials.

1.9 WARRANTY

A. Manufacturer's standard warranty covering sealant materials.

B. Applicator's standard warranty covering workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tremco Sealant/Weatherproofing Division of RPM International, Inc.

B. Dow Corning Corporation.

C. Sonneborn Building Products Division, Rexnord Chemical Products, Inc. (Master Builders).

D. Architect pre-approved equivalent.

2.2 SILICONE SEALANTS

A. Single Component Silicone Basis-of-Design: Dow Corning Dowsil 795 Silicone Building Sealant, color as selected, at exterior and interior perimeter of windows and doors.

2.3 POLYURETHANE SEALANTS

A. Single Component Non-Sag Polyurethane Basis-of-Design: MasterSeal NP 1 (formerly known as Sonolastic NP 1), color as selected, at locations other than exterior and interior perimeter of windows and doors.

B. ACCESSORIES

1. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
2. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
3. Joint Backing: Closed-cell round foam rod compatible with sealant; oversized 25 to 50 percent larger than joint width; recommended by sealant manufacturer to suit application
4. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
5. Masking tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate surfaces and joint openings are ready to receive work.

1. Verify joint surfaces are clean and dry.
2. Ensure concrete surfaces are fully cured.

B. Report unsatisfactory conditions in writing to the Architect;

C. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Prepare joints in accordance with ASTM C 1193 and manufacturer's instructions.

B. Clean joint surfaces to remove dirt, dust, oils, wax, paints, and other contamination capable of affecting primer and sealant bond.

C. Protect elements surrounding the Work of this section from damage or disfiguration. Apply masking tape to adjacent surfaces when required to prevent damage to finishes from sealant installation.

3.3 EXISTING WORK

A. Mechanically remove existing sealant.

B. Clean joint surfaces of residual sealant and other contaminates capable of affecting sealant bond to joint surface.

C. Allow joint surfaces to dry before installing new sealants.

3.4 SEALANT INSTALLATION

A. Install primer and sealants in accordance with ASTM C 1193 and manufacturer's instructions.

B. Install joint backing to maintain the following joint ratios:

1. Joints up to 1/2 inch (13 mm) Wide: 1:1 width to depth ratio.
2. Joints Greater than 1/2 inch (13 mm) Wide: 2:1 width to depth ratio; maximum 1/2 inch joint depth.

C. Install bond breaker where joint backing is not used.

D. Apply primer where required for sealant adhesion.

E. Install sealants immediately after joint preparation.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

G. Joining Silicone and Polyurethane Sealants:

1. Install polyurethane sealants first.
2. Join silicone sealant to polyurethane in accordance with manufacturer's instructions.

H. Tool exposed joint surface concave.

3.5 CLEANING

A. Remove masking tape.

B. Clean adjacent surfaces soiled by sealant installation.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

1.2 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. HMMA: Hollow Metal Manufacturers Association.

C. NAAMM: National Association of Architectural Metal Manufacturers.

D. NFPA: National Fire Protection Association.

E. SDI: Steel Door Institute.

F. UL: Underwriters Laboratories.

1.3 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2015.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

J. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames 2016.

K. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

L. ITS (DIR) - Directory of Listed Products current edition.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

O. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.

P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

R. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

T. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.

U. UL (DIR) - Online Certifications Directory Current Edition.

V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

W. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, anchorage, connections, and identifying location of different finishes, if any.

1.5 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch (102 mm) high wood blocking. Do not store in manner that traps excess humidity.

1. Provide minimum 1/4 inch (6 mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
5. Architect pre-approved equivalent.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
7. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40z (12G) coating designation; mill phosphatized.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire-Rated:

1. Based on SDI Standards: ANSI/SDI A250.9 (SDI-100)
   a. Level 2 - Heavy-Duty
   b. Physical Performance Level B 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2, seamless design, continuously welded seam dressed smooth.
   d. Door Face Metal Thickness: 18-gauge, 0.042 inch (1.0 mm), minimum.

2. Door Core Material: Manufacturer's standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

C. Interior Doors, Fire-Rated:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2, seamless design, continuously welded seam dressed smooth.
   d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
   b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   c. Attach fire rating label to each fire rated unit.
   d. Smoke and Draft Control Doors (including all fire-rated doors): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following:
      1) Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
      2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
      3) Label: Include the "S" label on fire-rating label of door.
3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
5. Door Face Sheets: Flush.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Interior Door Frames, Non-Fire Rated: Full proile/continuously welded type.

1. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.

D. Interior Door Frames, Fire-Rated: Full profile/continuously welded type.

1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.

E. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.5 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

A. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

B. Exposed Fasteners: Provide countersunk, flat- or oval-head screws and bolts for exposed fasteners unless otherwise indicated.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

E. Frame Anchors

1. Jamb Anchors:
    a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
    b. Provide number and spacing of jamb anchors as follows:
        1) Fire ratings may require additional anchors.
        2) Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
            (a) Three anchors per jamb up to 60 inches (1524 mm) high.
            (b) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
            (c) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
            (d) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
            (e) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
2. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
    a. Attachment: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
    b. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.7 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. 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 Section 08 7100.

1. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
2. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
3. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 and Division 28 Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

D. Examine rough-in for embedded and built-in anchors to verify actual locations before frame installation.

E. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the requirements listed in Tolerances article below.

C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Smoke-Control Doors: Install doors according to NFPA 105.

D. Coordinate frame anchor placement with wall construction.

E. Install door hardware as specified in Section 08 7100.

1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

H. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).

b. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).

c. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3. Smoke-Control Doors: Install doors according to NFPA 105.

3.4 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

C. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

D. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

E. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

F. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

3.5 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. 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.

C. SCHEDULE

1. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for hollow metal doors.

B. Hardware for fire-rated doors.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. BHMA A156.1 - Standard for Butts and Hinges 2021.

C. BHMA A156.4 - Door Controls - Closers 2019.

D. BHMA A156.8 - Door Controls - Overhead Stops and Holders 2021.

E. BHMA A156.18 - Materials and Finishes 2020.

F. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.

G. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.

H. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

I. ITS (DIR) - Directory of Listed Products Current Edition.

J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

K. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

N. UL (DIR) - Online Certifications Directory Current Edition.

O. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

1.4 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Provide complete description for each door listed.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1. Submit manufacturer's parts lists and templates.

F. Keying Schedule:

1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

G. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.6 WARRANTY

A. See Section 01 7700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.

1. Closers: Five years, minimum.
2. Exit Devices: Three years, minimum.
3. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Applicable provisions of NFPA 101.

4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
6. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.

D. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
    a. Aluminum fasteners are not permitted.
    b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Fire-Rated Applications: Comply with NFPA 80.
    a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
    b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.2 HINGES

A. Manufacturers:

1. McKinney; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. Bommer Industries, Inc: www.bommer.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
5. Architect pre-approved equivalent.

B. Hinges: Comply with BHMA A156.1, Grade 1.

1. Provide hinges on every swinging door.
2. Provide following quantity of butt hinges for each door:
    a. Doors From 60 inches High up to 90 inches High: Three hinges.
3. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    a. Widths up to 3'-0": 4-1/2" heavy weight as specified.
    b. Widths from 3'-1" to 4'-0": 5" heavy weight as specified.

2.3 MORTISE LOCKS

A. Locks to be provided by Owner.

2.4 CLOSERS

A. Manufacturers; Surface Mounted:

1. Corbin Russwin, Norton, Rixson, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. DORMA USA, Inc; 7400 Series, 8600 Series, 8900 Series, and TS93: www.dorma.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. LCN, an Allegion brand: www.allegion.com/us/#sle.
5. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
6. Architect pre-approved equivalent.

B. Closers: Comply with BHMA A156.4, Grade 1.

1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.

2.5 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:

1. Rixson or Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. DORMA USA, Inc; 900 Series: www.dorma.com/#sle.
3. Glynn-Johnson, an Allegion brand: www.allegion.com/us/#sle.
4. Architect pre-approved equivalent.

B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.

1. Provide stop for every swinging door, unless otherwise indicated.

2.6 SILENCERS

A. Manufacturers:

1. Ives, an Allegion brand: www.allegion.com/us/#sle.
2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Architect pre-approved equivalent.

B. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.

1. Single Door: Provide three on strike jamb of frame.
2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
3. Material: Rubber, black color.

2.7 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.

1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Install hardware for smoke and draft control doors in accordance with NFPA 105.

D. Use templates provided by hardware item manufacturer.

E. Do not install surface mounted items until application of finishes to substrate are fully completed.

F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
2. Mounting heights in compliance with ADA Standards.

G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01 4000 - Quality Requirements.

B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Adjust work under provisions of Section 01 7300 - Execution.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.5 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.6 PROTECTION

A. Protect finished Work under provisions of Section 01 7300 - Execution.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Gypsum wallboard.

E. Joint treatment and accessories.

1.2 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2018).

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2018.

H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2020.

I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

J. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

K. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.

L. GA-216 - Application and Finishing of Gypsum Panel Products 2018.

1.3 SUBMITTALS

A. See Section 01 3300 for submittal procedures.

B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.2 METAL FRAMING MATERIALS

A. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).

1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.

B. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
3. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.

a. Products:

1) ClarkDietrich; BlazeFrame RipTrak: www.clarkdietrich.com/#sle.
2) FireTrak Corporation; Posi Klip: www.fire-trak.com/#sle.
3) Metal-Lite, Inc; The System: www.metal-lite.net/#sle.
4) Architect pre-approved equivalent.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

1. American Gypsum Company: www.americangypsum.com/#sle.
2. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
3. National Gypsum Company: www.nationalgypsum.com/#sle.
4. USG Corporation: www.usg.com/#sle.
5. Architect pre-approved equivalent.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

a. Mold resistant board is required at all locations.

3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
    a. Vertical Surfaces: 5/8 inch (16 mm).

2.4 GYPSUM WALLBOARD ACCESSORIES

A. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
    1. Types: As detailed or required for finished appearance.
    2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
    1. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
    2. Joint Compound: Drying type, vinyl-based, ready-mixed.
C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
D. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
B. Studs: Space studs at 16 inches on center (at 406 mm on center).
    1. Extend partition framing to structure in all locations.
    2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

3.3 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

1. Space control joints in accordance with ASTM C840 at specific locations indicated on drawings or approved by Architect.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.5 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

3.6 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.2 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2022.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2022.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

A. Product Data: Provide data on suspension system components and acoustical units.

B. Samples: Submit two samples 4 by 4 inch in size illustrating material and finish of acoustical units.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.5 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:

1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
2. CertainTeed Corporation: www.certainteed.com/ceilings-and-walls/#sle.
3. Rockfon: www.rockfon.com/#sle.
4. USG Corporation: www.usg.com/ceilings/#sle.
5. Architect Pre-Approved Equivalent.

B. Suspension Systems:

1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

A. Acoustical Panels: Painted mineral fiber, with the following characteristics:

1. Classification: ASTM E1264 Type III.
2. Size: At locations noted on Reflected Ceiling Plans as ACP 2x2, size to be 24 x 24 inches. At locations noted on Reflected Ceiling Plans as ACP 2x4, size to be 24 x 48 inches.
3. Thickness: 3/4 inch.
4. Panel Edge: Square.
5. Suspension System: Exposed grid.
6. Products:
   a. Basis-of-Design USG Corporation; Radar Acoustical Panels: www.usg.com/ceilings/#sle.
   b. Architect pre-approved equivalent.

2.3 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

2.4 ACCESSORIES

A. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

B. Perimeter Moldings: Same metal and finish as grid.

C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

1. Use longest practical lengths.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.3 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:

1. Cut to fit irregular grid and perimeter edge trim.

2. Make field cut edges of same profile as factory edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 CLEANING

A. Clean surfaces.

B. Replace damaged or abraded components.

END OF SECTION

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SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish new wall, new door and frame, and other surfaces as indicated.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Concealed pipes, ducts, and conduits.

1.2 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.3 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2019.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

F. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.4 SUBMITTALS

A. See Section 01 3300 for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
2. MPI product number (e.g., MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F (10 degrees C) for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Paints:

1. Diamond Vogel Paints: www.diamondvogel.com/#sle.
2. PPG Paints: www.ppgpaints.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
4. Architect pre-approved equivalent.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. Architectural coatings VOC limits of State in which the project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect/Engineer from the manufacturer's full line.

D. Colors:

1. Selection to be made by Architect/Engineer after award of contract.

2.3 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, uncoated steel, shop primed steel, and galvanized steel.

1. Paint hollow metal doors and door frames in all spaces indicated to receive new finishes.
2. Two top coats and one coat primer.
3. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
   a. Products:
      1) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
      2) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)
      3) Architect pre-approved equivalent.

4. Top Coat Sheen:
    a. Eggshell: MPI gloss level 3; use this sheen at gypsum wallboard locations.
    b. Semi-Gloss: MPI gloss level 5; use this sheen for hollow metal doors and frames.
5. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:

1. Gypsum Wallboard: 12 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces:

1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

I. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 8223
INTERIOR GRILLES AND SCREENS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior metal grilles and screens attached to existing radiator enclosures.

1.2 REFERENCE STANDARDS

A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

B. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs 2022.

1.3 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal procedures.

B. Shop Drawings: Submit detailed shop drawings, indicating component profiles, sections, finishes, fastening details, special details, and manufacturer's technical and descriptive data.

1. Include field dimensions of openings and elevations on shop drawings.
2. Indicate distinction between factory-assembled and field-assembled work on shop drawings.
3. Include large-scale details of anchorages and connecting elements.

C. Samples: Submit samples for color verification, 12 inches by 12 inches minimum.

1.4 QUALITY ASSURANCE

A. Mock-up: Provide a mock-up for evaluation of fabrication workmanship and installation methods.

1. Locate where directed.
2. Provide products finished as specified.
3. Mock-up may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in manufacturer's original, unopened packaging, with labels clearly identifying manufacturer and material.

1. Protect finishes by applying heavy duty removable plastic film during production.
2. Package for protection against transportation damage.
3. Provide markings to identify components consistently with drawings.

B. Store materials indoors, protected from moisture, humidity, and extreme temperature fluctuations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Interior Perforated Metal Screens

1. Basis-of-Design: McNichols Designer Perforated, GRECIAN 2235: www.mcnichols.com
2. Architect pre-approved equivalent.

2.2 PERFORATED METAL

A. Material: Carbon Steel, Cold Rolled

B. Thickness: 22 Gauge (0.0299" thick)

C. Hole Pattern: 5/8" square (four 3/8" interior triangles) on 3/4" straight centers.

D. Hole Size: 5/8"

E. Hole Centers: 3/4"

F. Bar Width: 1/8"

G. Hole Arrangement: Straight Centers.

H. Margins Parallel to Width: Sheared through both ends.

I. Margins Parallel to Length: Minimum solid both ends.

J. Product Form: Sheet.

2.3 ACCESSORIES

A. U-Edging: Carbon Steel, Cold Rolled, 18 gauge, Type 403 U-Edging, used to frame the edges of perforated metal as a finished screen.

2.4 FABRICATION

A. Shop fabricate grilles and screens to the greatest extent possible.

B. Disassemble as necessary for shipping and handling, clearly mark units for proper reassembly.

C. Provide supports, anchorages, and accessories as required for complete assembled system.

2.5 FINISHES

A. Mill Finish, Primed for painting.

2.6 ACCESSORIES

A. Fasteners: ASTM F593 stainless steel or ASTM A307 carbon steel, sizes to suit installation conditions.

B. Anchors and Inserts: Corrosion resistant; type, size, and material required for loading and installation as indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that painting and other adjacent work that might damage grille finish have been completed prior to start of installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written installation instructions.

B. Set grilles/screens level, plumb, with uniform joints, and in alignment with adjacent work as indicated.

C. Mechanically secure grilles/screens to supporting structure.

3.3 CLEANING

A. Clean finished surfaces as recommended by manufacturer and maintain clean condition until Date of Substantial Completion.

B. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

C. Replace grilles/screens that have been damaged beyond touch-up repair.

3.4 PROTECTION

A. Protect installed grilles/screens to ensure grilles/screens are without damage until Date of Substantial Completion.

END OF SECTION

SECTION 21 0523
GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Two-piece ball valves with indicators.
B. Bronze butterfly valves with indicators.
C. Iron butterfly valves with indicators.
D. Check valves.
E. Bronze OS&Y gate valves.
F. Iron OS&Y gate valves.
G. NRS gate valves.
H. Indicator posts.
I. Trim and drain valves.

1.2 RELATED REQUIREMENTS

A. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
B. Section 21 1300 - Fire-Suppression Sprinkler Systems.

1.3 ABBREVIATIONS AND ACRONYMS

A. EPDM: Ethylene-propylene diene monomer.
B. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
C. NRS: Non-rising stem.
D. OS&Y: Outside screw and yoke.
E. PTFE: Polytetrafluoroethylene.
F. SBR: Styrene-butadiene rubber.

1.4 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
C. ASME B31.9 - Building Services Piping 2020.
D. AWWA C606 - Grooved and Shouldered Joints 2022.
E. FM (AG) - FM Approval Guide Current Edition.
F. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. UL 262 - Gate Valves for Fire-Protection Service Current Edition, Including All Revisions.
H. UL 312 - Check Valves for Fire-Protection Service Current Edition, Including All Revisions.

I. UL 789 - Indicator Posts for Fire-Protection Service Current Edition, Including All Revisions.

J. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service Current Edition, Including All Revisions.

1.5 SUBMITTALS

A. See Section 01 3300 for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
   a. Provide temporary inlet and outlet caps.
   b. Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
   a. Store valves indoors and maintain at higher than ambient dew point temperature.
   b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.

C. Use the following precautions for handling:

1. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads on threaded-end valves.
3. ASME B31.9 for building services piping valves.

B. Comply with AWWA C606 for grooved-end connections.

C. Comply with NFPA 13 for valves.

D. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Hand-lever: For quarter-turn trim and drain valves 2 NPS and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.

B. Description:

1. Minimum Pressure Rating: 175 psig.
2. Body Design: Two piece.
3. Body Material: Forged brass or bronze.
4. Port Size: Full or standard.
5. Seat: PTFE.
6. Stem: Bronze or stainless steel.
7. Ball: Chrome-plated brass.
8. Actuator: Worm gear or traveling nut.
9. Supervisory Switch: Internal or external.
10. End Connections for Valves 1 NPS through 2 NPS: Threaded ends.
11. End Connections for Valves 2-1/2 NPS: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Minimum Pressure Rating: 175 psig.

B. Body Material: Bronze.

C. Seat: EPDM.

D. Stem: Bronze or stainless steel.

E. Disc: Bronze with EPDM coating.

F. Actuator: Worm gear or traveling nut.

G. Supervisory Switch: Internal or external.

H. End Connections for Valves 1 NPS through 2 NPS: Threaded ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.

B. Minimum Pressure Rating: 175 psig.

C. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.

D. Seat: EPDM.

E. Stem: Stainless steel.

F. Disc: Ductile iron, nickel plated.

G. Actuator: Worm gear or traveling nut.

H. Supervisory Switch: Internal or external.

I. Body Design: Grooved-end connections.

2.5 CHECK VALVES

A. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.

B. Minimum Pressure Rating: 175 psig.

C. Type: Center guided check valve.

D. Body Material: Cast iron, ductile iron.

E. Center guided check with elastomeric seal.

F. Hinge Spring: Stainless steel.

G. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).

B. Minimum Pressure Rating: 175 psig.

C. Body and Bonnet Material: Bronze or brass.

D. Wedge: One-piece bronze or brass.

E. Wedge Seat: Bronze.

F. Stem: Bronze or brass.

G. Packing: Non-asbestos PTFE.

H. Supervisory Switch: External.

I. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).

B. Minimum Pressure Rating: 175 psig.

C. Body and Bonnet Material: Cast or ductile iron.

D. Wedge: Cast or ductile iron, or bronze with elastomeric coating.

E. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.

F. Stem: Brass or bronze.

G. Packing: Non-asbestos PTFE.

H. Supervisory Switch: External.

I. End Connections: Flanged.

2.8 NRS GATE VALVES

A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).

B. Minimum Pressure Rating: 175 psig.

C. Body and Bonnet Material: Cast or ductile iron.

D. Wedge: Cast or ductile iron with elastomeric coating.

E. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.

F. Stem: Brass or bronze.

G. Packing: Non-asbestos PTFE.

H. Supervisory Switch: External.

I. End Connections: Flanged.

2.9 INDICATOR POSTS

A. UL 789 and FM (AG) standard listing for indicator posts.

B. Type: Underground.

C. Base Barrel Material: Cast or ductile iron.

D. Extension Barrel for Adjustable Length Indicator Posts: Cast or ductile iron.

E. Cap: Cast or ductile iron.

F. Operation: Wrench.

2.10 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Description:

a. Pressure Rating: 175 psig.

b. Body Design: Two piece.

c. Body Material: Forged brass or bronze.

d. Port Size: Full or standard.

e. Seat: PTFE.

f. Stem: Bronze or stainless steel.

g. Ball: Chrome-plated brass.

h. Actuator: Hand-lever.

i. End Connections for Valves 1 NPS through 2-1/2 NPS: Threaded ends.

j. End Connections for Valves 1-1/4 NPS and 2-1/2 NPS: Grooved ends.

B. Globe Valves:

1. Description:

a. Pressure Rating: 175 psig.

b. Body Material: Bronze with integral seat and screw-in bonnet.

c. Ends: Threaded.

d. Stem: Bronze.

e. Disc Holder and Nut: Bronze.

f. Disc Seat: Nitrile.

g. Packing: Asbestos free.

h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Confirm valve interior to be free of foreign matter and corrosion.

B. Remove packing materials.

C. Examine guides and seats by operating valves from the fully open position to the fully closed position.

D. Examine valve threads and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage.

1. Check bolting for proper size, length, and material.
2. Verify gasket for size, defects, damage, and suitable material composition for service.
3. Replace all defective valves with new valves.

3.2 INSTALLATION

A. Comply with specific valve installation requirements and application in the following Sections:

1. Section 21 1300 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.

B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.

1. Install permanent identification signs indicating portion of system controlled by each valve.

C. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.

D. Valves in horizontal piping installed with stem at or above the pipe center.

E. Position valves to allow full stem movement.

F. Install valve tags. Comply with Section 21 0553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION

SECTION 21 0553
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Ceiling tacks.

1.2 REFERENCE STANDARDS

A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.3 SUBMITTALS

A. See Section 01 3300 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.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Pumps: Nameplates.

B. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.2 NAMEPLATES

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Company: www.kolbipipemarkers.com/#sle.
3. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
4. Engineer Pre-Approved Equivalent.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Thickness: 1/8 inch.
5. Plastic: Comply with ASTM D709.

2.3 CEILING TACKS

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

B. Color code as follows:

1. Sprinkler Valves: Red.

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 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. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 21 1100
FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water pipe.

B. Valves.

1.2 RELATED REQUIREMENTS

A. Section 21 1300 - Fire-Suppression Sprinkler Systems.

1.3 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

C. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe 2021.

D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.

E. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings 2022.

F. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2018.

G. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings 2021.

H. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings 2017.

I. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast 2017, with Errata (2018).

J. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances 2017.

K. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL (DIR) - Online Certifications Directory Current Edition.

1.4 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures for submittal procedures.

B. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.

C. Project Record Documents:

1. Record actual locations of piping mains, valves, and connections.

1.5 QUALITY ASSURANCE

A. Provide grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

B. Valves: Bearing product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

C. Products:

1. Listed, classified, and labeled as suitable for the purpose specified and indicated.

D. Perform Work in accordance with local authorities having jurisdiction requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

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

1.7 FIELD CONDITIONS

PART 2 PRODUCTS

2.1 WATER PIPE

A. Steel Pipe and Fittings:

1. Pipe:

a. Schedule 40, black, plain and threaded ends, for threaded, cut-groove and rolled-groove joints, listed, ASTM A53/A53M.

b. Schedule 10, black, with plain ends, for rolled-groove joints, listed, ASTM A135/A135M.

2. Fittings: Comply with ASME B16.3 Class 150, zinc-coated, threaded.

B. Ductile Iron Pipe: Listed, AWWA C151/A21.51.

1. Fittings: AWWA C110/A21.10, ductile iron, standard thickness.

2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR rubber gasket with 3/4 inch diameter rods.

C. CPVC Pipe and Fittings:

1. CPVC piping shall only be used where concealed. Exposed CVPC piping is not allowed.

2. CPVC fire sprinkler pipe and fittings shall be extruded/molded. The pipe compound shall meet cell class 23547 and the fittings compound shall meet cell class 24447 as defined by ASTM D1784. Both pipe and fittings compounds shall be certified by NSF International for use with potable water and shall be pressure rated by Plastics Pipe Institute (PPI).

3. Pipe shall meet or exceed the requirements of ASTM F442 material designation CPVC4120-06 in standard dimension ratio (SDR) 13.5. Additionally, the pipe must be marked with the following pressure ratings: “320 PSI @ 73° F”, “175 PSI @ 150° F” and “100 PSI@ 180° F”.

4. Fittings shall meet or exceed the requirements of ASTM F437 (schedule 80 threaded), ASTM F438 (schedule 40 socket) or ASTM F439 (schedule 80 socket).
5. Both pipe and fittings shall be Listed by Underwriters Laboratories for use in automatic fire sprinkler systems and shall bear the logo of the Listing Agency. See UL Fire Protection Equipment Directory, categories VIWT and HFYH.
6. Both pipe and fittings shall be certified by NSF International for use with potable water.
7. Ancillary products (including, but not limited to fire stops, thread sealants, leak detectors, etc.) coming into contact with pipe and fittings must be chemically compatible with CPVC pipe and fittings.
8. All socket type joints shall be assembled with solvent cements that meet or exceed the requirements of ASTM F493. Safe handling of solvent cements shall be in accordance with ASTM F402. Solvent cement shall be certified by NSF International for use with potable water, and approved by the manufacturers. The solvent cements shall be approved for use with CPVC pipe and fittings.
9. Manufacturers:
    a. Blazemaster Fire Sprinkler Systems
    b. NIBCO
    c. Tyco
    d. The Viking Corporation
    e. Engineer Pre-Approved Equivalent.

2.2 VALVES

A. General:
1. Manufacturer's name and pressure rating marked on valve body.
2. Minimum Compliance: UL (DIR) listed and labeled.
3. Maximum Inlet Pressure: 400 psi.
4. Maximum Service Temperature: 180 degrees F.
5. Valve Coatings:
    a. Internally: 4 mils, 0.004 inch epoxy, minimum.
    b. Externally: Epoxy base then fire red enamel paint or heat-fused red epoxy paint.

2.3 FIRE SAFING

A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.

B. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.

C. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 degree F (121 to 177 degree C), UL listed.

D. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.

E. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.

F. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:

1. 3M Brand.
2. Flame Stop
3. Dow Corning
4. Metacaulk
5. Engineer Pre-approved Equivalent

G. Horizontal penetrations through fire rated walls where plenum rated cables or tubing bundles are located shall be made with EZ-Path Fire-rated Pathway by Specified Technologies, Inc. or Engineer Pre-approved Equivalent.

PART 3 EXECUTION

3.1 HYDRAULIC CALCULATIONS

A. Size system piping such that total required system pressure at demand flow (including hose streams) is at least 5 psi less than the available pressure at demand flow. Including in calculations, the greater of the following:

1. 8 psi allowance for future reduced pressure principle backflow preventer installed at service entrance.
2. Actual backflow preventer installed.

3.2 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. General Requirements:

1. Pipe Schedule:

a. Drains and pipe between fire department connections and check valves: Use galvanized steel pipe instead of black steel pipe when steel pipe is specified. Do not use welded joints.

b. Sizes 2-1/2" and smaller or larger than 6" for wet pipe systems: Schedule 40 steel pipes with rolled groove or cut groove ends, grooved and steel pipe fittings, and grooved coupling joints.

c. Sizes 2-1/2" to 6" for wet pipe systems: Schedule 10 steel pipe with rolled groove ends, grooved end steel pipe fittings, and grooved coupling joints.

2. Pipe Laying and Jointing:

a. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general locations and arrangement of piping. Install piping as indicated, as far as practical.

1) Deviations from approved shop drawings for sprinkler piping require written approval from authority having jurisdiction. File written approval with the Architect prior to deviating from approved shop drawings.

b. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

c. Install flanges or flange adapters on valves, apparatus, and equipment have 2-1/2 inch and larger connections.

d. Install combination Inspector's General Test Connection and Drain in sprinkler piping, sized on the system riser, if acceptable to the authority having jurisdiction.

e. Install sprinkler piping with drains for complete system drainage.

f. Install ball drop valves to drain piping between fire department connections and check valves, and where indicated. Drain outside building.

g. Install alarm devices in piping systems.

h. Hangers and Supports: Comply with NFPA 13.

1) Install hanger and support spacing and locations for steel piping joined with grooved mechanical couplings according to manufacturer's written instructions for rigid systems.
2) Do not hang from joist bridging. Joist bridging is not considered structural.

i. Install pressure gauges on riser. Include pressure gauges with connection not less than 1/4 inch and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

j. Hold riser piping and components as close to wall as allowable. Install riser components vertically when possible, rather than horizontally to minimize space requirements. Risers to second floor shall not pass through sales areas or electrical rooms.

k. Remove fins and burrs from pipe and fittings.

l. Prior to placing in position, clean pipe, fittings, valves, and accessories, and maintain in clean condition.

m. Cut pipe in a neat, workmanlike manner accurately to length established at the site and work into place without forcing or springing.

n. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material.

o. Secure firm, uniform support.

p. Provide proper provisions for expansion and contraction of pipelines.

B. Special Requirements:

1. Ductile Iron Piping:

a. Unless otherwise specified, install pipe and fittings in accordance with paragraph "General Requirements".

b. Jointing:

c. Allowable Deflection:

1) Maximum Allowable Deflection: As stated in AWWA C600.
2) If the alignment requires deflection in excess of the above limitations, furnish special blends or a sufficient number of shorter pipe lengths to provide angular deflections within the limit set forth.

d. Pipe Anchorage:

1) Provide concrete thrust blocks (reaction backing), for pipe anchorage except where metal harness is indicated.
2) Thrust blocks to comply with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks to be as indicated.
3) Use concrete, ASTM C94/C94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
4) Provide metal harness in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as indicated in NFPA 13, except as otherwise indicated.

e. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.

2. CPVC Plastic Piping:

a. Joints: Solvent cement shall conform to ASTM F493. Follow manufacturer's written instructions for set and cure time.

b. System design shall be in accordance with standard industry practices and standards for fire sprinkler systems and the manufacturer’s design/installation instructions. The design shall take into consideration the pressure and flow requirements, friction loss, operating temperatures, support spacing, joining methods, and thermal expansion and contraction.

c. The fire sprinkler piping system shall be hydraulically calculated using a Hazen-Williams C Factor of 150, and designed in accordance with the Standard for Installation of Sprinkler Systems (NFPA 13).

d. The maximum design temperature/pressure rating shall not exceed 175 psi at 150°F.

e. Installation practices such as pipe support spacing, bracing, allowance for thermal expansion/contraction, solvent welding and handling and storage shall be in accordance with the manufacturer's instructions and the UL Listing which includes installation limitations.

f. After the system is installed and solvent-welded joints have cured per the manufacturer's installation instructions, the system shall be hydrostatically tested per the manufacturer's installation instructions and the requirements of the applicable NFPA Standard (NFPA 13, 13R or 13D) and per the local Codes/Rules/Regulations for the jurisdiction installed in.

3. Steel Piping:

a. Jointing:

1) Grooved:

(a) Make grooved type joints with the couplings specified for this type joint connecting pipe with roll-grooved ends or pipe with welded-on cut-grooved adapters, each with dimensions as previously specified for this type of joint.

(1) Mechanical "T" bolted branch outlet fittings, instead of fitting types specified may be used for branch connections.

(b) Groove pipe ends in the field only with approved groove rolling equipment and groove adapters in the field only with approved groove cutting equipment; use only groove rolling and groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings.

(c) Obtain approval for field-cut grooves prior to assembling the joint.

b. Allowable Offsets:

1) Form short-radius curves and closures by short lengths of pipe or fabricated specials specified.

3.4 FIRE SAFING

A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections:

1. Fill pipeline 24 hours before testing and apply test pressure to stabilize system, using only potable water.

2. Test water piping in accordance with NFPA 13, where the additional water added to the system must not exceed the limits given in NFPA 13.

3. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
4. Prepare reports of testing activities.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of system to Owner's personnel.

END OF SECTION

SECTION 21 1300
FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. Dry-pipe sprinkler system.

C. Nitrogen generator.

D. System design, installation, and certification.

E. Fire department connections.

1.2 RELATED REQUIREMENTS

A. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

B. Section 21 3000 - Fire Pumps.

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

1.3 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide current edition.

B. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2015.

C. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2016.

D. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 1963 - Standard for Fire Hose Connections 2019.

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

G. UL 405 - Standard for Safety Fire Department Connection Devices Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 for submittal procedures.

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:

1. Sprinkler drawings and hydraulic calculations are provided with these documents. See the end of this specification for calculations. See drawings for sprinkler layout and details.

2. Field verify installation of sprinkler system prior to installation. Submit any changes to engineer for revisions.

3. Submit included sprinkler plans and calculations to Authorities Having Jurisdiction for approval.
    a. In addition to the AHJs, submit shop drawings to Kevin Lyons with Xenia Rural Water District, kylons@xeniawater.org.

D. Installer's Qualification Statement.

E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
2. Sprinkler Wrenches: For each sprinkler type.

G. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Sprinklers, Valves, and Equipment, unless noted otherwise below:
1. Anvil International: www.anvilintl.com/#sle.
2. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
3. Viking Corporation: www.vikinggroupinc.com/#sle.
4. Globe Fire Sprinkler Corp.
5. Reliable Automatic Sprinkler Co, Inc.
6. Engineer Pre-Approved Equivalent

2.2 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for building areas noted on drawings.

B. The sprinkler system's hydraulic design criteria shall be indicated on the Drawings.

C. Interface system with building fire and smoke alarm system.

D. Provide fire department connections where indicated.

E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

F. Pipe 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.

2.3 SPRINKLERS

A. Suspended Ceiling Type: Concealed type with matching escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Cover Plate Finish: Enamel, white.
   5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

B. Exposed Area Type: Upright type.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish:
      a. For finished spaces: Enamel, color white.
      b. For unfinished spaces (basements, attics, workshops, etc.): Brass.
   4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Concealed horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish:
      a. For finished spaces: Enamel, color white.
      b. For unfinished spaces (basements, attics, workshops, etc.): Brass.
   4. Cover Plate Finish: Enamel, color white.
   5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

D. Dry Sprinklers: Concealed type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Finish: Brass.
   4. Escutcheon Plate Finish: Brass.
   5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

E. Guards: Wire cage type, including fastening device for attaching to sprinkler. Finish to match sprinkler finish.

F. Flexible Drop System: Stainless steel, multiple use, open gate type.
   1. Application: Use to properly locate sprinkler heads.
   2. Include all supports and bracing.
   3. Provide braided type tube as required for the application.
   4. Manufacturers:
      a. FlexHead Industries, a brand of Anvil International: www.anvilintl.com/#sle.
      b. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.
      c. Engineer Pre-Approved Equivalent.

2.4 PIPING SPECIALTIES

A. Pressure Gauges: UL 393, 3-1/2" to 4-1/2" diameter dial, with dial range of 0-250 psig.

B. Specialty Sprinkler Fittings:
   1. Mechanical "T" fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.
   2. Mechanical cross fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.
   3. Drop-nipple fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.
   4. Sprinkler alarm test fittings: Ductile-iron housing with 1-1/2" (DN 40) inlet and outlet, integral test valves, combination orifice and sight glass, and threaded or locking lug ends.

C. Dry Pipe Sprinkler Valve: Duct iron body with aluminum bronze clapper and latch, stainless sheet shaft, peroxide cured EPDM clapper seal, nitrile o-rings, stainless steel springs and peroxide cured EPDM diagram with fabric reinforcement.
   1. Provide all required pipe nipples and fittings for operation with standard galvanized finish.
   2. Provide all trim accessories required for operation.
   3. Provide all required gauges for operation.
   4. Provide alarm pressure switch.
   5. Dry Accelerator.
   6. Provide air supervisory pressure switch.
   7. Provide air supply system for establishing and maintaining air in the system.
      a. Nitrogen generator.
      b. Low-pressure alarms.
      c. Ball valves.
      d. Required trim.
   8. Activate electric alarm.
   9. Test and drain valve.
   10. Externally resettable.
   11. Replaceable internal components without removing valve from installed position.

12. Manufacturers:
    a. Victaulic Company; Series 768 - NXT: www.victaulic.com/#sle.
    b. Engineer Pre-Approved Equivalent.

D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

E. Fire Department Connections:
1. Type: Exposed, projected wall mount made of corrosion resistant metal complying with UL 405.
    a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
    b. Outlet: Back with pipe threads, 4 NPS.
    c. Finish: Brass or bronze.
    d. Signage: Raised or engraved lettering 1 inch minimum indicating system type.
    e. Manufacturers:
        1) Elkhart Brass Manufacturing Company, Inc: www.elkhartbrass.com/#sle.
        2) Fire End & Croker Corporation: www.croker.com/#sle.
        3) Engineer Pre-Approved Equivalent.

F. Alarm Devices:
1. Alarm Devices: Types and sizes that will match piping and equipment connections.
2. Supervisory Switches: UL 753 for valves, electrical-supervision type, SPDT, normally closed contacts, designed to signal controlled valve in other than full open position.

2.5 NITROGEN GENERATOR

A. Manufacturers:
1. Potter Electric Signal Company, LLC; IntelliGen INS Series: www.pottersignal.com/#sle.
2. Engineer Pre-Approved Equivalent.

B. Nitrogen Generator:
1. Provide FM (AG) approved system and accessories.

C. Minimum Nitrogen Purity: 98 percent.

D. Provide piping and accessories to connect to dry and preaction fire suppression systems.

E. Accessories:
1. Provide control panel.
2. Provide air maintenance device.
3. Provide nitrogen storage tank sized to comply with NFPA 13.
4. Provide purge valves to remove oxygen from the system.

5. Provide nitrogen analyzer to determine the nitrogen purity.
6. Provide system with replaceable filters.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install sprinklers in locations indicated. When sprinkler locations are not indicated in an area, locate sprinklers to meet this specification.

C. Install equipment in accordance with manufacturer's instructions.

D. Install buried shut-off valves in valve box. Provide post indicator.

E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

F. Place pipe runs to minimize obstruction to other work.

G. Place piping in concealed spaces above finished ceilings.

H. Install sprinklers in suspended ceiling in center of acoustical panels and in center of half of 24"x48" acoustical panels. The location of sprinklers may deviate up to 1/4" from the center unless approved otherwise by the Architect/Engineer.

I. Install and connect to fire pump system in accordance with Section 21 3000.

J. Install nitrogen generator on vibration isolators. Refer to Section 22 0548.

K. Flush entire piping system of foreign matter.

L. Install guards on sprinklers in janitor closets and on non-recessed heads within 84 inches of the floor.

M. Hydrostatically test entire system.

N. Electrical Connections: Power wiring as specified in Division 26.

O. Require test be witnessed by Authority Having Jurisdiction.

3.2 FIELD QUALITY CONTROL

A. Perform field acceptance tests of each fire protection system with authority having jurisdiction present.

1. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter "System Acceptance."

B. Replace piping system components that do not pass test procedures specified then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

3.4 SPRINKLER APPLICATIONS

A. Sprinkler Temperature Ratings: Use sprinklers with the following temperature ratings in the applications listed unless noted otherwise on Drawings:

1. Ordinary Temperature Classification (155 °F): Public areas, classrooms, offices, janitor closets, mechanical equipment rooms.
2. Intermediate Temperature Classification (212 °F): Top of elevator hoistways where ambient temperatures can exceed 100 °F, stock rooms.
3. High Temperature Classification (286 °F) Where subject to high temperatures caused by unit heaters, hot pipes, radiant ceilings, or other heat source.

3.5 COMMISSIONING

A. Starting Procedures: Follow manufacturer's written procedures. If manufacturer prescribes no procedures, proceed as follows:

1. Verify that valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.
2. Verify that specified tests of piping are complete.
3. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
4. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
5. Check that potable water supplies have correct type of backflow preventer.
6. Check that fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
7. Fill wet pipe sprinkler systems with water.
8. Energize circuits to electrical equipment and devices.
9. Adjust operating controls and pressure settings.

B. Coordinate with fire alarm system tests.

3.6 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

END OF SECTION

SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Plumbing Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete plumbing installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.

B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.

C. Provide labor necessary to demolish the existing plumbing systems as shown on the drawings, as described in Part 3.1, Existing Conditions, or as required.

D. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment.

1.2 DAMAGE

A. The Contractor shall be responsible for damage to the work of other trades, or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work in addition to specific applications specified by individual work sections of these specifications.

1. IECC - International Energy Conservation Code
2. ANSI Pressure Piping Standards (B31)
3. AWWA Standards
4. ASME Boiler and Pressure Vessel Code and State Boiler Code
5. IFGC - International Fuel Gas Code
6. NFPA/NEC 70 - National Electrical Code
7. Local and/or State Plumbing, Mechanical and Building Codes
8. Occupational Safety and Health Act (OSHA)
9. Uniform Plumbing Code
10. International Mechanical Code
11. NFPA Codes and Standards

C. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

D. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above Authorities, the Contractor shall promptly notify the Architect/Engineer in writing and do so no less than 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.

E. Installations must be safe in every respect, and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

A. A complete set of current up-to-date Project Drawings and Specifications shall be kept on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.

B. The contract drawings for plumbing work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.

C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.

D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.

E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.

F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.

G. All valves, pumps, etc. shall be accessible for maintenance purposes. Locate items carefully and coordinate with other trades so that each valve and piece of equipment is accessible and functional. Items located above a non-accessible ceiling, chase, or soffit shall be accessible through an access door. Coordinate location of access doors with the general contractor.

1.6 RESPONSIBILITY

A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire plumbing installation functions properly in every detail.

1.7 COORDINATION

A. Coordinate the work with other trades prior to installation.

B. No piping or equipment, which is foreign to the electrical equipment, or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110.26. This does not prohibit sprinkler protection for the installation.

C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.

D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.

E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.

F. No piping or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway or machine room in accordance with NEC 620.37 and ASME A17.1 Safety Code for Elevators and Escalators.

1.8 GUARANTEE AND MAINTENANCE

A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed.

B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.

C. Equipment which fails to meet performance ratings as specified and shown on the drawings shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.

D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

PART 2 PRODUCTS

2.1 SUBMITTALS

A. Submit shop drawings and catalog data for plumbing equipment as called for in Division 01 - General Requirements.

B. Submittal data for plumbing equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.

C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Architect/Engineer, verbal approval will not be considered binding.

D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Architect/Engineer. The Architect/Engineer will review shop drawings to aid in interpreting the plans and specifications, and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Architect/Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Architect/Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as S-1, WH-1) shall be indicated for each item.

E. Near completion of project, before conducting Owner orientation and training sessions and before authorization of final payment, submit to the Owner or their designated Representative for review: three (3) sets of installation and operational information, parts lists, and maintenance instructional manuals. These OMMs shall be organized, formatted and bound in accordance with Division 01 - General Requirements.

F. At the completion of the project, prepare and submit to the Owner record drawings showing the location of piping and valves. Drawing shall give accurate dimensions of such equipment for future use by the Owner. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

2.2 SUBCONTRACTORS AND MATERIALS

A. Submit to the Architect/Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Architect/Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Architect/Engineer, whether or not said items are herein specified.

2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., American Water Works Association (AWWA), American Gas Association (AGA), etc., if a standard has been established by that agency for the type of material.

B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.

C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Architect/Engineer.

D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, faucets shall be from the same manufacturer.

E. Materials shall be protected from damage, and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Architect/Engineer.

F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.

G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

2.4 MATERIAL SUBSTITUTIONS

A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Architect/Engineer. Such permission for substitution must be requested, in writing and in accordance with Division 01 - General Requirements.

B. The Architect/Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Architect/Engineer.

C. Changes required by alternate equipment shall be made at no additional cost to the Owner; and costs incurred by other trades, public utilities or the Owner, as a result of the use of such equipment, shall be the responsibility of the Contractor.

D. Furnish to the Architect/Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Architect/Engineer as long as needed.

E. Identify the differences in alternate material or equipment as compared to that specified, and indicate the benefits to the project as a result of selecting the alternative.

F. The Architect/Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Architect/Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

2.5 JOINING MATERIALS

A. Refer to individual Division 22 piping sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

1) AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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

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

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

H. Solvent Cements for Joining Plastic Piping:

1. 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.
5. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.6 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with piping to be joined.

1. Available Manufacturers:
   a. Cascade Waterworks Mfg. Co.
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
      1) Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
      2) Underground Piping NPS 2 (DN 50) and larger: AWWA C219, metal sleeve-type coupling.
      3) Aboveground Pressure Piping: Pipe fitting.
   g. Engineer Pre-Approved Equivalent.
2. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   a. Available Manufacturers:
      1) Eslon Thermoplastics.
      2) Engineer Pre-Approved Equivalent.
3. 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.
   a. Available Manufacturers:
      1) Thompson Plastics, Inc.
      2) Engineer Pre-Approved Equivalent.

4. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
    a. Available Manufacturers:
        1) NIBCO INC.
        2) NIBCO, Inc.; Chemtrol Div.
        3) Engineer Pre-Approved Equivalent.
5. Flexible Transition Couplings for Aboveground 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.
    a. Available Manufacturers:
        1) Cascade Waterworks Mfg. Co.
        2) Fernco, Inc.
        3) Mission Rubber Company.
        4) Plastic Oddities, Inc.
        5) Engineer Pre-Approved Equivalent.

2.7 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

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

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
    1. Available Manufacturers:
        a. Capitol Manufacturing Co.
        b. Central Plastics Company.
        c. Eclipse, Inc.
        d. Epco Sales, Inc.
        e. Hart Industries, International, Inc.
        f. Watts Industries, Inc.; Water Products Div.
        g. Zurn Industries, Inc.; Wilkins Div.
        h. Engineer Pre-Approved Equivalent.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
    1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
    2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
    3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Examine the existing buildings and grounds and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.

B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Architect/Engineer. Do not remove from the premises any equipment that may have maintenance value to the Owner without permission of the Owner. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.

C. Where existing equipment is removed or changed, all piping no longer in service shall be removed and stubs plugged as directed by the Architect/Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the Construction Manager to minimize the damage to the building in order to reduce the amount of patching required.

D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.

E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or municipality having jurisdiction.

F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Owner and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Architect/Engineer, in writing, before submitting his bid.

3.2 INTERRUPTION OF SERVICE

A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, notify the proper building authorities no less than 48 hours in advance and obtain approval from these authorities before making changes. Such notices shall give duration and nature of shutdown. Temporary arrangements shall be approved by the Architect/Engineer and/or Owner.

B. Any and all interruptions to building services shall be in accordance with Division 01 - General Requirements.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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

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

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

E. Install piping at indicated slopes.

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

G. Install piping to allow application of insulation.

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

3.4 OPENINGS, CUTTING, AND PATCHING

A. Coordinate the placing of openings in the new structure, as required for the installation of the plumbing work.

B. Furnish the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.

C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.

D. Underfloor Plumbing Work:

1. Contractor shall coordinate all related activity with Construction Manager at least 24 hours before beginning construction activity.

2. Contractor, before saw-cutting floor, must first field verify all existing piping service, sizes, locations, depths, flow directions as well as coordinate with any other trades who may have utilities such as wires or conduits concealed beneath floor and which may be subject to damage and subsequent service interruptions. The cost to repair any damaged utilities shall be borne by The Contractor.

3. Contractor shall be responsible for erecting and maintaining suitable temporary construction barriers and enclosures for containment of all construction dust and debris. Enclosures and barriers shall be maintained under negative pressure and fans and filters as needed to assist with containment.

3.5 EXCAVATION AND BACKFILL

A. Contractor shall coordinate all related activity with Construction Manager at least 24 hours before beginning construction activity.

B. The Contractor shall be responsible for erecting and monitoring of all safety barricades and related protection around excavation and work areas.

C. Trenches and excavations may be backfilled by the Contractor only after required testing has been satisfactorily performed and locations of connections and appurtenances which will be concealed have been recorded by the Contractor in the construction record documents.

D. Bedding:

1. Gravity Storm Sewer or Sanitary Sewer Pipe Bedding Material:

a. Rigid Pipe:

1) Rigid gravity storm or sanitary sewer pipe shall be provided with compacted granular bedding having a minimum thickness of 4" (100 mm) or 1/8th of the outside pipe diameter, whichever is greater.

2) Clean gravel or crushed rock shall meet the following gradation for rigid sewer pipe (RCP, DIP, VCP).

b. Non-Rigid Pipe:

1) Non-rigid gravity storm or sanitary sewer pipe shall be provided with compacted granular bedding having a minimum thickness of 4" (100 mm) or 1/4th of the outside pipe diameter, whichever is greater.

2) Gravel or crushed rock shall meet the following gradation for non-rigid sewer pipe: 100% passing a ¾" (19 mm) sieve, 50-80% passing a No. 4 (4.75 mm) sieve, and 25-60% passing a No. 8 (2.36 mm) sieve. (IADOT Gradation No. 10).

2. Water mains or sanitary sewer force mains may be installed with undisturbed or compacted soil bedding provided the subgrade is consistent and the Contractor provides hand excavation for bells such that the pipe barrel bears evenly on the subgrade.

3. Contractor shall be responsible for prompt cleanup and disposal of all unsuitable or excess bedding materials.

E. Backfill:

1. Suitable excavated material: Free of cinders, ashes, refuse, rocks, pavement fragments, vegetative or organic matter. Unless noted otherwise on the plans, sand shall not be used.

2. Granular backfill shall be crushed limestone or gravel with 100% passing a ¾" (19 mm) sieve, 50-80% passing a No. 4 (4.75 mm) sieve, and 25-60% passing a No. 8 (2.36 mm) sieve. (IADOT Gradation No. 10)

3. Place backfill simultaneously on both sides of pipe to prevent displacement and place at an angle so that impact on installed pipe is minimized.

4. Backfill in the pipe envelope (top of bedding to a point 12" (300 mm) above the pipe) shall be hand placed. Material shall be of even consistency and free of clumps and boulders, finely divided, and shall be compacted to 90% maximum Standard Proctor Density. Material within the pipe envelope shall be the same as specified for trench backfill, unless noted otherwise on the Plans.
5. Contractor shall be responsible for prompt cleanup and disposal of all unsuitable or excess backfill materials.

3.6 CONCRETE AND MASONRY WORK

A. Locate, furnish and install all support, hanger and equipment anchor bolts and related hardware.

B. Underfloor Plumbing Work:

1. Contractor shall coordinate all related activity with Construction Manager at least 24 hours before beginning construction activity.
2. Contractor shall saw cut, remove and properly dispose of concrete and related debris as required to accommodate new underfloor piping and fixtures.
3. Patch floor to match adjacent floor textures and reinforce with #3 rebar, 18” O.C. (drill and grout 3” imbed).
4. Unless noted otherwise, concrete shall be commercial grade with a minimum 28-day compressive strength of 3,000 PSI. Do not allow air content of troweled finished floors to exceed 3%

3.7 ROOF OPENINGS

A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and adequately reinforced by an experienced roofing contractor.

B. Roof penetrations for piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.

C. All roof work shall be completed such that it does not void any existing roof warranty.

3.8 PAINTING

A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Architect/Engineer and the Owner.

3.9 CLEANING

A. Keep the premises clean of all dirt and debris, caused by the work in accordance with Division 1 - General Requirements.

B. Keep the premises clean of all debris caused by the work at all times, and keep materials stored, in areas designated by the Owner, in such a manner as not to interfere with the progress of the work of other Contractors or with the operation of existing facilities.

C. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

3.10 SUSPENSION FROM WOOD STRUCTURAL MEMBERS

A. In general, concentrated or other loads shall not be suspended directly from the bottom of wood structural members, unless approved by the Architect/Engineer. Loads suspended from open web joists or trusses may be transferred to the bottom chord of the structural member at the panel points. Loads suspended from solid web joists shall be transferred to the joists only through the top flange or web. Suspension systems shall be reviewed by the Architect/Engineer.

3.11 PROTECTION

A. Special steps shall be taken as necessary for the protection of equipment and materials furnished under Division 22. Equipment and materials shall be protected by Contractor from any physical damage due to weather elements, dirt, dents, sheet rock installation, and painting until the project is completed. Damage, if incurred, shall be promptly repaired at no additional cost to Owner, as-needed to restore equipment and materials to original as-new condition.

B. Protection of equipment during the finishing (sheet rock, plastering and painting) of the building interior shall be the responsibility of the contractor or contractors performing that work. This shall not relieve this Division 22 Contractor of the ultimate responsibility of checking and ensuring that adequate protection is provided and maintained at all times.

C. Where the installation or connection of equipment requires Division 22 Contractor to work in areas previously finished by other Contractors, the Division 22 Contractor shall be responsible to ensure that such finished areas are adequately protected and are not marred, soiled or otherwise damaged during the course of their said work. If damage occurs this Division 22 Contractor shall be responsible to arrange for the other Contractors to repair and refinish any damaged areas and shall pay for all repair, rework and refinishing required.

D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

3.12 ASBESTOS IDENTIFICATION AND CONTROL

A. In the event that suspected asbestos containing material (ACM) is encountered during the course of the work, cease operations in the immediate area and promptly notify both the Owner and Architect/Engineer. Suspected materials will then be sampled and analyzed by the Owner' s Representative.

B. Should ACM be confirmed, the Owner's Representative shall direct the abatement procedures. This work shall be awarded either by subcontract to the Contractor or under a separate contract.

C. During abatement operations, cease operations in the immediate area of the abatement. Operations in other areas of the project may be performed, but care must be taken to control dust to avoid contamination of air monitoring samples. The Contractors shall coordinate activities with the asbestos abatement contractor as well as the Owner' s Representative.

D. Should no ACM be identified, operations in the restricted areas may be resumed. At the discretion of the Owner or Owner' s representative, any schedule delays caused by identification, analysis or abatement may be added in the form of an extension of time to the contract via a Change Order.

3.13 NOISE AND VIBRATION

A. Contractor shall install all equipment in a such a manner so as to control the transmission of noise and vibration from any installed equipment, components or systems, so the sound level in any occupied area does not exceed NC-35 levels. Contractor shall correct all objectionable noise levels in any occupied areas and at no additional cost to Owner, which are due to improperly installed or isolated equipment, components or systems.

3.14 TESTS AND DEMONSTRATIONS

A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.

B. Prior to acceptance of the plumbing installation, demonstrate to the Owner or his designated representative’s essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.

C. Furnish the necessary trained personnel to perform the demonstrations and instructions, and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

END OF SECTION

SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor, and supervision necessary to install thermometers and gauges.

B. Thermometers.

C. Thermometer Wells.

D. Gauges.

1.2 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 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; 2007.

1.3 QUALIFICATIONS

A. Thermometers: Weiss, Weksler, Ashcroft, Reotemp, U.S. Gauge Therice or Engineer Pre-Approved Equivalent.

B. Gauges: Weiss, Weksler, Ashcroft, McDaniel, U.S. Gauge, Therice or Engineer Pre-Approved Equivalent.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product and installation data. Provide list that indicates use, operating range, total range and location for manufactured components.

PART 2 PRODUCTS

2.1 THERMOMETERS

A. Stem Type:

1. 9 in. "Adjust-Angle" industrial thermometer, complete with double thick glass front, non-toxic blue ribbon liquid, separable socket and arranged so the unit can be set at any required angle front to back or left to right during or after installation. Range 32° F - 240° F for hot water, 50° F - 400° F for steam, and 0° F - 100° F for chilled or domestic cold water.

B. Dial Type:

1. 4-inch diameter, all stainless steel hermetically sealed per ASME B40.3, stainless steel stem, head and bezel. Coordinate stem length with system served. Bi-metal coil sensor, aluminum dial with black markings, glass lens, 1% full scale accuracy. Range 20 deg F - 240 deg F for hot water, 0 deg F - 100 deg F for domestic cold water.

2.2 GAUGES

A. 4 in. compound pressure vacuum gauge, liquid filled, aluminum, steel or stainless steel case, white dial, 1/4-in. male NPT. Range 30 in. vacuum to 100 pound pressure for water, 30 in. vacuum to 30 pound pressure for low pressure steam, 30 in. vacuum to 1-1/2 times system pressure for medium and high pressure steam. Provide siphon (pigtail) for steam gauges. Provide level handle union cock for steam and water gauges.

2.3 THERMOMETER WELLS

A. Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install thermometers in discharge and hot water recirculation return piping at water heaters, and at other points as shown on the Drawings.

B. Install gauges at pressure reducing valves and at other points as shown on the Drawings.

END OF SECTION

SECTION 22 0523
GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Provide equipment, materials, labor, and supervision necessary to install valves as indicated on drawings and in schedules, and herein specified.

B. Valves of the same type shall be of a single manufacturer.

C. Valves shall conform to ANSI standard dimensions.

D. ASME Compliance:

1. ASME B16.10 for ferrous valve dimensions.
2. ASME B31.9 for building services piping valves.

E. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.2 SUBMITTALS

A. Submit detailed Shop Drawings clearly indicating manufacturer, model, size, dimensions and pressure rating.

1.3 PACKAGING

A. Valves shall be furnished or provided with protective packaging to prevent damage during shipping or on the job site.

B. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

C. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

D. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.4 DEFINITIONS

A. CWP: Cold Working Pressure.

B. EPDM: Ethylene Propylene Copolymer Rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. PTFE: Polytetrafluoroethylene plastic.

E. SSP - Saturated Steam Pressure.

F. WP - Working Pressure.

G. SWP - Steam Working Pressure.

H. W.O.G. - Water, Oil, Gas Pressure.

I. BR – Bronze.

J. I.B.B.M. - Iron Body, Bronze-Mounted.

K. O.S.&Y. - Outside Screw and Yoke.

L. N.R.S. - Non-Rising Stem.

M. R.S. - Rising Stem.

N. M.S.S. - Manufacturer's Standardization Society of the Valve and Fitting Industry, Inc.

O. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials: Discs, gaskets, packings, seats, diaphragms and lubricants shall conform to recommendations of the valve manufacturer for the intended use.

B. Body materials, unless otherwise stated:

1. Bronze: 125-150 lbs., ASTM B62
2. High Grade Steam-Metal or Valve-Bronze Alloy: 200-300 lbs., ASTM B61
3. Cast Iron: ASTM A126, Class B
4. Ductile Iron: ASTM A395, A536
5. Cast Steel: ASTM A216

C. Lead Free silicon bronze (ASTM listed) valves shall be made with corrosion-resistant materials. Manufacturer shall provide third party certification tested in accordance with EN ISO 6509 regarding dezincification corrosion resistance and stress corrosion cracking.

D. Bronze Valves: NPS 2 (DN 50) and smaller with threaded or solder ends, unless otherwise indicated.

E. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

F. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWAA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.
5. Copper Press: With sockets according to ASME B16.22/ASTM B75.

I. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material that meets UL 2043 approved for inside air plenum, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
2. Butterfly Valves: Shall have 2" extended neck for insulation clearance.
3. Gate Valves: With rising stem.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products manufactured by one of the following, as listed for each valve type, or Engineer pre-approved equivalent.

Valve Type	Approved Manufacturer
Globe Valves	Crane, Stockham, Lunkenheimer, Hammond Industrial Series, NIBCO, Milwaukee
Ball Valves	Jamesbury, Apollo, Jenkins, Milwaukee, Watts, Worchester, Powell, or NIBCO

2.3 GLOBE VALVES

A. Provide globe valves complying with MSS SP-80 or MSS SP-85. Globe valves shall be installed where shown on the drawings for tight shutoff and shall be as follows:

1. 2 in. and smaller: 150-lb. saturated steam, rising stem, bronze body meeting ASTM B62 bronze trim, stainless steel disc and seat, union bonnet with stuffing box.
2. Over 2 in.: 125-lb. saturated steam, flanged iron body and yoke bonnet meeting ASTM A126 Class B, rising stem with stuffing box and yoke bushing.
3. Equip valves with packing suitable for intended service.
4. Provide globe valves such that the back seating protects packing and stem threads from fluid when valve is fully opened. Equip valves with gland follower.

2.4 BALL VALVES

A. Provide ball valves complying with MSS SP-72 or MSS SP-110. Ball valves shall be as follows unless otherwise indicated on the drawings.

1. 2 in. and smaller: ASTM B584 bronze body, 2-piece, full port stainless steel brass ball, screwed or soldered ends with teflon seats and seals, blow out proof stem, tee or lever handle rated to 150 SWP/600WOG.

2. Over 2 in.: ASTM A2116 carbon semi-steel or ASTM A536 ductile iron body, 2-piece, full port stainless steel brass ball, ANSI rated flanged ends with teflon seats and lever handle rated to 150 SWP/600WOG.

2.5 DRAIN VALVES (HOSE BIBBS)

A. Soldered or Threaded Ends: Bronze body, screwed bonnet, rising stem, composition disc, 3/4 in. threaded hose outlet connection; 125 psi maximum pressure rating.

2.6 ACTUATORS, HANDWHEELS, OPERATORS, HANDLES, AND WRENCHES

A. Provide suitable handwheels for gate, globe and drain valves.

B. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (ND 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Hand lever: For quarter-turn valves NPS 6 (DN 150) and smaller.

PART 3 EXECUTION

3.1 VALVE LOCATIONS – GENERAL

A. Install isolation valves at each branch off of horizontal mains and vertical risers.

3.2 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent this movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.3 VALVE INSTALLATION

A. Follow the manufacturer's recommended installation instructions concerning soldering, silver brazing, welding, threading, and installation of flanged valves in order to prevent damage to the valve and assure its maximum efficiency. Additional specific installation requirements are as follows:

1. Thread pipe for threaded valves to standard length only, using new block dies.
2. Put pipe compound on the pipe end, not into the valve threads. Securely screw pipe and valve together.
3. Blow out or otherwise thoroughly clean pipe sections before they are installed.

4. Close valve before installation.
5. Secure and adjust valves for no leaks and for easy operation.
6. Install valves with stems horizontal or vertical above the pipe and square with building construction. Install valves in position to allow full stem movement.
7. Install valves so piping does not place a stress or strain on the valve body. Locate valves for easy access and provide separate support where necessary.
8. Install extended-stem valves where insulation is indicated. Stems shall be extended such that the handle moves freely without contact with the insulation.
9. Install drain valves at low points of piping, at each mechanical equipment item, and elsewhere, where indicated.
10. Locate valves, cock, and hose bibbs to allow easy accessibility for operation, maintenance and repair.
11. Lugged butterfly valves with rubber-lined seats shall be installed with the disc(s) partially open. Bolts shall be torqued to the manufacturer's recommendations.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

D. When soldering use paste fluxes that are approved by the manufacturer for use with Lead Free Alloys.

3.4 SPECIAL OPERATORS FOR 1/4 TURN PRODUCTS

A. Special slow closing operators shall be provided for quick closing valves to prevent the destructive fluid action of "water hammer" effects.

1. Incompressible fluids: As recommended by the manufacturer.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Drawings indicate valve types to be used. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or globe (where indicated on drawings) valves.
   a. Piping NPS 2 (DN 50) and smaller: Furnish bronze ball or gate valves.
   b. Piping NPS 2-1/2 (DN 65) and larger: Furnish cast-iron butterfly or gate valves with flanged ends.
2. Drain Duty: Hose-end drain valves.
3. CPVC ball, butterfly and check valves may be used in matching piping materials.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. If valves with specified CWP ratings are not available, the same types of valves with CWP ratings may be substituted.

E. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, Sweat solder, or Press-to-fit ends.

END OF SECTION

SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.

B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.

C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.

D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCE STANDARDS

A. American National Standards Institute, ANSI:

1. ANSI B31.1 Power Piping
2. ANSI B31.9 Building Services Piping

B. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP-69: Pipe Hangers and Supports - Selection and Application.

C. Anvil International, 2 Holland Way, Exeter, NH 03833, www.anvilintl.com, (603) 418-2800.

1. Pipe Hangers and Supports Catalog (Jan. 2015)

1.3 DEFINITIONS

A. Pipe Hanger: A device normally suspended from structure and is used to carry the piping weight in tension.

B. Pipe Support: A device by which piping is normally carried from beneath and is used to carry the piping weight in compression.

1.4 SUBMITTALS

A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or Engineer pre-approved equivalent. Figure numbers within are based on Anvil International, Inc.

PART 3 EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1 1/4"	3/8"	7'-0"
1 1/2" and 2"	3/8"	9'-0"
2"	3/8"	10'-0"
2 1/2", 3", and 3 1/2"	1/2"	10'-0"
4" and 5"	5/8"	12'-0"

B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1/2" and 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1 1/4"	3/8"	7'-0"
1 1/2"	3/8"	8'-0"
2"	3/8"	8'-0"
2 1/2"	1/2"	9'-0"
3", 3 1/2", and 4"	1/2"	10'-0"
5"	1/2"	13'-0"
6"	5/8"	14'-0"
8"	3/4"	16'-0"

C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.

D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.

E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.

F. For suspending hanger rods from brackets attached to walls, use welded steel brackets: Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig. 199 for loads up to 3000 lbs.

G. Where pipes are to be racked along walls, use “Unistrut” pipe racks or 12 gauge steel strut channel, 1-5/8" x 1-5/8" minimum.

1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.

H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.

B. Support vertical cast iron soil pipe at every floor line.

C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.

D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use adjustable pipe roll stand, Fig. 177.

B. For horizontal copper pipe and tube, use copper-plated, carbon steel adjustable swivel ring, Fig. CT-69.

C. When thermal expansion for horizontal pipe is in excess of ½” axially, use adjustable steel yoke pipe roll, Fig. 181, or adjustable pipe roll stand, Fig. 177.

D. For horizontal cast iron soil pipe, use carbon steel adjustable clevis hanger, Fig. 260.

E. For vertical steel, wrought iron and cast iron pipe, use extension pipe or riser clamps, Fig. 261.

F. For vertical copper pipe and tube, use copper-plated, copper plated copper tubing riser pipe clamp, Fig. CT-121.

3.4 INTERMEDIATE ATTACHMENTS

A. Hanger rods: Carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod, Fig. 146 may be used wherever possible.

B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron universal concrete inserts; Fig. 282 for loads up to 1140 lbs.

B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.

C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 lbs.

D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to ½", 320 lbs. max. load. For hanger rods larger than ½" use attachment plate, Fig. 52, with wedge anchors.

E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

A. Provide supplemental steel as required to hang or support plumbing equipment or piping.

END OF SECTION

SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide materials, equipment labor and supervision necessary to install piping identification products.

B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

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

1.3 SUBMITTALS

A. Submit manufacturer's product data.

B. Submit sample of each type of identification product and clearly identify the contents in a schedule.

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

D. Schedule:

1. Submit valve schedule for each system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve ID tag number, system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves that are intended for emergency shut-off and similar special uses, by special "flags" in margin of schedule.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar.

B. Engineer Pre-Approved Equivalent.

2.2 PIPE MARKERS

A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.

B. Provide full-band pipe markers, extending 360° around pipe at each location or self-sticking pipe markers, fastened in the following method:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.

2. Secure to piping and install banding tape on both ends of each pipe label.

C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance.

D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

2.3 EQUIPMENT MARKERS

A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:

B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

2.4 BRASS VALVE TAGS

A. Provide manufacturer's standard brass valve tags with stamped black filled lettering, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 3/16" hole for fastener.

B. Provide 1-1/2" round brass tags with black lettering. Seton 250 BL or equal.

2.5 VALVE TAG FASTENERS

A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

2.6 VALVE SCHEDULE FRAMES

A. For each page of schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSD-grade sheet glass.

2.7 PIPING AND EQUIPMENT IDENTIFICATION

A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to the following:

1. Reverse Osmosis.
2. Domestic cold water, hot water, and hot water recirculation.
3. Non-potable water system.
4. Sanitary and sanitary vent.

B. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule. Equipment shall include but is not limited to the following:

1. Water heaters.
2. Reverse osmosis.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Install pipe markers on each system, and include arrows to show normal direction of flow.

C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. At each pipe passage to underground.
7. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
8. On piping above removable acoustical ceilings, maximum spacing of 10 feet along each piping run.
9. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
10. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.

D. Provide valve tags for all major valves 1/2" size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.

E. List each tagged valve in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve lists as part of closeout documents.

3.2 ADJUSTING AND CLEANING

A. Relocate any mechanical identification device which has become visually blocked by work of this division or by other divisions.

B. Clean face of identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 22 0700
PLUMBING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.

B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84, or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.

B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.

C. Insulation materials shall be non-corrosive to the materials they are applied to, including stress corrosion cracking of stainless steel and shall not breed or promote mold, fungus or bacteria.

D. Insulation shall meet or exceed all requirements of IECC - International Energy Conservation Code .

1.3 QUALIFICATION

A. Insulating materials by Owens-Corning, Armacell, Pittsburgh-Corning, Knauf, Johns Manville, or Engineer pre-approved equivalent.

B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and jacket. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

PART 2 PRODUCTS

2.1 INSULATION

A. Description:

1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures form - 20° F to +850° F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU-in/hr-ft2-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Johns Manville "Micro-Lok HP or Engineer approved equivalent.
2. Type B: Flexible, elastomeric pipe and sheet insulation with closed-cell structure. Shall comply with ASTM C534, Type I, Grade 1 for tubular materials and ASTM C534 Type II, Grade 1 for sheet materials. Suitable for operating temperatures from –40° F to 220° F. Outdoor applications, and where otherwise noted, shall receive a weather-resistant, protective, latex enamel finish. Thermal conductivity of 0.28 BTU-in/hr-ft2-°F @ 75° F mean temperature. Water vapor permeance of 0.08 perms. Insulation shall be equivalent to Armacell AP Armaflex; adhesive equivalent to Armacell Armaflex 520 or Armaflex 520 BLV Low-VOC Contact Adhesive; finish equivalent to Armacell Armaflex WB finish or Engineer approved equivalent.
3. Type C: Flexible, elastomeric thermal insulation with an expanded, closed-cell structure. Pre-slit tubular form with a pressure-sensitive adhesive strip for closure and vapor sealing of the longitudinal joint. Butt joints, sealed with 3M-471 tape. White color. Suitable for operating temperature of 40° F to 200° F. Thermal conductivity of 0.28 BTU-in/hr-ft2- F mean temperature. Water vapor permeance of 0.20 perms. Insulation shall be Armacell Self-Seal Armaflex 2000 or Engineer approved equivalent.

2.2 PIPE INSULATION SCHEDULE (IECC - INTERNATIONAL ENERGY CONSERVATION CODE)

SERVICE	TYPE	THICKNESS	PIPE SIZES
DOMESTIC COLD WATER	A,B,C	1/2"	LESS THAN 1-1/2"
		1"	1-1/2" AND LARGER
DOMESTIC HOT WATER, HOT WATER RECIRCULATION	A,B,C	1"	LESS THAN 1-1/2"
		1-1/2"	1-1/2" AND LARGER

2.3 INSULATION JACKETS

A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR. Manville "Zeston 2000" or equivalent.

B. 6-oz/sq yd UL listed cotton canvas fabric secured with Childers CP50 lagging adhesive.

C. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic. Premolded jackets shall be Manville "Zeston 2000" or Engineer pre-approved equivalent.

D. At wall penetrations, provide an additional jacket of 0.020 inch thick smooth finish aluminum secured with 0.015 inch thick, 3/8-inch wide aluminum bands. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket.

E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.

F. PVC jackets shall be used in the following areas and systems:

1. Whenever piping is routed exposed through occupied spaces.
2. Exposed piping in kitchens and dishwasher rooms.
3. Premolded PVC at all fittings and valve jackets.

PART 3 EXECUTION

3.1 GENERAL

A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.

B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.

C. Insulation shall be kept clean and dry at all times.

D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.

E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.

1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Armacell Armaflex 520, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal.
2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. Seal longitudinal seam and butt joints with Armacell Armaflex 520 adhesive, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal. In all cases, the insulation, equal to Armacell AP, protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

3.2 PIPE INSULATION INSTALLATION

A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.

B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.

C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangars not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

D. Neatly finish insulation at supports, protrusions and interruptions.

1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem, but provides a seal against moisture incursion.

E. Wherever piping penetrates a floor or is exposed in a finished area such as kitchens, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

END OF SECTION

SECTION 22 1116
DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 CODES AND STANDARDS

A. Pipe materials specified in this Section shall apply to technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.

B. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.

C. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.3 PRODUCT HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.

B. Submit manufacturer's specifications and/or catalog data including material and pressure test certifications for pipe, fittings, valves, and other related items including but not limited to pipe hangers and supports.

PART 2 PRODUCTS

2.1 MATERIAL

A. Piping:

1. Copper water tube, hard temper ASTM B88:

   a. Type L: Aboveground domestic water piping

2. CPVC, Schedule 80, ASTM F441 / F441M: Reverse osmosis piping systems.

3. Polypropylene: Reverse osmosis piping systems.

B. Fittings:

1. Threaded pipe - ASME B16.3 malleable iron fittings, 125-pound, standard flat band water pattern.
2. Copper water tube, cast bronze or wrought copper, solder joint type. ANSI B16.18 and B16.22.
3. Copper water tube, cast bronze or wrought copper, press fitting joint type. ANSI B16.18 and B16.22. EPDM sealing elements.
4. CPVC pipe - Schedule 80 fittings, socket-type, ASTM F439 or threaded-type, ASTM F437.
5. Polypropylene fittings: ASTM D-2467 for socket fittings and ASTM D-2464 for threaded fittings.

2.2 JOINTS

A. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.

B. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.

C. Copper water and drainage tube press joints - Compression sealing via integral internal EPDM gaskets via use of specialized tools. Assured leakage path feature to assist installer in determining un-pressed joint assembly condition.

D. Solid wall schedule 80 CPVC DWV - solvent cemented joints per ASTM D2466.

E. When soldering use paste fluxes that are approved by the manufacturer for use with Lead Free Alloys.

F. Polyproylene: Electrical resistance fusion.

2.3 NIPPLES AND UNIONS

A. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.

B. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.

C. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.4 SLEEVES

A. Floor sleeves shall be provided by the contractor. Coordinate with existing structure and notify engineer if structure interferes with design.

B. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.

C. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.

D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.

E. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.

F. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.5 PIPE ESCUTCHEONS

A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

D. Manufacturer: Chicago Specialty; Producers Specialty; Sanitary-Dash, or Engineer pre-approved equivalent.

2.6 GUARDS

A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

2.7 FIRE SAFING

A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.

B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.

C. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.

D. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 degree F (121 to 177 degree C), UL listed.

E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.

F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.

G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:

1. 3M Brand.
2. Flame Stop.
3. Dow Corning.
4. Metacaulk.
5. or Engineer pre-approved equivalent.

H. Horizontal penetrations through fire rated walls where plenum rated cables or tubing bundles are being installed shall be made with EZ-Path Fire-rated Pathway by Specified Technologies, Inc. or Engineer pre-approved equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install pipe for plumbing and mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein.

B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.

C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.

D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.

E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.

F. Verify final equipment locations before roughing in.

G. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.

H. Press fit piping connections shall be made in accordance with manufacturer's installation instructions, using the manufacturer's approved tools and methods. Installation must meet or exceed IAPMO PS 117 functional performance criteria.

I. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

J. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

3.2 SLEEVES

A. Install sleeves for piping passing through floors, roof, walls and foundations.

B. Install fireproofing per manufacturer's written instructions.

3.3 ESCUTCHEONS

A. Install escutcheons for pipes entering finished spaces.

3.4 PIPE PENETRATIONS

A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.5 FIRE SAFING

A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

3.6 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test metal domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

C. Test plastic water piping as follows:

1. Plastic piping shall not be tested with air. Do not overpressurize the system beyond maximum rating.
2. Pneumatically pressure test with air each section or segment prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
3. The system and all joints shall be tested using an air compressor and pressure gauge or manometer testing apparatus.
4. Fill tested system with air to a uniform, stabilized gauge pressure of 5 PSI. The system shall be held at the test pressure without the addition of air for a period of not less than 15 minutes.
5. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as needed, without additional cost to the Owner, until system is certified tight and leak free.

D. Inspect press joint systems for proper installation and leak free integrity per the manufacturer's installation requirements.

3.7 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

END OF SECTION

SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide materials, equipment, labor, and supervision necessary to install water supply system as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

A. ASSE 1011 - Hose Connection Vacuum Breakers.

B. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.

C. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principal Backflow Preventers.

D. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type.

E. ASSE 1048 - Performance Requirements for Double Check Detector Fire Protection Backflow Assemblies.

F. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers.

G. ANSI / AWWA, C700

H. The Plumbing and Drainage Institute - PDI Standard WH 201 for Water Hammer Arrestors

I. Uniform Plumbing Code.

J. NFPA Codes and Standards

K. University of Southern California Foundation for Cross-Connection Control and Hydraulic Research - USCFCCC.

L. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.

M. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.3 SUBMITTALS

A. Product data: Submit manufacturer's specifications and/or catalog data including material and pressure test certifications for all equipment herein.

B. Installation, Operations and Maintenance data.

1. Include signed copies of certified testing results reports.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in water supply systems. Where more than one type of material or product are indicated, selection is Installer's option.

2.2 BACKFLOW PREVENTERS

A. Backflow prevention devices shall be designed and tested for compliance with USCFCCC manual for cross connection control, and ASSE and AWWA standards as applicable to backflow prevention and cross connection control.

B. Reduced Pressure Principle Backflow Preventer

1. Reduced pressure-type backflow preventer shall consist of two independently operating, spring loaded check valves separated by an independent diaphragm type differential pressure relief valve located between check valves, provide third check valve that opens under backpressure in case of a diaphragm failure. Provide non-threaded drain connection with air gap and pipe to nearest floor drain.
2. Provide gate valves for shut-off duty on both sides of backflow preventer, an in-line strainer on upstream side of backflow preventer and four (4) test cocks.
3. Manufacturer: Subject to compliance with requirements, provide reduced pressure principal backflow preventer manufactured by one of the following:
    a. Watts
    b. Febco
    c. Zurn, Wilkins Division
    d. Engineer pre-approved equivalent

PART 3 EXECUTION

3.1 INSTALLATION

A. Extend cold water and hot water piping to each fixture and other equipment requiring water supplies.

B. Generally follow indicated lines, exact layout to be made on job for alignment with surrounding work and space for covering.

C. Pitch pipes to accessible drainage point where unions, plugged tees or drainage valves shall be provided.

D. Provide valves as shown and specified herein. Branch serving four or more fixtures shall be provided with an accessible shut-off valve.

E. Pipes built into masonry or concrete construction shall be wrapped with tar paper or burlap to prevent bonding to the concrete.

F. No pipe shall be located in an outside wall or other location where freezing is likely to occur, and no pipe shall be in contact with or attached to a structural member in a manner that causes the transmission of noise to the structure. Block ends of runs to prevent movement due to water hammer.

G. Install approved backflow prevention devices on plumbing lines where contamination of domestic water may occur, including, but not limited to, the following locations. Install devices in accordance with manufacturer's instructions, complete with accessories as required.

1. Boiler feed water piping

H. Extend relief piping from backflow prevention devices to nearest floor drain.

3.2 TESTING AND CLEANING

A. Test, flush and clean domestic water piping specialties per Section 22 1116 “Domestic Water Piping” requirements and in compliance with the Uniform Plumbing Code. Certification of testing results shall be provided to Owner in writing.

B. Backflow Prevention:

1. After system test, flushing, and chlorinating, backflow preventer shall be disassembled by a certified backflow specialist and all debris shall be cleared from the valve, reassembled, and tested to verify proper operation.

2. Inspect and flow test all backflow preventers in accordance with NFPA 13 and or NFPA 25 requirements and ASSE testing procedures and protocols.

3. Certification of testing results shall be provided to Owner in writing.

END OF SECTION

SECTION 22 1316
SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete soil, waste and vent system.

1.2 CODES AND STANDARDS

A. Pipe materials specified in this Section shall apply to other technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.

B. Local and/or State Plumbing, Mechanical and Building Codes

C. Uniform Plumbing Code

D. International Mechanical Code

E. NFPA Codes and Standards

1.3 PRODUCT HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

C. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

1.4 SUBMITTALS

A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.

B. Submit product and performance data for equipment specified herein.

PART 2 PRODUCTS

2.1 SANITARY SEWERS, SOIL, WASTE AND VENT MATERIALS

A. Piping:

MATERIAL	**SERVICE**
Solid wall Schedule 40 PVC pipe, ASTM D2665, (DWV) drain, waste and vent.	Belowground soil, waste and vent piping.
Soild wall Schedule 40 PVC pipe, ASTM D2665, (DWV) drain, waste and vent.	Aboveground soil, waste and vent piping.

B. Fittings:

1. Solid wall Schedule 40 PVC DWV - solvent cemented joints per ASTM D2665.

C. Joints:

1. Solid wall Schedule 40 PVC DWV - solvent cemented joints per ASTM D2665.

2.2 SLEEVES

A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.

B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.

C. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.

2.3 PIPE ESCUTCHEONS

A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

D. Manufacturer: Chicago Specialty; Producers Specialty; Sanitary-Dash, or Engineer pre-approved equivalent.

2.4 FIRE SAFING

A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.

B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.

C. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.

D. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350oF (121 to 177oC), UL listed.

E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.

F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.

G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:

1. 3M Brand.
2. Flame Stop.
3. Dow Corning.
4. Metacaulk.
5. Engineer pre-approved equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install underground building drains as shown and in accordance with the Uniform Plumbing Code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

B. Follow indicated lines generally, but make exact layout on the job to work actual fitting dimensions, align piping, and avoid interference. Provide proper support to maintain uniform fall of 1/4 in. per ft. for lines 3 in. and smaller and 1/8 in. per ft. for lines larger than 3 inches. Protect openings against the entrance of dirt.

C. No soil or waste pipe shall be covered by earth or concealed by construction without first being proven free of leaks by means of a hydrostatic water test of no less than 10-feet of head or pneumatic air test of no less than 5 PSI. Pressure shall be held constant for a period of not less than 15 minutes before beginning inspection or 15 minutes without the addition of air. Plastic pipe shall not be tested by air.

D. Install vents in practical alignment and supported with constant pitch back to the drainage system, concealed from finished spaces, unless shown or directed otherwise.

E. Soil, waste and vent connections to fixtures shall be accurately located and concealed from finished spaces, unless shown otherwise.

F. Refer to Section 22 0500 for excavating, trenching and backfilling requirements.

3.2 SLEEVES

A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.

B. Install fireproofing per manufacturer's written instructions.

3.3 ESCUTCHEONS

A. Install escutcheons for pipes entering finished spaces.

3.4 PIPE PENETRATIONS

A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply fire stop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.5 FIRE SAFING

A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

3.6 TESTING AND CLEANING

A. Provide labor, materials, facilities, and administration required to conduct the tests required under this section. Tests which fail to meet the specified performance shall be retested at no expense to the Owner. Repair all defective installations.

B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

C. Testing shall be done in compliance with the Uniform Plumbing Code and to the satisfaction of the Owner or Owner's representative.

D. Perform final testing after all fixtures have been set and all traps have been filled with water.

E. Hydraulic Water Testing:

1. Hydraulically pressure test each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.

2. The system and all joints shall be tested with no less than 10 feet head of water pressure. Top of test standpipe to be filled with water shall be a minimum of 10 feet above the highest point of section being tested.

3. The water shall be kept in the tested system or sub-section for not less than 15 minutes before inspection for leakage begins.

4. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as needed, without additional cost to the Owner, until system is certified tight and leak free.

END OF SECTION

SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor and supervision necessary to install soil, waste and vent system.

1.2 CODES AND STANDARDS

A. Local and/or State Plumbing, Mechanical and Building Codes

B. Uniform Plumbing Code

C. International Mechanical Code

D. NFPA Codes and Standards

1.3 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Floor drains.
2. Floor sinks
3. Miscellaneous sanitary drainage piping specialties.

1.4 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, operating characteristics, and accessories.

B. Installation, Operations and Maintenance data. Include signed copies of certified testing results reports.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

A. General:

1. Body: Floor and shower drains shall be epoxy-coated cast iron with bottom outlet, convertible membrane clamp, adjustable collar with seepage slots.
2. Strainer: Polished heavy-duty vandal-proof secured polished nickel bronze strainer and removable sediment bucket.
3. End Connections: hub and spigot, hubless, or threaded.

B. Sizes: Refer to Project Drawings and Schedules.

C. Traps and Seals:

1. Drains without integral traps shall have service weight cast iron P traps.
2. Furnish inline type trap seals on all floor drains. Sure Seal or Engineer pre-approved equivalent.

D. Manufacturers: Subject to compliance with requirements, provide clean outs by one of the following:

1. Zurn Plumbing Products Group
2. J.R. Smith
3. Wade
4. Watts Drainage Products Inc.
5. Engineer pre-approved equivalent.

2.2 FLOOR SINKS

A. General: See drawings for fixture schedule

B. Sizes: Refer to Project Drawings and Schedules.

C. Traps and Seals:

1. Drains without integral traps shall have deep seal P traps.
2. Furnish inline type trap seals on all floor drains. Sure Seal or Engineer pre-approved equivalent.

D. Manufacturers: Subject to compliance with requirements, provide clean outs by one of the following:

1. Zurn Plumbing Products Group
2. J.R. Smith
3. Wade
4. Watts Drainage Products Inc.
5. Engineer pre-approved equivalent.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps

1. Description: Epoxy coated cast iron, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
   b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install floor sinks at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor sinks for easy access and maintenance.
2. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
3. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
4. Install deep-seal traps on floor drains, and other waste outlets unless otherwise indicated.
5. Install inline type trap seals on all floor drains. Sure Seal or Engineer approved equivalent.

C. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 3300
ELECTRIC DOMESTIC WATER HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide materials, equipment, tools, labor and supervision necessary to install Electric Domestic Water Heaters as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

A. ASHRAE/ANSI/IES 90.1 - Energy Efficiency for Buildings Except Low-Rise Residential Buildings

B. IEEC - International Energy Conservation Code

C. ASME Boiler and Pressure Vessel Code

D. NFPA/NEC 70 - National Electrical Code

E. UPC - Uniform Plumbing Code

F. IMC - International Mechanical Code

G. Local and/or State Plumbing, Mechanical and Building Codes

H. NFPA Codes and Standards

I. IAPMO, NSF and U.L. 174 or 1453 Listed

J. Federal Energy Conservation Standards (2015)

K. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

1.3 SUBMITTALS

A. Product Data: Submit product, dimensional, efficiency and performance data.

B. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to water heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

C. Installation, Operations and Maintenance data. Include wiring diagrams.

PART 2 PRODUCTS

2.1 ELECTRIC DOMESTIC STORAGE TANK WATER HEATERS

A. Tank: Steel, glass-lined, vermin-proof CFC foam insulation, stainless steel core anode corrosion protection. Outer jacket shall be baked enamel finish. 150 PSI rated working pressure.

B. Heating Elements: Dual, medium wattage density, zinc plated copper sheath heating elements.

C. Furnish with brass drain valve, thermometer and pressure gauges, and ASME rated T&P relief valve in accordance with State and local codes, regulations and ordinances.

D. Electrical and Controls:

1. Provide NEMA 4 electrical junction box with terminal block for wiring connections.

E. Drain Pan: Furnish corrosion resistant material, watertight drain pan with 3/4 inch min. sized drain piping beneath water heaters.

F. Warranty: 6-year tank and parts warranty.

G. Water heater performance shall be as schedule on Drawings. Refer Schedules for energy efficiency factors, first hour ratings, recovery ratings, and storage capacity information.

H. Acceptable Manufacturers: Subject to compliance with requirements, provide equipment by one of the following:

1. A.O Smith
2. State
3. Lochinvar
4. Rudd
5. Patterson Kelly
6. Engineer pre-approved equivalent

PART 3 EXECUTION

3.1 INSTALLATION

A. Make hot and cold water piping connections including thermal checks.

B. Route T & P relief valve piping to within 6 inches of floor.

END OF SECTION

SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Mechanical Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete mechanical installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.

B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.

C. Provide labor necessary to demolish the existing mechanical system as shown on the drawings, as described in Part 3, Existing Conditions, or as required.

D. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment. Coordinate shipping splits for all equipment provided by this contractor.

1.2 DAMAGE

A. The Contractor shall be responsible for damage to the work of other trades or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

A. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work (in addition to specific applications specified by individual work sections of these specifications):

1. ASHRAE/IES 90.1 - 2010 Code for Energy Efficiency
2. ANSI Pressure Piping Standards (B31)
3. ASHRAE Safety Code for Mechanical Refrigeration (ANSI B9.1)

4. AWWA Standards
5. ASME Boiler and Pressure Vessel Code and State Boiler Code
6. American Gas Association
7. AWS Standards for Welding
8. National Electrical Code
9. Local and/or State Plumbing, Mechanical and Building Codes
10. Occupational Safety and Health Act (OSHA)
11. International Energy Conservation Code 2012
12. Uniform Plumbing Code
13. International Mechanical Code
14. NFPA Standards and Pamphlets

B. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above authorities, the Contractor shall notify the Architect/Engineer in writing 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.

C. Installations must be safe in every respect, and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

A. A complete set of drawings including civil, architectural, structural, mechanical, and electrical drawings shall be on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.

B. The contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.

C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.

D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.

E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.

F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.

1.6 RESPONSIBILITY

A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire mechanical installation functions properly in every detail.

1.7 COORDINATION

A. Coordinate the work with other trades prior to installation.

B. No piping, ducts or equipment foreign to the electrical equipment or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110-16 and 384-4. This does not prohibit sprinkler protection for the installation.

C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.

D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.

E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.

F. No piping, ducts or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway and machine room in accordance with NEC 620-37 and ASME A17.1, 102.2.

1.8 GUARANTEE AND MAINTENANCE

A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed.

B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.

C. Equipment, which fails to meet performance ratings as specified and shown on the drawings, shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.

D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

PART 2 PRODUCTS

2.1 SUBMITTAL PROCESS

A. Submit shop drawings and catalog data for mechanical equipment specified in Division 23 in accordance with Division 01.

B. Submittal data for mechanical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, control sequence, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.

C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Architect/Engineer, verbal approval will not be considered binding.

D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Architect/Engineer. The Architect/Engineer will review shop drawings to aid in interpreting the plans and specifications, and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Architect/Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Architect/Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as EF-1, RTU-1) shall be indicated for each item.

E. At the completion of the job, furnish three (3) copies of parts lists, operating and maintenance instructions, and manuals organized and bound, in three books.

F. At the completion of the project, prepare and submit to the Owner record drawings showing the location of piping and ductwork. Drawing shall give accurate dimensions of such equipment for future use by the Owner. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

2.2 SUBCONTRACTORS AND MATERIALS

A. Submit to the Architect/Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Architect/Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Architect/Engineer, whether or not said items are herein specified.

2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., Air Movement and Control Association (AMCA), American Gas Association (AGA), Air Conditioning and Refrigeration Institute (ARI), etc., if a standard has been established by that agency for the type of material.

B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.

C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Architect/Engineer.

D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, fans shall be from the same manufacturer and pumps from the same manufacturer.

E. Materials shall be protected from damage, and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Architect/Engineer.

F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.

G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

2.4 MATERIAL SUBSTITUTIONS

A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Architect/Engineer. Such permission for substitution must be requested, in writing in accordance with Division 01.

B. The Architect/Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Architect/Engineer.

C. Changes required by alternate equipment shall be made at no additional cost to the Owner; and costs incurred by other trades, public utilities or the Owner, as a result of the use of such equipment, shall be the responsibility of the Contractor.

D. Furnish to the Architect/Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Architect/Engineer as long as needed.

E. Identify the differences in alternate material or equipment as compared to that specified, and indicate the benefits to the project as a result of selecting the alternative.

F. The Architect/Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Architect/Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Examine the existing building and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.

B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Architect/Engineer. Do not remove from the premises, any equipment that may have maintenance value to the Owner without permission of the Owner. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.

C. Where existing equipment is removed or changed, all duct and pipe no longer in service shall be removed and stubs plugged as directed by the Architect/Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the Construction Manager to minimize the damage to the building in order to reduce the amount of patching required.

D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.

E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or municipality having jurisdiction.

F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Owner and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Architect/Engineer before submitting his bid.

3.2 INTERRUPTION OF SERVICE

A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, notify the proper building authorities no less than 24 hours in advance and obtain approval from these authorities before making changes. Such notices shall give duration and nature of shutdown. Temporary arrangements shall be approved by the Architect/Engineer and/or Owner.

B. Any and all interruptions to building services shall be in accordance with Division 01.

3.3 OPENINGS, CUTTING, AND PATCHING

A. Coordinate the placing of openings in the new structure, as required for the installation of the mechanical work.

B. Furnish accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.

C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, ducts, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.

D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

3.4 CONCRETE AND MASONRY WORK

A. Concrete work included herein or shown on the drawings shall be done only by experienced cement finishers. Brickwork, where included, shall be laid only by experienced brick masons. Brick shall be of uniform size, hard burned, and shall be laid in cement mortar, except for patch work at a location where cement and lime mortar has previously been used. Exposed, finish brickwork shall match existing brickwork as closely as practical and shall be to the satisfaction of the Architect/Engineer and Owner.

B. Concrete bases and pads for mechanical equipment shall be furnished by this Contractor. Size bases to extend minimum of 4" beyond equipment base in any direction, and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

C. Furnish equipment anchor bolts and be responsible for their proper installation and accurate location.

3.5 ROOF OPENINGS

A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and (if necessary) reinforced by an experienced roofing contractor.

B. Roof penetrations for duct and piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.

C. All roof work shall be completed such that it does not void any existing roof warranty.

3.6 PAINTING

A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Architect/Engineer and the Owner.

B. Painting and finishing of exposed mechanical systems including piping and duct shall be as shown on the drawings and in DIVISION 09 - FINISHES.

3.7 CLEANING

A. Keep the premises clean of all debris, caused by the work as described in DIVISION 01.

B. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

3.8 SUSPENSION FROM WOOD STRUCTURAL MEMBERS

A. In general, concentrated or other loads shall not be suspended directly from the bottom of wood structural members, unless approved by the Architect/Engineer. Loads suspended from open web joists or trusses may be transferred to the bottom chord of the structural member at the panel points. Loads suspended from solid web joists shall be transferred to the joists only through the top flange or web. Suspension systems shall be reviewed by the Architect/Engineer.

3.9 WIRING FOR MECHANICAL EQUIPMENT

A. The electrical contractor will provide power to and connection of motors and equipment furnished by this Contractor. Where disconnect switches are not specified to be furnished with the equipment, the electrical Contractor will furnish disconnect switches for equipment furnished by this Contractor.

B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.

C. Except where other Sections call for starters to be furnished by manufacturers as part of their equipment, the electrical contractor will furnish motor starters for motors furnished by this Contractor.

D. Furnish to the electrical contractor, shop drawings and a schedule for motors and other mechanical equipment furnished, which require electrical services. The schedule shall include the locations for rough-ins, electrical loads, size, and electrical characteristics for services required.

E. Additional costs incurred, where motors or equipment furnished by this Contractor require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, due to the Contractor furnishing substitute equipment, shall be paid for by this Contractor.

F. Review the Electrical Drawings and call to the attention of the Architect/Engineer, prior to bidding, omissions of electrical services required for equipment.

G. Mechanical equipment which requires fuse protection, to maintain UL listing, shall be coordinated with the electrical contractor to provide such protection.

3.10 PROTECTION

A. Special care shall be taken for the protection of equipment furnished by this Contractor. Equipment and material shall be protected from elements such as weather, painting and plastering until the project is completed. Damage from rust, paint or scratches shall be repaired as required to restore equipment to original condition.

B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the contractor performing that work, but this shall not relieve this Contractor of the responsibility of checking to assure that adequate protection is being provided.

C. Where the installation or connection of equipment requires this Contractor to work in areas previously finished by other contractors, this Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. This Contractor shall arrange with the other contractors for repairing and refinishing of such areas which may be damaged.

D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

3.11 ASBESTOS IDENTIFICATION AND CONTROL

A. In the event that suspected asbestos containing material (ACM) is encountered during the course of the work, cease operations in the immediate area and promptly notify the Architect/Engineer. Suspected materials will then be sampled and analyzed by the Owner. Should ACM be identified, the Owner's Representative will direct the procedures for abatement, either by subcontract to the Contractor or separate contractor. During abatement operations, cease operations in the immediate area of the abatement. Operations in other areas of the project may be performed, but care must be taken to control dust to avoid contamination of the abatement containment or air monitoring samples. The Contractor shall coordinate activities with the asbestos abatement contractor.

B. Should no ACM be identified, operations may be resumed. Delays caused by identification, analysis or abatement may be added to the time of the contract, at the discretion of the Architect/Engineer by Change Order.

3.12 NOISE AND VIBRATION

A. Be responsible for the installation of all equipment in such a manner as to control the transmission of noise and vibration from any installed equipment or system, so that the sound level does not exceed NC35 in any occupied space. Be responsible for the correction of any objectionable noise in any occupied area due to improperly installed equipment.

3.13 TESTS AND DEMONSTRATIONS

A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.

B. Prior to acceptance of the mechanical installation, demonstrate to the Owner or his designated representative's essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.

C. Furnish the necessary trained personnel to perform the demonstrations and instructions, and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

3.14 UTILITY REBATE APPLICATIONS

A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications, and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this mechanical contractor.

END OF SECTION

SECTION 23 0513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes general requirements for TEFC and ODP motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.
5. Motors for operation with variable speed drives shall include motor shaft grounding kits.

PART 2 PRODUCTS

2.1 MOTORS

A. Provide motors for all mechanical equipment furnished under Division 23, as indicated herein and as illustrated on the Contract Drawings.

B. The following equipment with 3-phase, 1 horsepower motors or larger shall be provided with NEMA Premium efficiency motors as specified herein:

1. Fans
2. Air Handling Units
3. Pumps
4. Fan Coil Units
5. Blower Coil Units

C. TEFC and ODP motors for equipment supplied by this contractor shall meet or exceed the listed values when tested in accordance with IEEE Standard 112 Method B as defined by NEMA Standard MG 1-12.6C. Efficiency values listed are based on NEMA Premium Efficiency Motors of NEMA MG 1-2003, Table 12-12 at 1800 RPM:

HP	ODP	TEFC
1	85.5	85.5
1.5	86.5	86.5
2	86.5	86.5
3	89.5	89.5
5	89.5	89.5

7.5	91.0	91.7
10	91.7	91.7
15	93.0	92.4
20	93.0	93.0
25	93.6	93.6
30	94.1	93.6
40	94.1	94.1
50	94.5	94.5
60	95.0	95.0
75	95.0	95.4
100	95.4	95.4
125	95.4	95.4
150	95.8	95.0
200	95.8	95.0

D. All motors that are indicated to be used with Variable Frequency Drives (VFDs) shall be inverter duty rated. Coordinate all motor requirements with the electrical contractor.

E. Certification: Provide manufacturer's literature indicating NEMA premium motor efficiency as tested in accordance with IEEE Standard 112, Test Method B. Provide documentation to verify motors served by variable frequency drives meet NEMA MG1.

PART 3 EXECUTION

3.1 VERIFICATION

A. Verify motor shaft grounding kit is properly installed and adjusted.

B. Verify motor and sheave alignment for all belt driven and direct coupled equipment.

END OF SECTION

SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING

MPART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor, and supervision necessary to install thermometers and gauges.

1.2 QUALIFICATIONS

A. Thermometers: Weiss, Weksler, Ashcroft, Reotemp, U.S. Gauge, Therice, or Engineer pre-approved equivalent.

B. Gauges: Weiss, Weksler, Ashcroft, McDaniel, U.S. Gauge, Therice, or Engineer pre-approved equivalent.

1.3 SUBMITTALS

A. Submit manufacturer's product and installation data.

PART 2 PRODUCTS

2.1 THERMOMETERS

A. 9 in. "Adjust-Angle" industrial thermometer, complete with double thick glass front, non-toxic blue ribbon liquid, separable socket and arranged so the unit can be set at any required angle front to back or left to right during or after installation. Range 32° F - 240° F for hot water, 50° F - 400° F for steam, and 0° F - 100° F for chilled water.

B. 3 in. diameter, all stainless steel hermetically sealed. Stem length to coordinate with air or water stream served. Range 20 deg F – 240 deg F for hot water, 0 deg F – 100 deg F for chilled water, and -40 deg F – 180 deg F for air streams.

2.2 GAUGES

A. 4 in. compound pressure vacuum gauge, liquid filled, aluminum, steel or stainless steel case, white dial, 1/4-in. male NPT. Range 30 in. vacuum to 100 pound pressure for water, 30 in. vacuum to 30 pound pressure for low pressure steam, 30 in. vacuum to 1-1/2 times system pressure for medium and high pressure steam. Provide siphon (pigtail) for steam gauges. Provide level handle union cock for steam and water gauges.

2.3 THERMOMETER WELLS

A. Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install thermometers in discharge and return piping at boilers, at each supply and return connection for large heating coils and at other points as shown on the Drawings.

B. Install gauge for each pump, mounted on 1/4 in. galvanized steel pipe manifold connected to the suction and discharge of the pump, with lever handle union cocks in the manifold on each side of the gauge, so that the gauge may be opened to either the suction or discharge pressure.

C. Install gauges on boilers and at other points as shown on the Drawings.

END OF SECTION

SECTION 23 0523
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor, and supervision necessary to install valves as indicated on drawings and in schedules, and herein specified.

B. Valves of the same type shall be of a single manufacturer. Valves shall conform to ANSI standard dimensions.

1.2 SUBMITTALS

A. Submit detailed Product Data clearly indicating manufacturer, model, size, dimensions and pressure rating.

1.3 PACKAGING

A. Valves shall be furnished or provided with protective packaging to prevent damage during shipping or on the job site.

1.4 DEFINITIONS

A. S.P. - Saturated Steam Pressure

B. W.P. - Working Pressure

C. W.O.G. - Water, Oil, Gas Pressure

D. BR - Bronze

E. I.B.B.M. - Iron Body, Bronze-Mounted

F. O.S.&Y. - Outside Screw and Yoke

G. N.R.S. - Non-Rising Stem

H. R.S. - Rising Stem

I. M.S.S. - Manufacturer's Standardization Society of the Valve and Fitting Industry, Inc.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products manufactured by one of the following, as listed for each valve type, or Engineer pre-approved equivalent.

Valve Type	**Approved Manufacturer**
Gate, Globe, and Check	Crane, Stockham, Lunkenheimer, Hammond Industrial Series, NIBCO, Milwaukee, Metraflex
Characterized Control Valves	Belimo, Apollo, Watts, Worchester
Ball Valves	Jamesbury, Apollo, Jenkins, Milwaukee, Watts, Worchester, Powell, or NIBCO
Butterfly Valves	Keystone, Demco, Milwaukee, Centerline, NIBCO, Metraflex

2.2 GENERAL

A. Materials: Discs, gaskets, packings, seats, diaphragms and lubricants shall conform to recommendations of the valve manufacturer for the intended use.

B. Body materials, unless otherwise stated:

1. Bronze: 125-150 lbs., ASTM B62
2. Iron: 200-300 lbs., ASTM B61
3. Cast Iron: ASTM A126, Class B
4. Cast Iron: ASTM 448
5. Ductile Iron: ASTM A395
6. Cast Steel: ASTM A216

2.3 GATE VALVES

A. Provide gate valves complying with MSS SP-80. Gate valves shall be as follows unless otherwise indicated on the drawings.

1. 2 in. and Smaller: 125-lb. saturated steam, screwed, solid wedge disc, and all parts ASTM B62 grade bronze except wheel and packing.
2. 2-1/2 in. through 16 in.: 125-lb. saturated steam, O.S.&Y., flanged ends, bronze seats and stem, double-seated solid wedge disc, iron body and bonnet.

B. Equip valves with packing suitable for intended service.

C. Provide gate valves designed such that back seating protects packing and stem threads from fluid when valve is fully opened. Equip valves with gland follower.

2.4 GLOBE VALVES

A. Provide bronze globe valves complying with MSS SP-80. Globe valves shall be installed where shown on the drawings for tight shutoff and shall be as follows:

1. 2 in. and smaller: 150-lb. saturated steam, rising stem, bronze body meeting ASTM B62 bronze trim, stainless steel disc and seat, union bonnet with stuffing box.
2. Over 2 in.: 125-lb. saturated steam, flanged steel body and yoke bonnet meeting ASTM A126 Class B, rising stem with stuffing box and yoke bushing.
3. Equip valves with packing suitable for intended service.
4. Provide globe valves such that the back seating protects packing and stem threads form fluid when valve is fully opened. Equip valves with gland follower.

2.5 CHECK VALVES

A. Check valves for water, steam, and air shall be as follows unless otherwise shown on the drawings:

1. 3 in. and smaller: 200-lb. saturated steam, swing type, threaded, bronze body meeting ASTM B62, pressure tight removable disc, hinge bumper to prevent sticking open, can be mounted horizontally or vertically.
2. Over 3 in.: 125-lb. saturated steam, swing check, flanged iron body meeting ASTM A126 Class B design to prevent disc sticking open, removable disc, bronze trimmed for steam or water, otherwise all iron construction.

3. Non-slam type for pump discharge duty – 2-1/2 in. and larger: I.B.B.M., flanged, class 300, wafer style.

2.6 BALL VALVES

A. 2 in. and smaller: ASTM B584 bronze body, 2-piece, full port stainless steel ball, screwed or soldered ends with teflon seats and seals, blow out proof stem, tee or lever handle rated to 150 SWP/600W06.

B. Over 2 in.: Carbon semi-steel or ductile iron body, 2-piece, full port stainless steel ball, ANSI rated flanged ends with teflon seats and lever handle.

2.7 BUTTERFLY VALVES

A. Lined

1. Disc - Aluminum bronze ASTM B148 Class 9B or ASTM B584 Alloy 876 for chilled, heating and condenser water, air, and fuels.
2. Seat
   a. Buna N hardback type ASTM D735-SB620AABE1E3G for hot water.
   b. Stem - Stainless steel dry journal type QQ-S-763.
   c. Bodies – Semi-steel; ASTM A126 Class B; cast iron, ASTM 448; ductile iron. ASTM A536; or cast steel, ASTM A216. On insulated piping, butterfly valves shall have extended neck suitable for 2 in. thick insulation.
   d. Actuators - Lever handle with infinite position lever with positive locking feature on valve sizes 2 in. through 5 in. Geared hand wheel on valve sizes 6 in. and larger.
   e. General Specifications.
      1) Butterfly valves may be of flanged, wafer, or lug type (lugs drilled and tapped). Grooved valve couplings may be used where grooved piping is applied.
      2) Elastomer seats shall be bonded to a rigid backup ring, be field replaceable, and of the types listed above.
      3) The disc shall be aluminum bronze of the floating type with no external disc to stem fasteners. Drive is accomplished by a square stem engaging in a broached disc.
      4) Stems shall be stainless steel of the one-piece type, completely sealed from line flow.
      5) Working Pressures: 28 in. vacuum to 250 lb. working pressures, 300 lb. test, with bubble-tight end of line shutoff.
      6) Dead end service at full pressure without the need of a downstream flange.

B. High Performance

1. Disc - 316 S.S. eccentric disc.
2. Seat - One-piece flexible TFE polymer seat.
3. Stem - 17-4 pH stainless steel with TFE shaft seal wrapped in stainless steel; Chevron type TFE packing.

4. Bodies - ANSI class 150 carbon steel; nickel aluminum bronze; 316 stainless steel; Monel Alloy 20.
5. Actuators - Lever handle with infinite position lever with positive locking feature on valve sizes 2 in. through 5 in. Geared handwheel on valve sizes 6 in. and larger. Geared handwheel on valve sizes 6 in. and larger.
6. General Specifications
    a. Butterfly valves may be of flanged, wafer, or lug type (lugs drilled and tapped). Grooved valve couplings may be used where grooved piping is applied.
    b. Elastomer seats shall be bonded to a rigid backup ring, be field replaceable, and of the types listed above.
    c. The spherical segmented wafer disc shall be aluminum bronze of the floating type with no external disc to stem fasteners. Drive is accomplished by a square stem engaging in a broached disc.
    d. Stems shall be of the two-piece type, completely sealed from line flow.
    e. Working Pressures: 28 in. vacuum to 150 lb. working pressures, 300 lb. test, with bubble-tight shutoff.

2.8 DRAIN VALVES (HOSE BIBBS)

A. Soldered or Threaded Ends: Bronze body, screwed bonnet, rising stem, composition disc, 3/4 in. threaded hose outlet connection; 125 psi, maximum pressure rating.

2.9 HANDWHEELS, OPERATORS, HANDLES, AND WRENCHES

A. Provide suitable handwheels for gate, globe and drain valves.

EXECUTION

3.1 VALVE LOCATIONS – GENERAL

A. Unless otherwise noted, shutoff valves shall be provided at all equipment connections (supply and return where applicable) for the following piping: pump suction and discharge, water, air, steam, condensate, fuel and gas and drain lines (except on gravity drains from pans). Equipment connections include such items as coils, condensers, tanks, pumps, heat exchangers, and similar items.

B. Check valves of the non-slam type shall be installed at the discharge of pumps unless otherwise shown on the drawings.

C. Install isolation valves at each branch off of horizontal mains and vertical risers.

3.2 INSTALLATION INSTRUCTIONS

A. Follow the manufacturer's recommended installation instructions concerning soldering, silver brazing, welding, threading, and installation of flanged valves in order to prevent damage to the valve and assure its maximum efficiency. Additional specific installation requirements are as follows:

1. Thread pipe for threaded valves to standard length only, using new block dies.

2. Put pipe compound on the pipe end, not into the valve threads. Securely screw pipe and valve together.
3. Blow out or otherwise thoroughly clean pipe sections before they are installed.
4. Close valve before installation.
5. Secure and adjust valves for no leaks and for easy operation.
6. Install valves with stems horizontal or vertical above the pipe and square with building construction.
7. Install valves so piping does not place a stress or strain on the valve body.
8. Install extended-stem valves where insulation is indicated. Stems shall be extended such that the handle moves freely without contact with the insulation.
9. Install drain valves at low points of piping, at each mechanical equipment item, and elsewhere, where indicated.
10. Locate valves, cock, and hose bibbs to allow easy accessibility for operation, maintenance and repair.
11. Lugged butterfly valves with rubber-lined seats shall be installed with the disc(s) partially open. Bolts shall be torqued to the manufacturer's recommendations.

3.3 PROVISION FOR WRENCHES

A. One operating wrench shall be provided for every 10 valves of each type not equipped with handwheels or levers. A minimum of two wrenches shall be provided for each type of valve.

3.4 VALVE SCHEDULE

A. Gate - All Sizes: Water, steam and oil for HVAC and process piping systems. For applications where ball valves are not suitable.

B. Characterized Control - All Sizes: Water, for HVAC systems; Suitable for on-off or throttling service.

C. Globe - All Sizes: Water, for HVAC systems; steam and air for HVAC and process piping systems. Suitable for throttling service.

D. Check - All Sizes: Water, air and steam for HVAC and process piping systems.

E. Ball - 2 in. and Under: Water for HVAC piping systems; for operation up to 200 psi at 500° F.

F. Ball - All Sizes: Water for HVAC piping systems; for operation up to 200 psi at 500° F.

G. Butterfly - 2 in. and Larger (Lined): Water for HVAC piping systems; for operation up to 200 psi at 500° F.

H. Butterfly - 2-1/2 in. and Larger (high performance): HVAC and process systems, as indicated on drawings.

I. Drain: HVAC systems.

J. Boiler and Pressure Vessel Isolation: Isolation valves for ASME section IV stamped pressure vessels shall be a gate type with an adjustable-type packing gland.

END OF SECTION

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SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.

B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.

C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.

D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCES

A. American National Standards Institute, ANSI:

B. ANSI B31.1: Power Piping

C. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.

1. MSS SP-58: Materials Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacturer.
2. MSS SP-69: Materials and Standardization Society: Pipe Hangers and Supports - Selection and Application.
3. NFPA 13-Standard for the Installation of Sprinkler Systems.
4. ASTM A123-Specification for Zinc Hot-Galvanized Coatings by the Hot Dip Process.
5. ASTM A653 G90-Specification for Steel Sheet, Zinc on Iron and Steel.

1.3 SUBMITTALS

A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or Engineer pre-approved equivalent. Figure numbers based on Anvil.

B. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

PART 3 EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/4"	3/8"	7'-0"
1-1/2" and 2"	3/8"	9'-0"
2"	3/8"	10'-0"
2-1/2", 3" and 3-1/2"	1/2"	10'-0"
4" and 5"	5/8"	12'-0"
6"	3/4"	12'-0"
8"	7/8"	14'-0"
10" and 12"	7/8"	16'-0"
14" and 16"	1"	16'-0"
18"	1-1/8"	18'-0"
20" and 24"	1-1/4"	20'-0"

B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1/2" and 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1-1/4"	3/8"	7'-0"
1-1/2"	3/8"	8'-0"
2"	3/8"	8'-0"
2-1/2"	1/2"	9'-0"
3", 3-1/2" and 4"	1/2"	10'-0"
5"	1/2"	13'-0"
6"	5/8"	14'-0"
8"	3/4"	16'-0"

C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.

D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.

E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.

F. For suspending hanger rods from brackets attached to walls, use welded steel brackets; Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig 199 for loads up to 3000 lbs.

G. Where pipes are to be racked along walls, use “Unistrut” pipe racks or 12 gauge steel strut channel, 1-5/8” x 1-5/8” minimum.

1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.

H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.

B. Support vertical cast iron soil pipe at every floor line.

C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.

D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use pipe roll stand, Fig. 177.

B. For horizontal copper pipe and tube, use copper-plated adjustable swivel ring, Fig. CT-69.

C. When thermal expansion for horizontal pipe is in excess of ½” axially, use adjustable swivel pipe roll, Fig. 181, or pipe roll stand, Fig. 177.

D. For horizontal cast iron soil pipe, use clevis hanger, Fig. 260.

E. For vertical, steel, wrought iron and cast iron pipe, use extension pipe clamps, Fig. 261.

F. For vertical copper pipe and tube, use copper-plated extension pipe clamp, Fig. CT-121.

3.4 INTERMEDIATE ATTACHMENTS

A. Hanger rods: use carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod: Fig. 146 may be used wherever possible.

B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts; Fig. 282 for loads up to 1140 lbs.

B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.

C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 lbs.

D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to ½", 320 lbs. max. load. For hanger rods larger than ½" use attachment plate, Fig. 52, with wedge anchors.

E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

A. Provide supplemental steel required to hang or support mechanical equipment or piping.

END OF SECTION

SECTION 23 0548
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING, HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This specification pertains to the furnishing and installation of vibration isolation devices for HVAC piping and rotating or reciprocating mechanical equipment.

B. This work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Architect/Engineer. Specific mounting arrangements for each item of mechanical equipment shall be as described herein and as indicated by schedules and details on the drawings.

1.2 QUALIFICATIONS

A. All rotating mechanical equipment shall be isolated from the structure by means of vibration isolators. The isolators and bases shall be as tabulated on the Vibration Isolation Schedule in this section. Any equipment not listed in this schedule shall be isolated with the isolator type and deflection shown in the 2007 ASHRAE HVAC Applications Handbook, Chapter 47, Table 48.

B. Vibration isolators and bases shall be as manufactured by Kinetics Noise Control, Mason Industries, Amber Booth or Engineer pre-approved equivalent, and shall all be provided by the mechanical contractor from a single manufacturer to assure single responsibility for the performance of all isolation equipment. The isolator manufacturer's submittal shall include a tabulation of the design data with dimensions for both free and operating heights of the isolators.

C. Engage manufacturer to provide technical supervision of installation of support isolation units produced, and of associated inertia bases.

D. The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:

1. Obtain from the Architect/Engineer the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical equipment to be resiliently mounted. Coordinate resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.

2. Select piping systems isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.

3. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that vibration isolators are installed in strict accordance with normally accepted practices for critical environments.

4. Replace, at no extra cost to the Owner, isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which do not produce the required isolation.

5. Cooperate with other contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.
6. Notify the Architect/Engineer of project conditions which affect vibration isolation system installation of performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibrations isolation system installation proceed without such notifications, remedial work required to achieve proper isolator performance shall be accomplished by the contractor at no additional cost to the Owner.
7. Be alert for possible short-circuiting of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Architect/Engineer so that preventive or remedial action can take place on a timely basis. Remedial measures required shall be undertaken by the contractor responsible at no additional cost to the Owner.

E. Vibration isolation products furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.

F. Refer to other sections of these specifications for equipment foundations, hangers, sealants, gaskets and other work related to vibration isolation work.

G. Where equipment manufacturer's recommendations differ from specified vibration isolation, submit to Architect for approval.

H. Furnish templates to fabricators of equipment bases, foundations and other support systems, as needed for coordination of vibration isolation units with other work.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, detailed drawings, performance characteristic data and installation instructions for each type of unit required. Indicate equipment to be installed with isolator, tabulation of design data with dimensions for both free and operating heights of isolators, and load on each.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: A.

PART 2 PRODUCTS

2.1 GENERAL

A. The vibration isolation systems described herein and identified by type number designations shall be applied to specific classifications of mechanical equipment as indicated in the Vibration Isolation Schedule.

2.2 TYPE 1 ISOLATORS (RUBBER & GLASS FIBER PADS AND HANGERS)

A. Pre-compressed Molded Fiberglass Vibration Isolation Pads, individually coated with a flexible moisture impervious elastomeric membrane. Pads shall be fine (.00018 dia.) bonded annealed glass fibers which have been stabilized during manufacture by overloading the material ten times. Pads shall have a constant natural frequency over the operating load range, and the stiffness shall increase proportionately with load applied. Pads shall be no taller than the shortest horizontal dimension. Where the equipment base does not provide a uniform load surface, steel plates shall be bonded to the top of the pads. Alternately, Neoprene Mounts incorporating completely enclosed metal inserts to permit bolting the supported unit may be used.

2.3 TYPE 2 ISOLATORS (PAD AND HANGER TYPE)

A. Molded isolators shall come in a range of 30 to 70 durometer and shall be designed for up to ½" deflection.

B. Hangers shall be designed for a 20° to 35° misalignment.

2.4 TYPE 3 ISOLATORS (SPRINGS)

A. Freestanding, Unhoused, Laterally Stable Steel Springs with leveling bolts and ¼-in. thick ribbed isolation pads. To assure stability, the spring shall have a lateral spring stiffness equal to the rated vertical stiffness, and shall be designed to provide 50% overload capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies.

B. Combination Spring and Rubber Hangers. The pre-compressed fiberglass shall be coated with a moisture impervious elastomeric membrane in series with springs, all encased in welded steel brackets. Springs shall be as specified for Type 3 isolators. Hangers shall be designed for 50% overload capacity, and shall accommodate rod misalignment over a 30° arc. Brackets shall be designed to carry 500% overload without failure.

2.5 TYPE 4 ISOLATORS

A. Freestanding, Laterally Stable Spring Isolators with vertical limit stops to assure a constant operating height if the supported weight is removed, and to reduce movement due to wind loads. Limit stops shall be isolated from the housing to prevent short-circuiting.

2.6 TYPE A BASES

A. No base required. Isolators may be attached directly to the supported equipment.

2.7 TYPE B BASES

A. Structural Steel Base, designed and supplied by reducing the mounting height of equipment. To assure adequate stiffness, the height of the members shall be a minimum of 8% of the longest span between isolators, or at least 6 inches. Where thinner sections are necessary due to head room limitations, the section modulus of the members selected shall be equivalent to or exceed the section modulus of wide flange steel members whose thickness is 8% of the longest span between isolators.

2.8 TYPE C BASES

A. Reinforces Concrete Inertia Base, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded steel frame with pre-located equipment anchor bolts, ½-in. diameter reinforcing bars on nominal 8-in. centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, but yet remain within the confines of the base. The thickness of the base shall be a minimum of 8% of the longest span between isolators, at least 6 in., or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be wide enough to support piping elbows.

2.9 TYPE D BASES

A. Roof Curb Isolators: Fabricated frame units sized to match roof curbs as shown, formed with isolation springs between extruded aluminum upper and lower sections, which are shaped and positioned to prevent metal-to-metal contact. Provide continuous airtight and waterproof seal between upper and lower extrusions. Include provisions for anchorage of frame unit to roof curb, and for anchorage of equipment to unit. Equivalent to Mason Type CMAB or RSC as required.

2.10 DUCTWORK ISOLATION

A. Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

1. Elgen Manufacturing Co.
2. Duro Dyne Corporation
3. Ventfabrics, Inc.
4. Metraflex MSRCDEE
5. Engineer pre-approved equivalent.

2.11 PIPING ISOLATION

A. Piping over 1 in. diameter in mechanical equipment rooms, and piping three supports away from other mechanical equipment shall be isolated from the structure by means of vibration and noise isolators.

B. Suspended piping shall be isolated with Type 2 Hangers.

C. Floor mounted piping shall be isolated with Type 2 Isolators (spring mounts).

D. Flexible members shall be incorporated in the piping adjacent to all equipment housing pipe connections (cooling tower, unit heaters, air handling units, chillers, etc.).

2.12 PUMP CONNECTORS

A. Provide flexible connectors at suction and discharge of circulating pumps.

B. Pipe connectors shall be 18 in. for pipe sizes 6 in. and larger, and 12 in. for smaller pipes.

C. Pipe connectors shall be of Butyl rubber material with reinforced carcasses and integral rubber and duck flanges. Connectors shall be suitable for 200-degree water at 150 psi working pressure.

D. Protection against elongation shall be provided by tie rod control units with rubber grommets.

E. Pipe connectors shall be Type 150 B with split galvanized retaining ring as manufactured by Mercer or approved equivalent.

2.13 ELECTRICAL CONNECTIONS TO RESILIENTLY MOUNTED EQUIPMENT

A. Electrical connections to equipment which is supported or suspended by vibration isolators shall be made with long lengths of flexible conduit or flexible armored cable. These flexible connections must be located so as to prevent rigid conduit connections between the resiliently mounted equipment and the building structure.

2.14 VIBRATION ISOLATION SCHEDULE

EQUIPMENT TYPE	**ON GRADE**		**UP TO 20 FT FLR SPAN**		**20 TO 30FT FLR SPAN**		**20 TO 30FT FLR SPAN**	
AIR COMPRESSORS & VACUUM PUMPS	TYPE B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL
TANK MOUNTED < OR =10 HP	A-3	0.75	A-3	0.75	A-3	1.75	A-3	1.75
TANK MOUNTED > OR =15 HP	C-3	0.75	C-3	0.75	C-3	1.75	C-3	1.75
BASE MOUNTED	C-3	0.75	C-3	0.75	C-3	1.75	C-3	1.75
PUMPS, CLOSE COUPLED	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL
IN-LINE	A-3	1.5	A-3	1.5	A-3	1.5	A-3	1.5
PUMPS, END SUCTION AND SPLIT CASE	TYPE B-I	MIN DFL	TYPE E-I	MIN DFL	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL
<50 HP	C-3	0.75	C-3	0.75	C-3	1.75	C-3	1.75
BOILERS	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL	TYPE B-I	MIN DFL
FIRETUBE	A-1	0.25	B-4	0.75	B-4	1.75	B-4	2.50
CONDENSING UNITS	TYPE B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL
CONDENSING UNITS	A-1	0.25	A-4	0.75	A-4	1.75	A/D-4	1.75

BASE TYPES:	ISOLATOR TYPES:
A. NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT	1. PAD, RUBBER, OR GLASS FIBER
B. +PAD, RUBBER, OR GLASS FIBER	2. RUBBER FLOOR ISOLATOR OR HANGER
C. CONCRETE INERTIA BASE	3. SPRING FLOOR ISOLATOR OR HANGER
D. CURB-MOUNTED BASE	4. RESTRAINED SPRING ISOLATOR
	5. THRUST RESTRAINT (SEE ASHRAE HANDBOOK)

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

B. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

D. Flexible Pipe Connectors: Refer to other section of these Specifications for the installation of flexible pipe connectors.

E. Install vibration isolators that are furnished with equipment.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide materials, equipment labor and supervision necessary to install piping identification products.

B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 QUALIFICATIONS

A. Brady Corp., Industrial Safety Supply, Emedco, Seton, Brimar or Engineer pre-approved equivalent.

1.3 SCHEDULES

A. Submit valve schedule for each system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves that are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.

1.4 SUBMITTALS

A. Submit manufacturer's product data.

B. Submit sample of each type of identification product and clearly identify the contents in a schedule.

PART 2 PRODUCTS

2.1 PIPE MARKERS

A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.

B. Provide full-band pipe markers, extending 360° around pipe at each location or self-sticking pipe markers, fastened in the following method:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Secure to piping and install banding tape on both ends of each pipe label.

C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance.

D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

2.2 EQUIPMENT MARKERS

A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:

1. All pumps shall include the full name description for system served.

B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

2.3 BRASS VALVE TAGS

A. Provide manufacturer's standard brass valve tags with stamped black filled lettering, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 3/16" hole for fastener.

B. Provide 1-1/2" round brass tags with black lettering. Seton 250 BL or equal.

2.4 VALVE TAG FASTENERS

A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.5 VALVE SCHEDULE FRAMES

A. For each page of schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSD-grade sheet glass.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Install pipe markers on each system, and include arrows to show normal direction of flow.

C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. At each pipe passage to underground.
7. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
8. On piping above removable acoustical ceilings, maximum spacing of 20' along each piping run.
9. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
10. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.

D. Provide valve tags for all major valves 3/4" size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.

E. Provide damper tags on all automatic control dampers, motorized dampers, and smoke dampers.

F. List each tagged valve in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve lists as part of closeout documents.

3.2 ADJUSTING AND CLEANING

A. Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Clean face of identification devices and glass frames of valve schedules.

3.3 PIPING DUCTWORK, AND EQUIPMENT IDENTIFICATION

A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to, the following:

1. Boiler Vent.
2. Boiler Intake.
3. Heating water (supply and return).
4. Low pressure steam. Indicate pressure on 50' intervals.
5. Steam condensate return.
6. Boiler feedwater.

7. Refrigerant (suction and liquid)
8. Chilled water (supply and return)

B. Equipment/Ductwork

1. Air separator.
2. Pumps.
3. Boilers.
4. Boiler Feedwater Units.
5. Unit Heaters.
6. Expansion Tank.
7. Humidifiers.
8. Electric Steam Generators.
9. Furnaces.
10. Air Cooled Condensing Units.
11. Fan Coil Units
12. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Commissioning – see Commissioning specifications. This contractor shall assist in the commissioning of the systems specified.

1.2 QUALIFICATIONS

A. Testing and balancing shall be performed by an independent certified testing and balancing contractor. The Contractor shall be certified by the AABC (American Association of Balancing Contractors) or NEBB (National Environmental Balancing Bureau). The Balancing Contractor shall provide labor, services, and test equipment required to test, adjust, and balance the specified systems. Personnel involved in the execution of the work under the Balancing Contract shall be experienced and trained in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor.

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

C. Field Reports: Submit under provisions of Division 01.

D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing work, submit report forms or outline indicating adjusting, balancing, and equipment data required.

F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

G. Provide report in PDF, Excel, or Word format, complete with cover page.

H. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

I. Test Reports: Indicate data on forms containing information indicated in Schedules.

1.4 SEQUENCING

A. Sequence work to commence after completion of systems installation and schedule completion of balancing work before Substantial Completion of Project.

B. Do not proceed with balancing work until systems scheduled for testing, adjusting, and balancing are clean and free from debris, dirt, and discarded building materials.

C. Complete all testing and balancing before start of commissioning functional performance tests.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 OTHER CONTRACTOR RESPONSIBILITIES

A. The Mechanical Contractors shall cooperate with the balancing agency by:

1. Putting complete system into operation during duration of balancing period.
2. Providing up-to-date set of Drawings and advising immediately of changes made to the system during construction.
3. Providing labor and equipment and cost of performing corrections such as dampers, belts, and pulley changes, etc. as required without undue delay.
4. Providing complete submittal information for mechanical equipment complete with pertinent engineering information.

3.2 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. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 of design for return and exhaust systems.

B. Diffusers, Registers and Grilles: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust diffusers, registers and grilles in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostat to specified settings.

3.6 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 the extent 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 allowance 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.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.02 inches positive static pressure on the behavioral health floor compared to the building exterior.

3.7 WATER SYSTEM PROCEDURES

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges 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. For pumps not on VFDs, pump impellers shall be trimmed to reduce flow. Balancing valve shall not be closed off where the throttling results in greater than 5 percent of the nameplate horsepower draw of the pump motor. Testing and balancing contractor shall measure the system flow and work with the mechanical contractor/pump manufacture on the revised pump impeller size. Mechanical contractor shall reinstall the new or trimmed impeller and the testing and balancing contractor shall test and balance the pump system again.

G. 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.

H. Three way valves shall be tested and balanced for flow capacities at full coil flow and full bypass flow, as indicated on the drawings or at a maximum coil flow, whichever is less.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

1. HVAC Pumps
2. Forced Air Furnaces
3. Boilers
4. Air Coils
5. Fan Coil Units
6. Unit Heaters
7. Fin Tube Radiation
8. Diffusers, Registers and Grilles

3.9 OUTDOOR AIR VENTILATION DATA

A. Air Handling Units shall be tested and balanced for the following conditions:

1. Capacity as scheduled on the drawings.

B. Coordinate testing with the temperature controls contractor and identify the % actuator stroke correlating with the above capacities.

C. Submit this in report form to the engineer prior to submitting final report.

3.10 REPORT FORMS

A. Title Page:

1. Name of Testing, Adjusting, and Balancing Agency
2. Address of Testing, Adjusting, and Balancing Agency
3. Telephone number of Testing, Adjusting, and Balancing Agency
4. Project name
5. Project location
6. Project Architect
7. Project Engineer
8. Project Contractor
9. Project altitude
10. Report date

B. Summary Comments:

1. Design versus final performance.
2. Notable characteristics of system.
3. Description of systems operation sequence.
4. Summary of outdoor and exhaust flows to indicate amount of building pressurization.
5. Nomenclature used throughout report.
6. Test conditions.

C. Instrument List:

1. Instrument
2. Manufacturer
3. Model number
4. Serial number
5. Range
6. Calibration date

D. 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

E. V-Belt Drive:
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

F. Pump Data:
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

G. Boilers:
1. Identification/Number
2. Boiler manufacturer
3. Model number
4. Serial number
5. Heat input
6. Burner manifold gas pressure
7. Flue gas temperature at outlet
8. Total hot water flow rate (GPM), specified and actual
9. Hot water entering and leaving temperature, specified and actual
10. Boiler pressure drop

H. Cooling Coil Data:
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. Saturated suction temperature, design and actual
11. Air pressure drop, design and actual
12. Type of refrigerant for DX coils

I. Heating Coil Data:

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
13. Coils with 3 way control valves shall have flow measured at full coil flow and full bypass flow. The bypass balancing valve shall be adjusted for flow as indicated on the drawings or at a maximum coil flow, whichever is less.

J. Return Air/Outside Air Data:

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

K. Supply, Return, and Exhaust Fan Data:

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
12. Fan BHP

L. Unit Heaters, Fin-Tube, etc.:

1. Unit type, manufacturer, model no., etc.
2. Entering and leaving air temperature
3. Entering and leaving water temperature (design and final)
4. Entering and leaving water pressure (design and final)
5. Water flow (GPM)
6. Electrical data

M. Air Distribution Test Sheet (Diffusers, Registers and Grilles):

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

END OF SECTION

SECTION 23 0700
HVAC INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.

B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84 or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.

B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.

C. Insulation materials shall be noncorrosive to the materials they are applied to, including stress corrosion cracking of stainless steel, and shall not breed or promote fungus and bacteria.

D. Insulation shall meet or exceed all requirements of the 2012 International Energy Conservation Code.

1.3 QUALIFICATION

A. Insulating materials by Owens-Corning, Aracell, Pittsburgh-Corning, Knauf, Johns Manville, or Engineer pre-approved equivalent.

B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

PART 2 PRODUCTS

2.1 PRODUCTS

A. Description:

1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures form –20° F to +850° F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU-in/hr-ft2-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Johns Manville "Micro-Lok HP or Engineer pre-approved equivalent.

Mean Temperature Rating (F)	Conductivity BTU in/(hr sqft F)
250	0.32 - 0.34
200	0.29 - 0.32
150	0.27 - 0.30
125	0.25 - 0.29
100	0.21 - 0.28
75	0.21 - 0.28

2. Type B: Flexible, elastomeric pipe and sheet insulation with closed-cell structure. Shall comply with ASTM C534, Type I, Grade 1 for tubular materials and ASTM C534 Type II, Grade 1 for sheet materials. Suitable for operating temperatures from –40° F to 220° F. Outdoor applications, and where otherwise noted, shall receive a weather-resistant, protective, latex enamel finish. Thermal conductivity of 0.28 BTU-in/hr-ft2-°F @ 75° F mean temperature. Water vapor permeance of 0.08 perms. Insulation shall be equivalent to Armacell AP Armaflex; adhesive equivalent to Armacell Armaflex 520 or Armaflex 520 BLV Low-VOC Contact Adhesive; finish equivalent to Armacell Armaflex WB finish.

3. Type C: Flexible, elastomeric thermal insulation with an expanded, closed-cell structure. Pre-slit tubular form with a pressure-sensitive adhesive strip for closure and vapor sealing of the longitudinal joint. Butt joints, sealed with 3M-471 tape. White color. Suitable for operating temperature of 40° F to 200° F. Thermal conductivity of 0.28 BTU-in/hr-ft2-°F mean temperature. Water vapor permeance of 0.20 perms. Insulation shall be Armacell Self-Seal Armaflex 2000 or Engineer pre-approved equivalent.

4. Type H: Rigid fiberglass board formed from inorganic glass fibers bonded with thermosetting fibers, 3.0 PCF, with factory applied foil Skrim-Kraft (FSK)foil Skrim-Kraft (FSK) suitable for operating temperature of –20° F to +450° F. Thermal conductivity of 0.23 BTU-in/hr-ft2-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Knauf "Insulation Board" or approved equivalent.

5. Type I: Fiberglass duct wrap, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin with factory applied foil Skrim-Kraft facing, suitable for operating temperature up to +250° F. Thermal conductivity of 0.26 BTU-in/hr-ft2-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Knauf Duct Wrap or Engineer pre-approved equivalent.

2.2 INSULATION JACKETS

A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR. Manville "Zeston 300" or equivalent.

B. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic. Premolded jackets shall be Manville "Zeston 300" or approved equivalent.

C. At wall penetrations and on exterior pipe, provide an additional jacket of 0.020 inch thick smooth finish aluminum. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket

D. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.

E. PVC jackets shall be used in the following areas and systems:

1. Exposed piping in kitchens and dishwasher rooms.
2. Premolded PVC at all fittings and valve jackets.
3. Exterior Insulated Refrigerant Suction Lines.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.

B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.

C. Insulation shall be kept clean and dry at all times.

D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.

E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.

1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Armacell Armaflex 520, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal.
2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. Seal longitudinal seam and butt joints with Armacell Armaflex 520 adhesive, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal. In all cases, the insulation, equal to Armacell AP, protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

3.2 PIPE INSULATION INSTALLATION

A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.

B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.

C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangars not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

D. Neatly finish insulation at supports, protrusions and interruptions.

1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.

2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem, but provides a seal against moisture incursion.

E. Wherever piping penetrates a floor or is exposed in a finished area, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

3.3 EQUIPMENT INSULATION

A. Do not insulate factory-insulated equipment.

B. Apply insulation as close as possible to equipment by grooving, scoring and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.

C. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

D. Cover insulation with metal mesh and finish with ¼" coat of insulating cement applied in two 1/8" layers, if non-faced insulation is used.

E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

F. When equipment with insulation requires periodical opening for maintenance, repair or cleaning such as at manway covers or strainer plugs, install insulation in such a manner that it can be easily removed and replaced without damage. Removable insulation shall have a vapor-proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.

G. Joints shall be sealed with 2" wide vapor barrier tape or strips to match insulation jacket, using a fire-resistive adhesive.

3.4 DUCT COVERING APPLICATION

A. Covering shall be cut slightly longer than circumference of duct to ensure full thickness at corners. Insulation shall be applied with edges tightly banded, and shall be adhered to duct with fire-resistant adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.

B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of ducts 18" or wider by means of adhesive pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed with a vapor barrier mastic and tape where the pins have pierced through. The vapor barrier shall be continuous to prevent condensation. Insulation shall not be compressed at any location so as to reduce insulating characteristics.

C. Joints shall be sealed with 2" wide pressure-sensitive tape or vapor barrier tape or strips, using a fire-resistive adhesive. Cuts or tears shall be sealed with strips of vapor barrier jacket applied with adhesive or pressure-sensitive tape.

3.5 PIPE INSULATION SCHEDULE (BASED ON 2012 IECC)

SERVICE	TEMP (°F)	TYPE	NOMINAL PIPE SIZE (INCHES)				
			<1	1 TO <1-1/2	1-1/2 TO <4	4 TO <8	8+
Heating Water	141 - 201	A,B,C	1-1/2"	1-1/2"	2"	2"	2"
	105 - 140	A,B,C	1"	1"	1-1/2"	1-1/2"	1-1/2"
Refigerant Suction, Refrigerant Hot Gas		B	1/2"	3/4"	3/4"	3/4"	3/4"
Condensation Drain Piping		A	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
Steam, Condensate	201 - 250	A	2-1/2"	2-1/2"	2-1/2"	3"	3"

3.6 EQUIPMENT INSULATION SCHEDULE

SERVICE	TYPE	THICKNESS
Air Separators	B	2"
Boiler Feed Water Storage Tanks < 28" diameter	A	3" (2 layers)
Boiler Feed Water Storage Tanks >= 28" diameter	I	3" (2 layers)
Steam Condensate Receivers (Square tank)	H	3"

3.7 MINIMUM DUCT INSULATION SCHEDULE (BASED ON 2012 IECC)

SERVICE	TYPE	THICKNESS
Supply Air Ducts	I	2"
Diffusers (top/backside) & Linear Plenums	I	2"
Exhaust Ducts within 10' of Roof Penetration or fan	I	2"
Outside Air Ducts	I	2"

END OF SECTION

SECTION 23 0800
MECHANICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. These requirements shall be in addition to applicable Division 23, 26, 27, and 28 Sections.

B. OPR and BOD, documentation prepared by the Owner's Design Professionals contains requirements that apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment.

B. This Section describes the requirements for start-up and commissioning for Division 23 installed work, including but not limited to:

1. All systems and alarms connected to the Building Automation System (BAS).
2. Heating water pumps.
3. Boilers and associated accessories.
4. Variable frequency drives.
5. Fin Tube.
6. Piping.
7. Direct digital control system performance or other control system type as applicable, for accuracy, conformance, and operational sequences.
8. Testing and balancing.
9. Unit heaters.

1.3 COORDINATION

A. Coordinate commissioning requirements noted in other Division 23 Sections.

1.4 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. BOD: Basis of Design.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements.

E. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

F. TAB: Testing, Adjusting, and Balancing.

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of the Construction Manager and each Contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.6 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and each Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BOD documentation, prepared by Architect/Engineer and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.7 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are components of the General Contractor scope identified in other related sections. This information is highlighted here for convenience and is not a list of additional services. The only exception to the responsibilities specified elsewhere is that the CxA must be present during these operations in order to comply with the commissioning specification.

1. Attend with responsible sub-contractors commissioning progress meetings and cooperate with CxA for resolution of issues related to commissioning.
2. Integrate and coordinate commissioning process activities with construction schedule.
3. Review and authorize responsible sub-contractors to complete Pre-Functional and Functional Performance Testing (FPT) checklists provided by the CxA.
4. Authorize sub-contractors to make available technicians and/or coordinate with the manufacturer's authorized technicians to startup HVAC systems, assemblies, and equipment and simulate conditions for the purpose of completing Functional Performance Testing.
5. Attend with responsible sub-contractors testing, adjusting, and balancing review and coordination meeting.
6. Participate with responsible sub-contractors in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

7. Provide equipment operational and maintenance and related information requested by the CxA for final commissioning documentation.
8. Certify that TAB work is complete.

B. Mechanical Subcontractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

C. HVAC Instrumentation and Control Subcontractor: With the CxA, review control designs for compliance with the OPR and BOD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

D. Testing and Balancing Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
    a. Verify the following:
        1) Accessibility of equipment and components required for TAB work.
        2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
        3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
        4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
        5) Air and water flow rates have been specified and compared to central equipment output capacities.
        6) Identify discontinuities and omissions in the Contract Documents.
        7) This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23, Section 23 0593, Testing, Adjusting, and Balancing.
    b. Additional Responsibilities: Participate in tests specified in Division 23, Section 23 0900 “Instrumentation and Control for HVAC".

E. Electrical Subcontractor:

1. With the Mechanical Subcontractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
2. Attend TAB verification testing.

1.8 CXA'S RESPONSIBILITIES

A. Provide commissioning specification to be incorporated into Contract Documents.

B. Provide Commissioning Plan for process and schedule for completing Pre-Functional checklists, manufacturer's pre-start and startup checklists for HVACR systems, assemblies, equipment, and components to be verified and tested, and Functional Performance Testing checklists.

C. Evaluate Contract Documents (plans and specifications) prior to bidding only as the contract documents relate to the OPR and BOD documents and Commissioning Process requirements specified elsewhere. The CxA's evaluation constitutes no responsibility over design concept, design criteria or compliance with codes. The CxA does not verify calculations, proof schematics or layouts in detail, or provide an in depth constructability review.

D. Provide Pre-Functional and Functional Performance Testing commissioning forms for the contractor to complete as work progresses.

E. Witness startup and simulation of conditions for equipment specified in this section. Contractor is responsible for start-up.

F. Verify that testing, adjusting, and balancing of work is completed as required by the Contract Documents and perform limited verification of testing, adjusting, and balancing report data.

G. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION –

A. Test Checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. In addition to the requirements specified in Division 01 Section 01 8100 "Building Systems General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Responses to control signals at specified conditions.
5. Sequence of response(s) to control signals at specified conditions.
6. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
7. Interaction of auxiliary equipment.
8. Deficiency log.

B. Contractors shall provide the following information to the CxA for inclusion in the Commissioning Process Final Report:

1. Copy of contractor's 'as-built' drawings indicating changes that occurred during the construction phase. The original as-built drawings are processed in accordance with requirements specified elsewhere.
2. Copies of plan and documentation requirements for start-up and initial checkout.

3. Copies of completed pre-functional and functional performance testing checklists.
4. Copies of commissioning corrective action report.

1.10 SUBMITTALS

A. The following submittals are in addition to those specified in Section 01 8100, General Commissioning Requirements.

B. Certificate of Readiness: MEPxA will compile certificates of readiness from the Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

C. Certified Pipe Cleaning and Flushing Report: CxA will collect and document that pipe cleaning; flushing, hydrostatic testing, and chemical treating have been completed.

D. Test and Inspection Reports: CxA will compile and submit test reports and certificates, and shall include them in systems manual and commissioning report.

E. Corrective Action Documents: CxA will maintain and submit corrective action documents.

F. Certified TAB Reports: CxA will submit verified, certified TAB reports.

G. Certificates of Completion of installation, pre-start, and start-up activities.

PART2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BOD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BOD, and Contract Documents; and that pre-test set points have been recorded.
3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
9. Annotate checklist or data sheet when a deficiency is observed.
10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
    a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
    b. Operation of terminal units in both heating and cooling cycles.
    c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    d. Building pressurization.
    e. Total exhaust airflow and total outdoor-air intake.
    f. Operation of indoor-air-quality monitoring systems.
    g. Verify proper responses of monitoring and control system controllers and sensors to include the following:
        1) For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
        2) Report deficiencies and prepare an issues log entry.
    h. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. Operational modes include the following:
    1. Occupied and unoccupied.
    2. Warm up and cool down.
    3. Economizer cycle.
    4. Life-safety and safety systems.
    5. Fire safety.

3.2 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Subcontractor Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: CxA, with HVAC Subcontractor, TAB Subcontractor, MEP Engineer of Record and HVAC Instrumentation and Control Subcontractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 23 Sections 23 0900 " Instrumentation and Controls for HVAC". The CxA, HVAC Subcontractor, and the HVAC Instrumentation and Control Subcontractor shall collaborate to prepare testing plans.

F. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping sections. HVAC Subcontractor shall prepare pipe system cleaning, flushing, and hydrostatic testing plan. CxA shall review and comment on plan and final reports. CxA shall certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

G. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to the Construction Manager or CxA. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

   If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

H. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect/Engineer to determine corrective action. Deficiencies shall be corrected and test repeated.
4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BOD documents shall be implemented or if tests will be accepted as submitted. If corrective work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION

SECTION 23 0923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System description.

B. Operator interface.

C. Controllers.

D. Power supplies and line filtering.

E. Auxiliary control devices.

F. Sensors and devices.

G. Wiring and raceways.

H. Refer to Drawings for control diagrams, control points, and control sequences.

1.2 DESCRIPTION

A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

1. The DDC system components shall be BACnet BTL certified, utilizing an operator workstation at the LAN (local IP at building) level; this LAN shall be sufficient to operate this building's systems as stand alone.

2. All components on IP subnets (field busses) shall support MS/TP architecture, with full functionality and communication both with and without the building controller.

3. Each controller shall be capable of full and complete standalone operation of respective unit.

4. The system shall be an extension of the existing Metasys system by Johnson Controls.

B. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms as specified on the drawings.

C. Project Specific Description:

1. All hardware, equipment and material shall be completely installed two (2) weeks prior to Substantial Completion, to allow immediate start by the temperature controls contractor (TCC) as identified directly below.

D. Meetings:

1. The Owner, Engineer, Controls Contractor and Commissioning Authority (CxA) to hold a meeting to review the Controls Submittal.

2. A subsequent Programming Review meeting will be held to review the actual program and proactively address any concerns. If factory-controlled equipment is being used, a manufacturer's representative should be available with an accurate points list and sequence of operations specific for the piece of equipment being supplied. The person from the controls contractor who will be actually writing the programming will be required to attend this meeting.

3. At turnover/substantial completion, the Controls Contractor shall meet with the Owner and CxA for a demonstration to confirm that the systems are under control and programming is complete.

E. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

F. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

G. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

1.3 RELATED REQUIREMENTS

A. Section 26 0519 Low-Voltage Electrical Power Conductors and Cables

B. Section 28 3111 Digital, Addressable Fire-Alarm System

1.4 REFERENCES

A. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests 2019h.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL (DIR) - Online Certifications Directory Current Edition.

D. Input/output devices, specified or future, associated with the DDC control system shall be ASCII (American Standard Code for Information Interchange) coded with standard EIA (Electronic Industries Association) interface hardware.

E. Wiring performed by the DDC Contractor shall be installed in accordance with all applicable local, state, and national codes.

F. Instrumentation hardware shall be supplied to directly interface with Instrument Society of America (ISA) Standards.

G. Applicable sections of International Building Code (IBC) include:

1. Fire Alarm and Detection Systems Section
2. Mechanical Section

1.5 SUBMITTALS

A. Submit the following within 30 days of contract award:

1. A complete bill of materials of equipment to be used indicating quantity, manufacturer, and model number.
2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.

3. Provide manufacturer's cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
    a. Building Controllers, Custom Application Controllers, and Application Specific Controllers
    b. Operator Interface Computer
    c. Auxiliary Control Devices
    d. Provide a sample graphic for each type of system being installed.

B. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Engineer and Owner for conformity with the plan and specifications.

C. Product Data: Provide data for each system component and software module.
    1. When manufacturer’s cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means.
    2. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover.
    3. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

D. Shop Drawings:
    1. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
    2. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
    3. List connected data points, including connected control unit, input device and the proposed English language object names.
    4. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
    5. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
    6. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
    7. Sequences included in the submittal must reflect what will be programmed. Copied sequences will not be accepted.

E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

B. Designer Qualifications: Perform design of system using manufacturer's software 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.

C. The installer shall have a service office within 100 miles of the project site and provide 24-hour response in the event of a customer call.

D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

E. The Contractor must be an authorized factory direct representative in good standing of the manufacturer of the proposed hardware and software components.

F. The Contractor shall technicians who have successfully completed the factory authorized training of the proposed manufactures hardware and software components and have successfully completed certification course(s).

G. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 10 years after completion of this contract. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

1.7 WORK BY OTHERS

A. The following incidental work shall be furnished by the Mechanical Contractor under the supervision of this Contractor.

1. Furnish and install all necessary valves, pressure taps, flow meters, water, drain and overflow connections and piping.

2. Furnish and install all necessary piping connections required for flow devices, valve position indicators, etc.

3. Install all automatic dampers.

1.8 WARRANTY

A. See Section 01 7700 - Closeout Procedures for additional warranty requirements.

B. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner’s warranty service request.

C. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

D. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.

E. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

F. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.9 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

B. Table 1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15º (±0.25ºF)
Water Flow	±2% of full scale
Water Pressure	±2% of full scale (see Note 2)

Measured Variable	Reported Accuracy
Electrical	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

1. Note 1: Accuracy applies to 10%-100% of scale.
2. Note 2: For both absolute and differential pressure.
3. Note 3: Not including utility-supplied meters.

C. Table 2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Space Temperature	±1.0ºC (±2.0ºF)	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

1.10 PRODUCTS NOT FURNISHED/INSTALLED UNDER BUT INTEGRATED WITH THIS SECTION

A. Section - General

1. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

B. Section 23 5216, 23 5217, and 23 5239 - Boilers

1. Boiler controls: The boiler vendor shall furnish boilers with an interface to the control and monitoring points as noted in drawings and boiler specifications. These specified points shall be the minimum acceptable interface to the boiler. The connection to these points shall be by one of the following methods:

a. Hardwired connection such as relay, 0-10VDC, or 4-20mA.

b. BACnet/IP network connection.

c. BACnet over ARCNET network connection.

d. BACnet MS/TP network connection.

C. Section 23 8000 series - Decentralized HVAC Equipment

1. Unit ventilators, unit heaters, fan coils, etc.: Unit ventilators, unit heaters, fan coils, cabinet heaters, convective or fin tube heaters, zone reheat, and similar terminal units: These units shall be furnished configured to accept control inputs from an external building automation system controller as specified on the drawings and equipment specifications. Factory mounted safeties and other controls shall not interfere with this controller.

1.11 DEFINITIONS

BACnet Interoperability Building Blocks (BIBB)	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application controllers, and application specific controllers.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Point-to-Point	Serial communication as defined in the BACnet standard.
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Router	A device that connects two or more networks at the network layer.
Wiring	Raceway, fittings, wire, boxes and related items.

1.12 ABBREVIATIONS

A. The following abbreviations may be used in graphics, schematics, point names, and other applications where space is at a premium:

1. **AAC** – Advanced Application Controllers
2. **AC** - Air Conditioning
3. **ACU** - Air Conditioning Unit

4. **AHU** - Air Handling Unit
5. **AI** - Analog Input
6. **AO** - Analog Output
7. **ASC** – Application Specific Controllers
8. **AUTO** - Automatic
9. **AUX** - Auxiliary
10. **BC** – Building Controllers
11. **BI** - Binary Input
12. **BIBB** – BACnet Interoperability Building Blocks
13. **BO** - Binary Output
14. **C** - Common
15. **CHW** - Chilled Water
16. **CHWP** - Chilled Water Pump
17. **CHWR** - Chilled Water Return
18. **CHWS** - Chilled Water Supply
19. **COND** - Condenser
20. **CxA** – Commissioning Authority
21. **CW** - Condenser Water
22. **CWP** - Condenser Water Pump
23. **CWR** - Condenser Water Return
24. **CWS** - Condenser Water Supply
25. **DA** - Discharge Air
26. **DDC** – Direct Digital Control
27. **EA** - Exhaust Air
28. **EF** - Exhaust Fan
29. **EVAP** - Evaporators
30. **CU** - Fan Coil Unit
31. **HOA** - Hand / Off / Auto
32. **HP** - Heat Pump
33. **HRU** - Heat Recovery Unit
34. **HTEX** - Heat Exchanger
35. **HW** - Hot Water**HWP** - Hot Water Pump
    HWR - Hot Water Return
    HWS - Hot Water Supply
    I/O – Input/Output
36. **HWP** - Hot Water Pump
37. **HWR** - Hot Water Return

38. **HWS** - Hot Water Supply
39. **I/O** – Input/Output
40. **IP** – Internet Protocol
41. **LAN** – Local Area Network
42. **LEED** – Leadership in Energy and Environmental Design
43. **MAX** - Maximum
44. **MIN** - Minimum
45. **MISC** - Miscellaneous
46. **MS/TP** – Master Slave Token Passing
47. **NC** - Normally Closed
48. **NO** - Normally Open
49. **OA** - Outdoor Air
50. **PID** – Proportional Integral Derivative
51. **PIU** - Powered Induction Unit
52. **RA** - Return Air
53. **RF** - Return Fan
54. **RH** - Relative Humidity
55. **RTU** - Roof-top Unit
56. **SA** - Supply Air
57. **SF** - Supply Fan
58. **SP** - Static Pressure
59. **TCC** – Temperature Control Contractor
60. **TEMP** - Temperature
61. **UH** - Unit Heater
62. **UV** - Unit Ventilator
63. **VAV** - Variable Air Volume
64. **VFD** – Variable Frequency Drive
65. **VVTU** - Variable Volume Terminal Unit
66. **W/** - With
67. **W/O** - Without

PART 2 PRODUCTS

2.1 MATERIALS

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least ten years after completion of this contract.

2.2 MANUFACTURERS

A. Johnson Controls, Inc.

B. Engineer Pre-Approved Equivalent.

2.3 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Controls for variable radiation, unit heaters, and the like when directly connected to the control units.

E. Provide control systems consisting of thermostats, control valves, and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.4 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

B. Install new wiring and network devices as required to provide a complete and workable control network.

C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

E. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.

F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.5 OPERATOR INTERFACE

A. Furnish a full graphics system to interface with the owners existing PC "operator workstation". The system shall include all software and hardware necessary to provide full graphics at the location of the existing operator workstation. Verify the available PC system data and furnish additional hardware if necessary.

2.6 CONTROLLERS

A. General: General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

B. Stand-Alone Operation. Each piece of equipment specified shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

C. Building Controllers (BC):

1. General:

a. Manage global strategies by one or more, independent, standalone, microprocessor-based controllers.

b. Provide sufficient memory to support controller's operating system, database, and programming requirements.

c. Share data between networked controllers.

d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.

e. Utilize real-time clock for scheduling.

f. Continuously check processor status and memory circuits for abnormal operation.

g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

h. Communication with other network devices to be based on assigned protocol.

2. Communication:

a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.

b. Perform routing when connected to a network of custom application and application specific controllers.

c. Provide service communication port for connection to a portable operator's terminal or handheld device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:

a. Outdoors and/or in Wet Ambient Conditions:

1) Mount within waterproof enclosures.
2) Rated for operation at -20 to 140 degrees F.

b. Conditioned Space:

1) Mount within dustproof enclosures.
2) Rated for operation at 32 to 120 degrees F.

4. Provisions for Serviceability:

a. Diagnostic LEDs for power, communication, and processor.

b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:

a. Maintain operation at 90 to 110 percent of nominal voltage rating.

b. Perform orderly shutdown below 80 percent of nominal voltage.

c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

D. Advanced (Custom) Application Controllers (AAC):

1. General:

a. Provide sufficient memory to support controller's operating system, database, and programming requirements.

b. Share data between networked, microprocessor-based controllers.

c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.

d. Utilize real-time clock for scheduling.

e. Continuously check processor status and memory circuits for abnormal operation.

f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

g. Communication with other network devices to be based on assigned protocol.

2. Communication:

a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.

b. Signal Management: Operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

3. Anticipated Environmental Ambient Conditions:

a. Outdoors and/or in Wet Ambient Conditions:

1) Mount within waterproof enclosures.
2) Rated for operation at -20 to 140 degrees F.

b. Conditioned Space:

1) Mount within dustproof enclosures.
2) Rated for operation at 32 to 120 degrees F.

4. Provisions for Serviceability:

a. Diagnostic LEDs for power, communication, and processor.

b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:

a. Maintain operation at 90 to 110 percent of nominal voltage rating.

b. Perform orderly shutdown below 80 percent of nominal voltage.

c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

E. Application Specific Controllers (ASC):

1. General:

a. Not fully user programmable, microprocessor-based controllers dedicated to control specific equipment.

b. Customized for operation within the confines of equipment served.

c. Communication with other network devices to be based on assigned protocol.

2. Communication:
    a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
    b. Provide service communication port for connection to a portable operator's terminal or handheld device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
    a. Outdoors and/or in Wet Ambient Conditions:
        1) Mount within waterproof enclosures.
        2) Rated for operation at -20 to 140 degrees F.
    b. Conditioned Space:
        1) Mount within dustproof enclosures.
        2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
    a. Diagnostic LEDs for power, communication, and processor.
    b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
    a. Maintain operation at 90 to 110 percent of nominal voltage rating.
    b. Perform orderly shutdown below 80 percent of nominal voltage.
    c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
7. Transformer:
    a. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

F. Input/Output Interface:
1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
    a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
    b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.

3. Binary Inputs:
    a. Allow monitoring of On/Off signals from remote devices.
    b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
    c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
    a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
    b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
    a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
    b. Outputs provided with three position (On/Off/Auto) override switches.
    c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
    a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
    b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
    c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
    a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
    b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
        1) Radiation.
    c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. Universal Inputs and Outputs
10. System Object Capacity:
    a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.

b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.7 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
   a. Dielectric strength of 1000 volts minimum.
   b. Response time of 10 nanoseconds or less.
   c. Transverse mode noise attenuation of 65 dB or greater.
   d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.8 LOCAL AREA NETWORK (LAN)

A. Provide communication between control units over local area network (LAN).

B. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

C. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

D. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

E. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.9 POWER FAIL RESTART

A. In the event of the loss of normal power, there shall be an orderly shutdown of the digital panels and workstation to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the clock and all volatile memory for a minimum of 72 hours.

B. Upon restoration of normal power, the panels shall automatically resume full operation without manual intervention.

C. Should Digital panel memory be lost for any reason, the user shall have the capability of reloading the panel via the local RS-232 port, or telephone line dial-in.

2.10 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers: Unless otherwise specified elsewhere, dampers shall be as follows:

1. Low leakage dampers shall be by Ruskin or Engineer pre-approved equivalent.
2. Damper leakage ratings shall be certified in accordance with AMCA Standard 500-D.
3. Provide any automatic control dampers not specified to be integral with other equipment.
4. All blade edges and top and bottom of frame shall be provided with compressible seals. Side seals shall be compressible stainless steel of the tight-seal spring type.
5. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6 inches.
6. Where ultra-low leakage dampers are specified the blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 6 cfm per square foot for dampers in excess of sixteen inches square at 1 inch of w.c.
7. Type: Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
    a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be opposed-blade and shall direct airstreams toward each other.
    b. Other modulating dampers shall be opposed-blade.
    c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
8. Frame: Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 inch) extruded aluminum with reinforced corner bracing. Frame construction shall not be less than 14 gauge galvanized steel or extruded aluminum at a minimum 4-1/2 inch X 1 inch X 0.125 inch in thickness.
9. Blades: Damper blades shall not exceed 20 cm (8 inch) in width or 125 cm (48 inch) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
10. Shaft Bearings: Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.

11. Seals: Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 liters per second per square meter (10 cfm per square foot) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
12. Sections: Individual damper sections shall not exceed 125 cm x 150 cm (48 in. x 60 in.). Each section shall have at least one damper actuator.
13. Axles shall be a minimum of 1/2" diameter and be welded to blade or riveted to blade.
14. Modulating dampers shall provide a linear flow characteristic where possible.
15. Linkages: Dampers shall have exposed linkages.

B. Electric Valve Actuators:

1. General:
    a. For dampers, the actuators used shall be provided from a single manufacturer. Furnish a separate damper actuator for each damper greater than 48 inches (1220 mm) in any dimension.
    b. For valves, the actuators used shall be provided from a single manufacturer.
    c. Actuators shall be provided from a manufacturer registered under ISO9001:2000.
    d. All rotary spring return actuators shall be capable of both clockwise and counterclockwise spring return operation. Linear actuators shall spring return to the retracted position.
    e. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
    f. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
    g. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
    h. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque. Actuators shall include a stroke limiting device.
2. Stall Protection: Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
3. Spring-return Mechanism: Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
4. Signal and Range: Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)

5. Wiring: 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
6. Manual Positioning: Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
7. Electronic Damper Actuators:
    a. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
    b. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
    c. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent any damage to the actuator during a stall condition.
8. Electronic Valve Actuators:
    a. Coupling: Directly couple end mount to stem, shaft, or ISO-style direct-coupled mounting pad.
    b. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
    c. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to deactivate the actuator at the end of rotation.
9. Terminal Unit Actuators
    a. Close-off (Differential) Pressure Rating: 200 psi.
    b. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle or an ISO-style direct-coupled mounting pad.

C. Control Valves:
1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
    a. Water Valves:
        1) Two-way: 150% of total system (pump) head.
        2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
3. Water Valves:
    a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service and have the following characteristics:
        1) NPS 2 and Smaller: ANSI Class 250 bronze body, stainless steel stem, brass plug, bronze seat, and a TFE packing. Two-way valves to have replaceable composition disc or stainless steel ball.

2) NPS 2-½ and Larger: ANSI Class 125 cast iron body, stainless steel stem, bronze plug, bronze seat, and a TFE V-ring packing
3) Bodies for valves 3" to 6" shall be iron, cast iron or cast steel with flanged connections and shall be rated for ANSI Class 125 working pressure. Packing shall protect against leakage at the stem.

b. Sizing Criteria:

1) Two-position service: Line size.
2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.

c. Water valves shall fail normally open or closed, as scheduled on Drawings, or as follows:

1) Water zone valves: Normally open preferred.
2) Heating coils in air handlers: Normally open.
3) Other applications: As scheduled or as required by sequences of operation.

4. Where specified, ball-style body automatic control valves shall adhere to the following:

a. NPS 3 and Smaller: Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, NPT female end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a Tefzel flow characterizing disc.

b. Sizing:

1) Two-Position: Line size or size using a pressure differential of 1 psi.
2) 2-way Modulating: 5 psig or twice the load pressure drop, whichever is greater.
3) 3-way Modulating: Twice the load pressure drop, but not more than 5 psig.

c. Close-off Pressure Rating: 100 psi. NPS ¾" and Smaller for Terminal Units: 200 psi.

d. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory with a single screw on a four-way DIN mounting-base.

e. All control ball valves shall feature characterized flow guides when used for modulating applications.

5. Where specified, butterfly control valves shall adhere to the following:

a. NPS 2 to 12: Valve body shall be full lugged cast iron 200 psig body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize an internal spline. External mechanical methods to achieve this mechanical connection, such as pins or screws, are not acceptable. The shaft shall be supported at four locations by RPTFE bushings.

b. Sizing:

1) Two-Position: Line size or size using a pressure differential of 1 psi.
2) Modulating: 5 psig or twice the load pressure drop, whichever is greater. Size for the design flow with the disc in a 60° open-position with the design velocity less than 12 feet per second.

c. Close-off Pressure Rating:

1) NPS 2" to 12" 200 psi bubble tight shutoff.

6. On/Off, Two-Position Applications:

a. NPS 1 and Smaller: Forged brass body, rated at no less than 300 psi, female NPT union or sweat with a stainless steel stem and EPDM seals.

b. Sizing: Two-Position: Line size or size using a pressure differential of 1 psi.

c. Close-off Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150% of total system head pressure for 2-way valves and 125% of the design pressure differential across the 3-way valves.

d. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory.

2.11 SENSORS AND DEVICES

A. Input/output sensors and devices shall be closely matched to the requirements of the BAS controller for accurate, responsive, noise-free signal input/output. Control input response shall be high sensitivity and matched to the loop gain requirements for precise and responsive control.

B. Sensors and transmitters shall be manually calibrated on site so that the wiring length does not detract from the sensor accuracy specified.

C. Provide guards (plastic or wire) for sensors, thermostats, and transmitters that are installed in public areas such as gymnasiums, classrooms, corridors, and vestibules.

D. Temperature Sensors:

1. Sensors shall have ±1.0 ˚F accuracy between 32 ˚F and 212 ˚F.
2. Type: Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
3. Temperature Sensor – Immersion: Provide thermo-well mounted temperature sensors as indicated in the control sequences and diagrams as follows:

a. Temperature sensors shall meet, at minimum, the following requirements:

b. Rigid 0.25 inch stainless steel probe of length, which is, at minimum, 20% of the pipe width.

c. Thermistor or RTD Compatible with BMS sealed in probe with three-part moisture protection system.

d. BMS shall report the monitored temperature with an accuracy of 1.0°F.

e. ABS housing with conduit entrance. (Optional metal or weatherproof available.)

f. Provide Brass or Stainless steel thermowell (316 or 304).

g. Provide with thermal grease to aid temperature sensing.

4. Temperature Sensor – Wall Mounted: Provide wall mounted stainless plate temperature sensors as indicated in the control sequences and diagrams as follows:
   a. Temperature sensors shall meet, at minimum, the following requirements:
   b. Stainless plate sensors to fit 4 inch X 2 inch junction box, available with tamperproof screws.
   c. Thermistor or RTD compatible with BMS.
   d. Mounting: typical space sensors at 48 inches above floor to center; sensors in common areas at 96 inches above floor to center.
5. Where reference is made on the drawings for a RTD transmitter, transmitters shall meet at minimum the following requirements:
   a. 100 ohm or 1000 ohm PT RTD
   b. 24V ac/dc power supply.
   c. 4-20 mA, 0-10Vdc or 0-5Vdc outputs compatible with BMS.
   d. Electronics accuracy of +/-0.1% of span.
   e. Operating temperature range of 32˚F to 158˚F. Outside air only - operating temperature range of -40˚F to 185˚F.
6. Temperature Sensor – Strap-On: Provide strap-on mounted temperature sensors as indicated in the control sequences and diagrams or where thermo well mounted sensors cannot be mounted. Temperature sensors shall meet, at minimum, the following requirements:
   a. 0.25 inch Stainless steel probe, 2 inches.
   b. Thermistor or RTD compatible with BMS, sealed in probe with a three part moisture protection system
   c. ABS housing with conduit entrance. (Optional metal or weatherproof available)
7. Temperature Sensor – Strap-On – Plate: Provide strap-on mounted temperature sensors as indicated in the control sequences and diagrams or where thermo well mounted sensors cannot be mounted. Temperature sensors shall meet, at minimum, the following requirements:
   a. Thermistor or RTD compatible with BMS, sealed in probe with a three part moisture protection system
   b. A single point strap-on temperature sensor to be precision bonded to a 1.5 inch x 1.5 inch aluminum plate and adhered to a 1.5 inch x 1 inch compressible foam. A 10 inch S/S Pipe clamp to be provided to secure the assembly to various sizes of pipe.
   c. ABS housing with conduit entrance. (Optional metal or weatherproof available.)

E. Water Pressure Sensor: Provide water pressure sensors as indicated in the control sequences and diagrams. Pressure sensors shall meet the following requirements:

1. Operating range shall be suitable for the application. Select range such that it covers from zero pressure to twice the amount of pressure desired for control purposes or that could be encountered.
2. 4-20 mA output proportional to water pressure.
3. 0.25% accuracy of range.
4. Temperature range of -40˚F to 260˚F.
5. Over pressure input protection of a minimum two times rated input.
6. An optional ABS wiring housing is available for an interior application and weatherproof wiring housing is available for an exterior application.
7. 17-4PH stainless steel wetted parts.
8. Burst pressure of a minimum five times rated input.

F. Water Differential/Gauge Pressure Sensor Provide water differential or gauge pressure sensors as indicated in the control sequences and diagrams. Water differential pressure sensors shall meet, at minimum, the following requirements:

1. Output of 4-20 mA, 0-10 or 0-5 Vdc proportional to the pressure sensed.
2. Momentary over pressure protection of five times the rated input.
3. Operating range shall be suitable for the application. Select range such that it covers from zero differential pressure up to a differential static pressure of 20% to 50% in excess of the maximum static pressure that could be encountered. Remember that if the sensor is used for the control of a chilled water bypass and is located across, for example, a chilled water AHU coil, the pressure drop of both the coil and the associated valve at full design flow have to be taken into account.
4. 4. Accuracy of better than 1% of full-scale reading.
5. Valve tapping shall be furnished and installed by the Mechanical contractor. Coordinate with the Mechanical contractor.

G. Relays:

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
3. Relays shall meet, at minimum, the following specifications:
   a. Rated for the applicable load.
   b. The output relay shall have an accessible trip adjustment over its complete operating range. Provide LED indication of relay status.
   c. Current relay shall have input and output isolation via current transformer.
   d. Current relay shall be self-powered with no insertion loss.