Project Manual

PROJECT NO. SU-031125

PROJECT TITLE: Modifications to Heating Plant for Temporary Boiler
Bid Documents

DATE: March 03, 2025
RMF Project No.: 06240058.B0

State University of New York

at

Purchase

Purchase College
STATE UNIVERSITY OF NEW YORK

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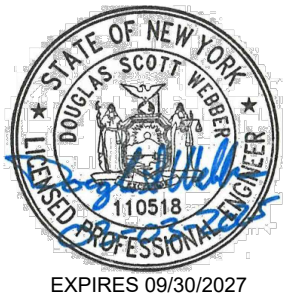
Purchase, New York 10577



EXPIRES 09/30/2027

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00 01 10 Table of Contents

SUNY PROJECT NO. SU-031125

PROJECT TITLE: Modifications to Heating Plant for Temporary Boiler

Bid Documents

SECTION TITLE

Technical Specifications

00 01 15 List of Drawings

GENERAL	
T0.01	TITLE SHEET
G0.01	TEMPORARY HTHW GENERATOR CONNECTIONS AS-LEFT CONDITIONS
STRUCTURAL	
S0.00	GENERAL NOTES AND DESIGN CRITERIA
SD1.02	PARTIAL ROOF STRUCTURAL DEMOLITION PLAN
S1.00	GROUND FLOOR STRUCTURAL PLAN
S1.02	STRUCTURAL ROOF PLAN
S2.00	TYPICAL DETAILS
S2.01	STRUCTURAL STACK & STACK SUPPORT DETAILS AT ROOF LEVEL
S2.02	STRUCTURAL STACK & STACK SUPPORT DETAILS AT ROOF LEVEL
MECHANICAL	
M0.00	MECHANICAL LEGEND AND ABBREVIATIONS
M0.01	MECHANICAL LEGEND AND ABBREVIATIONS
MD1.00	MECHANICAL - PLANT FLOOR 0' - 12' - DEMOLITION
MD1.01	MECHANICAL - PLANT FLOOR 12' - 30' - DEMOLITION
MD1.02	MECHANICAL - PLANT ROOF - DEMOLITION
MD6.01	HTHW SCHEMATIC - DEMOLITION
MD6.03	NATURAL GAS AND FUEL OIL SCHEMATIC - DEMOLITION
MD6.07	COMPRESSED AIR SCHEMATIC - DEMOLITION
MD7.00	MECHANICAL AXONOMETRICS - DEMOLITION
M1.00	MECHANICAL - PLANT FLOOR 0'-12' - NEW WORK
M1.01	MECHANICAL - PLANT FLOOR 12'-30' - NEW WORK
M1.02	MECHANICAL - PLANT ROOF - NEW WORK
M3.00	MECHANICAL - TEMP GEN SECTION
M5.01	MECHANICAL DETAILS
M5.02	MECHANICAL DETAILS
M6.01	HTHW SCHEMATIC - NEW WORK
M6.03	NATURAL GAS AND FUEL OIL SCHEMATIC - NEW WORK
M6.07	COMPRESSED AIR SCHEMATIC - NEW WORK
M6.09	TEMP GEN SCHEMATIC - NEW WORK
M7.01	MECHANICAL AXONOMETRICS - NEW WORK
M8.00	MECHANICAL SCHEDULES

SECTION 01 50 00 - TEMPORARY MECHANICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCE STANDARDS

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

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section includes requirements for temporary mechanical equipment, utilities, support facilities, and protection facilities.

B. The Contractor will be responsible for installing one HTHW Generator and all necessary mechanical and electrical connections. The Temporary HTHW Generator is to be online by the start of the 2025/2026 heating season.

1.4 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the General Conditions cost unless otherwise indicated.

B. Natural Gas: Owner will pay natural gas consumption and use charges by natural gas supplier for the construction operations.

C. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

D. Fuel Oil Service: Owner will pay fuel oil use charges for fuel oil used by all entities for construction operations.

1.5 INFORMATIONAL SUBMITTALS

A. Site Plans: Show temporary facilities, equipment locations, utility hookups, staging areas, and parking areas for all temporary equipment provided.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions for Accessibility Standards. Do not block any College egress pathways.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each temporary service to assume responsibility for operation, maintenance, and protection of each temporary service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. The Contractor shall be responsible for all activities required to provide a valid New York State boiler registration number and Certificate of Inspection issued by the Department of Labor, Boiler Safety Bureau.

PART 2 PRODUCTS

2.1 TEMPORARY MECHANICAL EQUIPMENT RENTALS

A. The Contractor shall provide a temporary HTHW Generator. There is an existing temporary HTHW generator run through an OGS Contract for the 2024-25 winter heating season. This generator is going to be removed by OGS during the Spring 2025 Plant outage. The Contractor is responsible for providing a fully operational temporary generator by the start of the 2025-26 heating season. Generator shall be removed from its flatbed trailers, relocated to the plant location as shown on drawings, and fully installed for temporary use. The Contractor shall fully assume all responsibility for this rental boiler. The Contractor shall assume responsibility for its costs including but not limited to, procurement, contracts, installation, monthly rental fees, all rigging operations, and the safe return to the rental company at the completion of its use. All natural gas and fuel oil consumption for this unit shall be provided by the Owner. Provide low NOx unit not to exceed 30 PPM emission rating. Maximum unit dimensions are shown on the Contract Drawings.

1. Refer to M8.00 of the Contract Drawings for temporary HTHW generator performance information.

2.2 AUXILLIARY EQUIPMENT

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

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Coordination: Provide the HTHW Generator ready for use when needed to avoid delay. Do not remove until Owner has approved the removal after temporary facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Connect to Existing Services

1. Refer to Contract Drawings for details on connecting the temporary HTHW generator to the temporary mechanical and electrical hookups.

B. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Maintain partitions during the Work to control entrance and egress.

2. Perform daily construction cleanup and final cleanup.

C. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner including suitable transformers, wiring, conduit, and fused disconnect switches for each temporary equipment unit.

D. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, and inspections.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Maintain support facilities until Owner schedules inspection. Equipment and devices remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Parking: Use designated areas of Owner's existing parking areas for construction personnel. Confirm to Owner's parking requirements.

C. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

D. Temporary Stairs: Provide temporary stairs to maintain temporary equipment access and where ladders are not adequate.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Heating Plant floor area and floor drains to be protected during the install and removal of the temporary HTHW Generator. Contractor is liable for any floor or floor drain damage during all the phases of work as equipment is moved across the Heating Plant floor.

B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas.

2. Provide suitable ABC fire extinguishers at each temporary equipment installation. Maintain current inspection certificates.

3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction (Hot Work Permits).

4. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Maintain all equipment in accordance with manufacturer’s requirements.

C. Termination and Removal: Remove each temporary facility when needed when its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that

cannot be satisfactorily repaired.

1. At temporary equipment removal: repair, renovate, and clean each site and all permanent facilities used during construction period. Restore all site conditions to their original conditions prior to the temporary equipment installations. Comply with final cleaning and closeout requirements.

END OF SECTION

SECTION 02 41 19S – SELECTIVE STRUCTURAL DEMOLITION AND SUPPORT

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

B. Section Includes:

1. Demolition and removal of selected portions of building or structure.

2. Salvage of existing items to be reused or recycled.

3. Temporary shoring, and bracing.

DEFINITIONS

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

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

MATERIALS OWNERSHIP

E. Unless otherwise indicated, demolition waste becomes property of Contractor.

PRE- DEMOLITION MEETING

F. Pre-demolition Conference:

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.

SUBMITTALS

G. Pre-demolition Photographs or Video: Submit to Architect/Engineer before Work begins.

H. Shop Drawings: Show types of shoring, bracing and sheeting used to support existing and new building structure or utilities. Shop drawings shall be signed and sealed by a qualified professional engineer licensed to practice in the State of New York.

I. Submit detailed description of construction methods and sequence of work operations.

J. Submit design calculations and drawings for shoring, bracing, sheeting and underpinning used in the preparation of the shop drawings that have been sealed and signed by a qualified professional Engineer licensed to practice in the State of New York. Calculations shall be complete and formatted such that others may check the calculations without additional references or clarifications.

K. Calculations shall reflect the proposed procedure and methodology, as well as equipment proposed and available to the Contractor.

QUALITY ASSURANCE

L. Shop Drawings and Calculations for shoring and bracing of the building structure shall be sealed and signed by a Professional Engineer licensed to practice in the State of New York to be provided by the Contractor.

M. Design loads shall be calculated and shall be determined by existing structure dead loads, construction loads, and stated live loads. The professional engineer shall determine all existing material loads.

N. Work shall be designed and executed in conformance with the current requirements of the Occupational Safety and Health Administration (OSHA) standards and requirements.

FIELD CONDITIONS

O. Retain, revise, or delete this article to suit Project. Insert other limitations if necessary, such as when adjacent floors will be occupied.

P. Notify Architect of discrepancies between existing conditions and contract drawings before proceeding with the work.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

C. Products, materials, and methods of fabrication shall conform to the applicable specification section of these Contract Documents including but not limited to: Structural Steel.

D. Provide suitable shoring and bracing materials as required to support loads imposed. Materials need not be new, but must conform to specifications and performance standards as if new.

E. Contractor shall adhere strictly to methods and procedures, using only materials and equipment as proposed in submittals.

F. Request from the owner a copy of all record documents of the existing construction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations. This verification includes the proper “lockout-tag out” of any/all electrical components as required.

B. Review record documents of existing construction provided by Owner and field verify the “As –Built” conditions are either compliant or non-compliant with the record documents. Owner does not guarantee that existing conditions are same as those indicated in record documents.

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

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report and sketches to Architect as required to properly represent the unanticipated elements.

E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

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

2. Dead loads of existing construction materials shall be determined by this professional engineer.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings & preconstruction photographs.

3.2 PREPARATION

A. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

B. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished until permanent load paths have been established.

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

C. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.

2. Install internal bracing if required to prevent spreading or distortion of braced frames.

3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand all vertical and lateral wind, seismic, earth, and hydrostatic pressures

3.3 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated repair and replacement of excessive demolition shall solely be the responsibility of the contractor. The determination of the extent of demolition required shall be the responsibility of the contractor. That determination shall be based upon the requirements for the construction of the project’s design documents, and shall not be limited to the proposed requirements of the project’s demolition documents. Use

methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover existing openings that are to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations. Fire watch personnel shall be provided as per governing safety standards.

4. Maintain adequate ventilation when using cutting torches.

5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement as determined by the design document, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

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

3.5 CLEANING

A. Clean adjacent areas and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 23 05 00

SECTION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.

2. Grout between added beams and existing concrete slab.

B. Related Sections:

1. Section 05 50 00 S "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

A. Contractor/Fabricator Disclosure

1. Contractor/Fabricator shall submit a product-specific, facility-specific and/or supply chain-specific Environmental Product Declaration’s (EPD) that include the amount of embodied carbon in given building materials for and of the following products:
   a. Fabricated Steel Plate
   b. Hot-Rolled-Sections

B. Provide details of simple shear and moment connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated in AISC 360.

2. Use LRFD; data are given at service-load level.

3. Connection design and calculations shall be certified by a qualified professional engineer licensed to practice in the State of New York.

C. Moment Connections: As indicated on the Drawings.

D. Spliced Connections: Spliced connections shall develop the full design capacity of the lesser member.

E. Fabricator may use alternate connections than those indicated in Contract Documents. Submit certified detail and calculations for review and acceptance prior to submitting shop drawings.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components. Shop drawings shall be signed and sealed by a qualified professional engineer licensed to practice in the State of New York.

1. Shop drawings shall be accompanied by an affidavit, countersigned by the appropriate contractor(s), attesting that all materials and products will conform to applicable specifications, standards, yield points, grades and the likes,

2. Include plans, details of cuts, connections, splices, camber, holes, and other pertinent data.

3. Contractor shall review all shop drawing submittals for compliance with design documents prior to submittal to architect for design concept review.

4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars and weld tabs that are to be removed and supplemental fillet welds where backing bars are to remain.

5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Connection Calculations: Calculations and typical connection details shall be submitted for all connections not specifically detailed on contract documents. Connections and details shall be designed per criteria provided on the structural contract documents and per all relevant AISC documents. Calculations and details shall be signed and sealed by a qualified professional engineer licensed to practice in the State of New York.

D. Qualification Data: For qualified Installer fabricator.

E. Welding certificates.

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

G. Mill test reports for structural steel, including chemical and physical properties.

1. Submit certified copies of mill test reports for all steel furnished.

2. Mill test reports shall comply with all applicable parts if ASTM specifications.

H. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.

2. Direct-tension indicators.

3. Tension-control, high-strength bolt-nut-washer assemblies.

4. Shear stud connectors.

5. Shop primers.

6. Nonshrink grout.

I. Source quality-control reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.

2. AISC 360.

3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.

E. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner’s testing and inspecting agency observes repackaging and seals containers.

2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.

3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 70 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles -Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

1. Shear connectors shall be ¾ inch diameter, by 3 inches long.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.

2. Nuts: ASTM A 563.

F. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563.

G. Adhesive Threaded Rod Anchors: ASTM F 1554, Grade 36 and Grade 55.

1. Nuts: ASTM A 563.

2. Provide Grade 55 anchors where called for on drawings. Anchors 1 inch diameter and greater shall be Grade 55.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning ."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

2.5 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2. All shop welds inaccessible for field testing after fabrication must be shop inspected.

2.6 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Fabricator will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports or become an AISC-Certified Plant, Category STD.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Ultrasonic Inspection: ASTM E 164.

4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment's for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedment's showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Weld plate washers to top of baseplate.

3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated on contract documents.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165.

    b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

    c. Ultrasonic Inspection: ASTM E 164.

    d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 12 00

SECTION 05 50 00 S – METAL FABRICATIONS (STRUCTURAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes but not limited to:

1. Steel framing and supports for applications where framing and supports are not specified in other Sections.

2. General miscellaneous steel applications.

B. Related Sections:

1. Section 05 12 00 "Structural Steel Framing."

2. Section 09 91 23 “Interior Painting”

1.3 SUBMITTALS

A. Product Data: For the following:

1. Paint products.

2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

2. Contractor shall review all shop drawing submittal for compliance with design documents prior to submittal to architect for design concept review.

C. Welding certificates.

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

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

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

2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

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

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

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work Area, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Steel Plates, Angles, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500, cold-formed steel tubing.

2.3 FASTENERS

A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

B. Plain Washers: Round, ASME B18.22.1.

C. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

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

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces such that they are “hand smooth”.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Fabricate seams and other connections that will be exposed to weather such that they are sealed in a manner to exclude water. Provide weep holes where required to avoid water accumulation.

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

H. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches oc., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated and recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where exposed at exterior, or as indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.8 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with 2.0 mils dry film thickness (DFT) zinc-rich primer unless otherwise indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength/corrosion resistance of base metals.

2. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors. Provide epoxy anchors with screen tube inserts for fastening to hollow core concrete and clay brick masonry.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

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

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

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

END OF SECTION 05 50 00 S

SECTION 09 91 23 - PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.

2. Exposed surfaces of steel lintels and ledge angles.

3. Mechanical and Electrical:

a. Paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.

b. Paint shop-primed items.

c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.

d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

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. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.

6. Piping aluminium jacketing

7. Marble, granite, slate, and other natural stones.

8. Floors, unless specifically indicated.

9. Ceramic and other tiles.

10. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.

11. Glass.

12. Concealed pipes, ducts, and conduits.

1.2 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; 2014.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

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

F. SSPC-SP 1 - Solvent Cleaning; 2015.

G. SSPC-SP 13 - Surface Preparation of Concrete; Society for Protective Coatings; 2003 (Reaffirmed 2015).

1.3 SUBMITTALS

A. 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.

4. Manufacturer's installation instructions.

B. Samples for Initial Selection: Submit two paper chip samples, 2 by 2 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.

C. Samples for Verification: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 6 by 6 inch in size.

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

2. Where sheen is not specified, submit each color in each sheen available.

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

E. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Manufacturer and Applicator qualifications.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten (10) years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three (3) years documented experience and approved by manufacturer.

1.5 REGULATORY REQUIREMENTS

A. Conform to NYS Building code for flame and smoke rating requirements for products and finishes.

1.6 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 Fahrenheit and a maximum of 90 degrees Fahrenheit, in ventilated area, and as required by manufacturer's instructions.

1.7 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 Fahrenheit above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees Fahrenheit for interiors unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 degrees Fahrenheit for interior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

G. Provide independent mechanical ventilation of existing spaces, such that fumes are adequately exhausted out of the building and away from any open windows or air intake equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer, no exceptions.

B. Paints:

1. Benjamin Moore & Co: www.benjaminmoore.com.

2. PPG Paints: www.ppgpaints.com.

3. Pratt & Lambert Paints: www.prattandlambert.com.

4. Basis of Design (Unless Noted Otherwise): Sherwin-Williams Company: www.sherwin-williams.com.

C. Primer Sealers: Same manufacturer as top coats.

D. Block Fillers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

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

1. 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.

2. Supply each paint material in quantity required to complete entire project's work from a single production run.

3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Colors: To be selected from manufacturer's full range of available colors.

1. Selection to be made by Owner after award of contract.

2. Multiple paint colors will be selected. Colors will transition at corners or reveals.

3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.3 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, and wood. Match existing paint type and sheen.

1. Prepare wall to paint manufacturers requirements including wire bush all existing peeling or cracking areas and cement mortar patch all existing CMU holes prior to paint coat application.

2. Two topcoats and one coat primer.

3. Topcoat(s): Interior Latex or Interior oil base to match existing MPI #43, 44, 52, 53, 54, or 114.

a. Basis of Design Product(s):

1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.

2) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)

3) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel. (MPI #52)

4. Topcoat Sheen (to matching existing sheen):

a. Flat: MPI gloss level 1.

b. Eggshell: MPI gloss level 3.

c. Semi-Gloss: MPI gloss level 5.

1) Primer: As specified under "PRIMERS" below.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and exposed structural, mechanical, plumbing, and electrical metal items:

1. Medium duty applications include doors, door frames, railings, handrails, guardrails, balustrades, and intumescent surfaces; exposed structural steel, including but not limited to stairs and platforms; exposed pipes, ducts, conduits, and their associated supports.

2. Two topcoats and one coat primer.

3. Interior Light Industrial Coating, Water Based; MPI #153 or 154.

a. Basis of Design Product(s):

1) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss. (MPI #153)

4. Primer: As specified under "PRIMERS" below.

2.4 PAINT SYSTEMS - EXTERIOR

A. Cold Piping - Ferrous Metal: Provide the following finish systems over cold ferrous metal such as natural gas vent piping and other cold systems:

1. Semigloss, Alkyd-Enamel Finish: Two finish coats over a primer.

2. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for the substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.

3. First and Second Coats: Odorless, semigloss, alkyd, exterior enamel. Provide 2 coats over primer with a total dry film thickness of not less than 3.5 mils.

B. Hot Piping - Ferrous Metal: Provide the following finish systems over hot ferrous metal such as safety relief vent piping, and boiler stacks :

1. High Heat Silicone Alkyd: Two coats (prime coat and one full coat) to achieve a 1.5 mil dry film thickness. Modified silicone alkyd with aluminum paste pigment. System shall be designed for a continuous dry heat resistance temperature of 800 deg F and an intermittent temperature of 900 deg F. Shall be designed to resist thermal shock. Volume solids shall be 40% or greater. Weight shall be 9.0 lb/gallon. Provide color as directed by the Owner . One acceptable product is M64 Silicone Alkyd Hi-Heat Coating by Bengamin Moore & Co.

2. High Heat Multipolymeric Matrix Coating: Two coats of PPG H:-Temp 1027, each 5.0 to 6.0 mils dry film thickness. System shall be designed for continuous service to 1200 degrees F and intermittent to 1400 degree F. Shall be designed to resist thermal shock. Volume solids shall be 65% or greater. Weight shall be 16 lb/gallon. Provide color as directed by the Owner .

2.5 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Interior Institutional Low Odor/VOC Primer Sealer. All substrates, except where noted otherwise.

   a. Basis of Design Product(s):

      1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer.

2. Interior/Exterior Latex Block Filler ; MPI #4. Substrate; Concrete Masonry Surfaces.

   a. Basis of Design Product(s):

      1) Sherwin-Williams Loxon Block Surfacer.

3. Alkali Resistant Water Based Primer ; MPI #3. Substrate; Concrete Surfaces.

   a. Basis of Design Product(s):

      1) Sherwin-Williams Loxon Concrete & Masonry Primer/Sealer. (MPI #3)

      2) Sherwin-Williams PrepRite Interior/Exterior Block Filler. (MPI #3)

4. Interior Rust-Inhibitive Water Based Primer ; MPI #107. Substrate; Preprimed and Unprimed Steel.

   a. Basis of Design Product(s):

1) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer. (MPI #107)

5. Latex Primer for Interior Wood ; MPI #39.

a. Basis of Design Product(s):

1) Sherwin-Williams Multi-Purpose Latex Primer/Sealer. (MPI #39)

2.6 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 properly prepared.

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

C. Verify that ventilation systems are in place and operational.

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

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 are below the following maximums:

1. Gypsum Wallboard: 12 percent.

2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

4. Concrete Floors and Traffic Surfaces: 8 percent.

G. Proceed with coating application only after unacceptable conditions have been corrected.

1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

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. Surfaces: Correct defects and clean surfaces which affect work of this section.

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. Concrete:

1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

2. Prepare surface as recommended by topcoat manufacturer and according to SSPC-SP 13.

G. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.

2. Prepare surface as recommended by topcoat manufacturer.

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

1. Inspect surface after primer coat application and make additional repairs as required.

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

1. Apply etching primer immediately following cleaning.

J. Copper: Remove contamination by steam, high pressure water, or solvent washing.

K. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after

primer has dried, sand between coats. Back prime concealed surfaces before installation.

L. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried, sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

M. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

N. Corroded Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing, or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime and paint entire surface; spot prime after repairs.

O. Interior Shop-Primed Steel Surfaces for be Finish Painted: 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.

3.3 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.4 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

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

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

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

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

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand wood and metal surfaces lightly between coats to achieve required finish.

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

I. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

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

3.5 CLEANING

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

3.6 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.7 SPARE PARTS

A. Provide one unopened gallon of each paint product and color used to the Owner.

END OF SECTION

SECTION 23 00 10 - BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. All Division 22, 23, and 41 Sections reference and are governed by this section.

1.2 SUMMARY

A. This Section includes the following:

1. Codes conformance.
2. Coordination.
3. Record documents.
4. Maintenance manuals.
5. Cutting and patching.
6. Installation of equipment.
7. Grout.

1.3 CODE CONFORMANCE

A. Codes include but are not limited to the latest editions of the following:

1. ASME Power Piping Code B31.1.
2. International Building Code.
3. International Fire Code.
4. International Plumbing Code.
5. International Fuel Gas Code.
6. National Electrical Code (NEC)
7. New York State Codes

8. In addition, all applicable state and federal laws and regulations including but not limited to:

    a. New York State Executive Order No. 111

    b. Section 504 of the Federal Rehabilitation Act of 1973

    c. The Americans with disabilities Act (ADA)

    d. Section 8.812 Minimum energy Efficiency Standards (ASHRAE Standard 90)

    e. Applicable Life Safety Codes shall be incorporated herein by reference.

1.4 QUALITY ASSURANCE

A. Equipment and appurtenances shall be designed in conformity with ANSI, ASME, CEMA, IEEE, NEMA, OSHA, AGMA, ASTM, and other generally accepted applicable standards.

B. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI, CEMA, OSHA, and local industrial codes, including but not limited to, shaft guards on all rotating shafts, cages around exposed fan blades, etc.

C. All mechanical work shall be performed by mechanics who are qualified to do such work and who are normally engaged in this type of work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Materials shall be new and shall conform to the materials specified on the Contract Drawings and as follows:

1. Shim stock used in leveling and alignment shall be Type 304 stainless steel.

2. Leveling plates and blocks shall conform to ASTM A 36. Steel plate stock with a thickness of 1/2-inch or less shall have sheared edges; thicker stock may be flame cut with burrs removed.

3. Grout shall be an approved premixed, prepackaged, nonshrink grout which requires only the addition of water. Grout shall be nonshrink, nonmetallic, and in accordance with ASTM C 1107, Grade B.

    a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

    b. Design Mix: 5000 psig, 28-day compressive strength.

PART 3 - EXECUTION

3.1 COORDINATION

A. It is the responsibility of the mechanical contractor to coordinate the work of his trade with all other trades prior to the commencement of construction. It is the responsibility of the contractors to provide, in his original bid, all necessary offsets, fittings, and transformations to provide a complete project. Any conflicts must be brought to the attention of the Engineer. Any work requiring removal and reinstallation due to the lack of coordination shall be the responsibility of the contractors with no additional cost to the Owner.

B. Coordination Documents

1. Coordination Drawings: Detail all elements, components, and systems of architectural, structural, mechanical, HVAC, plumbing, and electrical equipment and materials in relationship with other existing and new systems, installations, and building components. Show space requirements for installation, clearances, and access. Prepare comprehensive coordination drawings including all trades for submission at no less than ⅜” per foot for the entire building and each mezzanine. Electrical equipment rooms shall be drawn seperately at a scale not less than ½" per foot scale. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

   a. Planned piping layout, including equipment clearances, flowmeter straight pipe requirements, valve, strainers, and other specialty locations. Include valve handwheel, actuator, and valve stem movement.

   b. National Electric Code clearances

   c. Clearances for installing and maintaining insulation.

   d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly, tube replacement, burner replacement, and periodic maintenance.

   e. Equipment and accessory service connections and support details.

   f. Exterior wall, fire wall, and foundation penetrations.

   g. Size and location of required concrete pads and bases.

   h. Scheduling, sequencing, movement, and positioning of large equipment into out from, and onto building and surrounding site during construction.

i. Floor plans, elevations, and details to a scale not less than ½-inch per foot to indicate a detailed and fully coordinated installation process with the approved equipment and materials scheduled for installation.

j. New and existing structural steel components including building steel, mezzanine level structures, roof structures, catwalks, platforms, piping support structures, and all other major structural elements.

2. The plans and/or specifications may indicate that the Architect/Engineer designed or detailed a portion of the plans around a particular product (most commonly a piece of equipment). Should a different product be proposed by the Contractor and accepted, all modifications, rerouting, relocations and variations required for proper installation and coordination to comply with the design concept and requirements of the Contract Documents shall be the responsibility of the Contractor and shall be made at no extra cost to the Owner.

C. During coordination meetings discuss amongst the contractors scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3.2 MAINTENANCE MANUALS

A. OPERATING INSTRUCTIONS AND MANUALS. Include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. One complete set of non-reproducible (white print or blue print) as-built drawings.

6. A copy of all of the satisfactory reviewed submittals.

3.3 INSPECTION

A. Prior to performing work required, carefully inspect all existing conditions and the installed work of all other trades and verify that all conditions and all such work is complete to the point where the mechanical work may properly commence.

B. In the event of discrepancy, immediately notify the Consultant.

3.4 QUALITY ASSURANCE

A. Ample clearance shall be provided for repairs, inspection and adjustment. Protruding members such as joints, corners and gear covers shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

B. Secure and pay for all necessary fees, permits, and approvals, as required for the work of this Section.

3.5 CUTTING AND PATCHING

A. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.

2. Remove and replace defective Work.

3. Remove and replace Work not conforming to requirements of the Contract Documents.

4. Remove samples of installed Work as specified for testing.

5. Install equipment and materials in existing structures.

3.6 PERFORMANCE

A. Perform all work that is essential in completing the intended installation in the proper manner.

B. Field verification of all dimensions is required.

C. Wherever obstructions are encountered in the path or course of the work that are not shown nor anticipated in the Contract Documents, do not proceed with the installation of the work before advising the Engineer and receiving detailed information or drawings or both.

3.7 INSTALLATION OF EQUIPMENT

A. All equipment shall be installed true, level and in the location shown on the Drawings. Precision gauges and levels shall be used in setting all equipment.

B. Furnish, install and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment.

C. All equipment shall be installed in such a manner as to provide access for routine maintenance, including lubrication.

D. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed.

E. All foundations, anchor pads, piers, thrust block, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.

3.8 INSTALLATION

A. Technical Erection Supervision:

1. Work performed without the assistance of the manufacturer's technical erection supervisor shall adhere to dimensional requirements, assembly methods, and installation procedures specified herein and in the manufacturer's instruction manuals and drawings.

2. The Contractor shall comply with erection and installation methods, techniques, sequence, and procedures requested by the manufacturer's representative, if the manufacturer's representative is present.

3. Where manufacturer's written instructions differ significantly from those proposed by the manufacturer's technical erection supervisor, the Consultant shall determine the method to be used.

B. Manufacturer's Drawings and Instruction Books: Manufacturer's drawings and instruction books for Owner-furnished equipment and materials to be installed will be made available to the Contractor. Upon completion of the Work, all instruction books shall be returned to the Owner.

C. Preinstallation Requirements:

1. Protection:

a. The Work, material, and equipment installed by the Contractor shall be adequately covered and protected against dirt, water, frost, chemical, and mechanical damage. The Contractor shall make good, at his own expense

by repair or replacement as directed by the Owner and by using approved equivalent materials, any and all damages to equipment or buildings caused directly or indirectly by his workmen, workmanship, or by his failure to properly protect his Work.

b. Equipment that may be damaged by freezing shall be checked to insure that all water has been drained from the unit prior to placing the equipment in storage or on its foundation.

c. The shafts of assembled rotating equipment shall be rotated a minimum of once per week while in storage, unless the manufacturer's instructions advise otherwise. Bearings shall be checked to insure lubrication prior to rotating.

d. Material shall not be stacked or piled on finished surfaces unless the surfaces are positively protected by substantial wooden covers rigidly secured in place. Finished bottom surfaces shall be set only on clean, dry wooden dunnage.

2. Foundations: Foundations shall be checked to determine that there are no omissions or errors in the equipment locations, anchor bolt locations, and projections from that shown on the Drawings. The Owner shall be notified if a foundation is determined to be defective or incorrect.

3. Cleaning:

a. Protective coatings, shipping protection, oil, grease, and loose material shall be removed from the surfaces of the equipment.

b. Grease- and oil-lubricated bearings shall be thoroughly inspected for contamination. Any contamination shall be thoroughly cleaned with the manufacturer's/Owner's recommended solvent prior to lubrication.

c. Just prior to assembly, all finished surfaces shall be uncovered and thoroughly cleaned of loose paint, foreign matter, and rust. Rust shall be removed by means of a high-grade rust remover applied with lint-free cloths.

d. The underside of all equipment shall be cleaned of all dirt, oil, grease, and loose material. Foundation anchor bolts shall be straightened and the threads rerun with a suitable die prior to setting the equipment on its foundation.

D. Equipment Handling: Proper and adequate handling equipment and rigging shall be used at all times. Equipment and rigging shall be examined and checked at frequent

intervals. The weights and dimensions of the equipment shall be obtained from the manufacturer's drawings, as required, to insure the use of adequate equipment.

E. Leveling: Leveling shall comply with the manufacturer's leveling instructions or with the following procedure where the manufacturer's instructions are not available:

1. Equipment shall be lowered over foundation bolts holding the underside of the base a minimum of 1 inch above the surface of the foundation to allow adequate space for grouting.

2. Units equipped with leveling screws: Rectangular steel leveling blocks shall be placed on the foundation close to and straddling each foundation bolt. Additional steel leveling blocks shall be placed directly under all parts of base which carry direct heavy loads. Leveling blocks shall be placed close enough to give uniform support and shall not project excessively beyond the edge of the base. Each block shall rest solidly on good concrete.

3. With the unit resting on leveling blocks, the unit shall be adjusted to alignment and elevation established by the Drawings. Level shall be checked in both directions with a precision level.

4. Shims shall be installed, as required, to maintain even weight distribution on all leveling blocks. In building up shim height, thickness shall be selected to minimize the number of shims required. If wedges are used in adjusting elevation, the base shall be supported in the final level position entirely by the leveling blocks and not partially by wedges.

5. Level of base shall be determined by use of accurate precision spirit levels, resting wherever possible on leveling pads or clean, finished surfaces. Painted surfaces shall not be used as a datum for checking level.

6. When the unit has been satisfactorily leveled in all directions, the foundation bolts and nuts shall be drawn down tight.

F. Alignment:

1. After leveling, shafts of all machinery utilizing shaft couplings between drivers, speed reducers, and the equipment shall be carefully and accurately aligned.

2. Couplings on factory-assembled equipment shall be disconnected and checked for alignment in accordance with the manufacturer's recommendations. Alignment shall be documented and the Owner and Consultant shall have the right to witness alignment and documentation.

3. All necessary corrections shall be made to meet manufacturer's tolerances for both types of misalignment defined below:

    a. Angular misalignment – Shafts having axes neither concentric nor parallel.

    b. Parallel misalignment – Shafts having axes parallel but not concentric.

4. Flexible Shaft Couplings: The minimum dimensions for the separation of coupling halves shall rigidly adhere to the manufacturer's drawings or instructions. In lieu of manufacturer's specifications, the following procedure shall apply:

    a. Faces of coupling halves shall be spaced to prevent contact when shafts are rotated.

    b. Angular alignment shall be checked by means of feeler gages inserted between faces of couplings.

    c. Gage readings shall be taken at four points spaced at 90-degree intervals around the coupling. Both shafts shall be rotated 180 degrees, and a second set of gage readings shall be taken. When all gage readings taken in both shaft positions correspond, the shafts are in angular alignment.

    d. Parallel alignment shall be checked by placing a straight edge across both coupling rims. It shall be checked at two points 90 degrees apart. Necessary horizontal and vertical adjustments of machine components shall be made. When the straight edge rests evenly on the coupling rims in all positions, the shafts are in parallel alignment.

    e. Machine components shall be shimmed underneath to adjust shaft misalignment. Total shim thickness shall not exceed 1/4 inch; excess thickness shall be corrected by relocating base or sole plates. Shims shall be selected to minimize the number of shims required.

    f. Where each coupling half has a different diameter, an appropriate type of gage shall be used in combination with a straight edge.

5. Gear-Type Shaft Coupling: Gear-type coupling shall be gaged and aligned essentially as specified above for flexible shaft couplings, except that coupling covers shall be pulled back and all gaging shall be performed on the coupling hubs.

6. Spacer-Type Coupling:

    a. Angular misalignment shall be checked essentially the same as for flexible shaft coupling by substituting inside micrometers for taper or feeler gages.

b. Spacer section of coupling shall be removed while all gaging is being performed.

c. Parallel alignment shall be checked by means of a rigid, L-shaped bracket bolted to the face of one coupling half and used in combination with an indicator or feeler gage applied between extended bracket arm and periphery of opposite half of spacer coupling.

7. Dial indicator gages may be used in combination or in lieu of gage specified above. Indicator-type gaging techniques shall be subject to Consultant approval.

G. Bearings:

1. Where available, manufacturer's instructions shall be followed for handling, mounting, and lubrication of bearings.

2. Bearings requiring forced-fit installation shall be mounted by the application of uniformly distributed pressure, squarely applied. Hammering shall not be permitted. Brinelled bearings shall be replaced.

3. Drip ring-type bearings:

a. During erection of equipment, each dip ring-type bearing shall be checked for the presence of the dip ring which shall be in place and free to revolve on shaft.

b. Immediately at onset of tests and startups, each dip ring type bearing shall be checked to insure that dip ring is rotating freely. Where ring fails to rotate, operation shall be stopped immediately, and ring shall be adjusted or replaced.

H. Gaskets: Gaskets shall be installed in proper alignment, free of tears and wrinkles. Bolts shall be tightened evenly all around to insure uniform stress over the entire gasket area.

I. Guards: Guards shall be installed and adjusted over all exposed rotating mechanisms, such as shaft couplings, V-belt drives, and similar devices, following rotational checks.

J. Grouting of Rotating Machinery:

1. Equipment shall be grouted as specified herein. The premixed grout shall be delivered to the site in the manufacturer's original container. Each package of premixed grout shall be accompanied by printed instructions from its manufacturer for mixing, placing, and curing and shall include temperature limitations for use of the grout.

2. Mixing: Premixed grout shall be mixed in accordance with the manufacturer's instructions. The water to grout ratio shall not exceed that shown on the manufacturer's test results for the desired strength. Water mixed with grout shall be a minimum and shall not exceed the quantity required to make the grout placable.

3. Before grouting, the Owner's written approval shall be obtained to proceed with each piece of equipment. Unless specified otherwise, the equipment to be grouted shall be in place on its foundation, leveled, aligned, and completely assembled.

4. Rigid connections to equipment shall not be made until grout has been placed and allowed to cure for a minimum of 5 days.

5. Surface Preparation and Forms:

    a. The surface of the concrete shall be either bush hammered or chipped to present a sound, rough surface free of laitance, oil, and other contamination.

    b. The baseplate undersurface shall be cleaned of loose rust, mill scale, oil, grease, and other foreign materials before being set into place.

    c. The concrete surface anchor bolt holes shall be thoroughly saturated by being maintained visibly wet for 24 hours immediately before grout is placed. Standing water, including water in anchor bolt holes, shall be removed before grout is placed.

    d. Formwork shall be fixed around each baseplate to the level of the top of the plate or to above the level of high, trapped areas under the plate, whichever is higher. Forms on the pouring side of the plate shall be raised to provide a sufficient head for the grout to flow under the plate. Forms shall be caulked on the inside to prevent leakage, using the same grout material as is to be poured but mixed to a plastic consistency.

6. Placement of Grout:

    a. Anchor bolt holes shall be filled first. If interference from formwork is anticipated, anchor bolt holes may be filled a day or two in advance, provided presoaking of the concrete is resumed as soon as the holes have been filled.

    b. Grout shall be poured from only one side of the plate, starting at one corner and moving across the same side to the other corner, until the entire space is filled and the grout is visible on the opposite side at the top

of the plate.

c. The grout may be kept flowable during short pauses in pouring by working it with flat steel straps (not chains), preferably inserted from pouring side.

d. Grout shall not be placed when the temperature of air, plate, or foundation concrete is below 45 degrees F or the temperature specified by the manufacturer, whichever is higher. The temperature of the grout shall be maintained at a minimum of 45 degrees F or in accordance with the manufacturer's instructions, whichever is higher, for 24 hours after the grout has been placed. Thereafter, it shall be maintained above freezing until the grout has attained a compressive strength of 3000 psi or for 6 days, whichever occurs first.

e. If the ambient temperature exceeds 80 degrees F, the baseplate and concrete shall be cooled by means such as shading and placing soaking burlap on the baseplate before grouting is begun.

f. Whenever sufficient handling and placing time is desired at ambient temperatures near 80 degrees F, iced mixing water may be used in place of some of the batch water to extend the usable life of the grout, provied the temperature of the grout after mixing is not below 45 degrees F. The total of water plus ice shall not exceed the mix design water content.

7. Finishing and Curing: Grout shall be cured as follows, unless the manufacturer recommends otherwise:

a. As soon as grout reaches initial set (such that grout is not damaged by wet cloth or burlap), all exposed surfaces shall be covered with cloth or burlap which shall be maintained constantly wet until forms are stripped to prevent moisture loss from grout. When multiple lifts are used, the grout shall be covered with wet cloth or burlap for 48 hours after each lift.

b. When grout has thickened sufficiently to be troweled, any excess grout that has spilled over and accumulated on top of the plate shall be removed until grout is flush with the top of the plate. The curing cloth may be removed temporarily for this purpose.

c. Forms shall not be removed nor grout disturbed below the level of the underside of the plate until grout is sufficiently hard that it cannot be penetrated by the point of a hand-held trowel.

d. After removal of forms, the exposed edges of the grout shall be chamfered or bullnosed and all exposed surfaces coated with curing compound.

e. Unless the Drawings indicate otherwise, shims shall remain in place for at least 48 hours after completion of the grouting and then shall be removed. After removal of shims (or screws), voids shall be filled or back-packed with grout.

8. Rechecking Level and Alignment After Curing Grout:

a. After grout has cured a minimum of 5 days and after rigid connections have been made, level and alignment of the equipment shall be checked completely, and all adjustments necessary to correct level and alignment shall be made.

b. Where possible, shims required for adjustments between component parts of the equipment shall be installed without disturbing the bond between the grout and under the surface of the equipment base.

c. Where the necessary level and alignment adjustments require breaking of the bond between the equipment base and grout, the original grout shall be removed and the base regrouted after completion of leveling and alignment.

9. Securing Foundation Bolts: The foundation bolt nuts shall be tightened securely, after confirmation of correction of equipment level and alignment on the grout, in accordance with manufacturer's torque requirements. Leveling screws shall be backed off at this time so that equipment is supported on the grout. If the manufacturer's torque requirements are not provided, the foundation bolt nuts shall be tightened to the following minimum torque requirements.

a. ½ inch dia 15 lb ft

b. 5/8 inch dia 25 lb ft

c. ¾ inch dia 40 lb ft

K. Doweling: Doweling, where required by manufacturer's drawings and instructions or where directed by the Owner, shall be installed only after hot and cold initial operation of equipment, unless the manufacturer's instructions advise otherwise. The holes shall be drilled and reamed, as necessary, to install the dowels.

3.9 CLEANING AND LUBRICATION

A. Cleaning and Flushing after Equipment Installation:

1. Force-feed lubricating systems shall be cleaned and flushed in accordance with the manufacturer's instructions prior to lubricating the system.

2. Tank internals shall be cleaned and inspected prior to placing in service.

3. The Contractor shall be responsible for any damage to equipment and piping caused by dirt, chips, and any foreign materials.

B. Lubrication:

1. Prior to starting the equipment, the Contractor shall insure that all parts, particularly bearings, are properly lubricated in accordance with the manufacturer's instructions and that all lubricating systems are completely operational with all valves and controls adjusted and properly sequenced. Any damage caused by failure to lubricate properly shall be repaired by the Contractor at no cost to the Owner.

2. Excluding bearings served by centralized lubricating systems, the lubricant levels shall be as follows:

   a. Grease-lubricated bearing housings shall be approximately one-third full of grease, never packed completely full.

   b. Oil-lubricated bearings on horizontal shafts shall have the oil level approximately even with the centerline of the lowermost ball or roller when the bearing is stationary.

3. Rotating equipment packing gland nuts shall be backed off until slight leakage of seal water occurs.

END OF SECTION

SECTION 23 03 00 - BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Specification Sections:

1. All Division 23 Specification Sections

1.2 SUMMARY

A. This Section describes general mechanical demolition and installation requirements.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."

1.4 COORDINATION

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

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

C. Coordination Documents

1. Coordination Drawings: Detail all elements, components, and systems of architectural, structural, mechanical, HVAC, plumbing, and electrical equipment and materials in relationship with other existing and new systems, installations, and building components. Show space requirements for installation, clearances, and access. Prepare comprehensive coordination drawings including all trades for submission at no less than ⅜” per foot for the entire building and each mezzanine. Electrical equipment rooms shall be drawn seperately at a scale not less than ½" per foot scale. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

a. Planned piping layout, including equipment clearances, flowmeter straight pipe requirements, valve, strainers, and other specialty locations. Include valve handwheel, actuator, and valve stem movement.

b. National Electric Code clearances

c. Clearances for installing and maintaining insulation.

d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly, tube replacement, burner replacement, and periodic maintenance.

e. Equipment and accessory service connections and support details.

f. Exterior wall, fire wall, and foundation penetrations.

g. Size and location of required concrete pads and bases.

h. Scheduling, sequencing, movement, and positioning of large equipment into out from, and onto building and surrounding site during construction.

i. Floor plans, elevations, and details to a scale not less than ½-inch per foot to indicate a detailed and fully coordinated installation process with the approved equipment and materials scheduled for installation.

j. New and existing structural steel components including building steel, mezzanine level structures, roof structures, catwalks, platforms, piping support structures, and all other major structural elements.

2. The plans and/or specifications may indicate that the Architect/Engineer designed or detailed a portion of the plans around a particular product (most commonly a piece of equipment). Should a different product be proposed by the Contractor and accepted, all modifications, rerouting, relocations and variations required for proper installation and coordination to comply with the design concept and requirements of the Contract Documents shall be the responsibility of the Contractor and shall be made at no extra cost to the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PIPING SYSTEMS – COMMON DEMOLITION REQUIREMENTS

A. Preparation:

1. Provide and erect such temporary supports as are required for the work and for pipe and equipment affected by the work.

2. Prevent damage to existing equipment, electrical conduit and wiring, foundations, piping and other services to remain intact and functional after demolition.

3. Do not disable or disrupt fire piping, fire alarms or other safety systems without written permission from the Campus.

4. Furnish, erect, and maintain approved barriers around dangerous areas of operation.

5. Furnish, erect, and maintain approved Danger, Warning and Keep Out signs at locations necessary for general safety.

B. Requirements:

1. Conduct demolition to minimize interference with adjacent areas.

2. Immediately cease demolition when dangerous conditions develop such as structure instability. Notify the Campus immediately.

3. Cease demolition work immediately when hazardous materials are discovered. Notify Campus for approval of an acceptable course of action.

4. Prior to cutting or disconnecting any electrical cables, de-energize, lock-out and tag the circuit. Do not cut or remove any energized cable.

5. Remove demolished materials from the site unless otherwise directed by the Campus. Transport demolished materials and rubbish safely to avoid injury to personnel and spillage on roadways or adjacent area. Adhere to federal, state and local regulations.

6. Remove demolished materials from the site as work progresses. Upon completion of work, leave areas in clean condition.

7. All cutting and burning torch operations that produce sparks shall be controlled to prevent fire and damage in accordance with NFPA 51B. Existing facilities, such as electrical conduit, and equipment, shall be adequately protected from such operations.

3.2 PIPING SYSTEMS – COMMON INSTALLATION REQUIREMENTS

A. Piping Installation:

1. Piping cuts for piping connections to be used in the final installation shall preferably be made by sawing or machining. If arc and torch cutting are used, the cut shall be smooth and true and shall be cleaned of all slag. Wherever piping cuts are made at the location of existing welds, the existing weld shall be removed completely as part of the new weld preparation. In the layout of modifications to existing piping, butt welds shall be spaced a minimum of 6 inches apart. Any deviation from this shall be approved by the Consultant.

2. Piping shall be erected in accordance with the plans and sections, as shown on the Drawings. Piping elevations and locations of existing lines may not reflect as-built conditions and shall be verified before erecting new piping. The Contractor shall take extra care to assure correctness of all cut lines when connecting to existing piping. The Contractor shall also verify dimensions of all shop-fabricated piping assemblies prior to fabrication.

3. Piping shall be installed straight without kinks or pockets and shall be parallel or perpendicular to building walls, beams, and girders. Vertical piping shall be installed straight and plumb. Full lengths of pipe shall be used, where possible; couplings and short lengths of pipe shall not be used where a single length can be used.

4. The Contractor shall endeavor to erect prefabricated pipe lines before the erection of field-fabricated piping in the same area.

5. Final piping system closure welds shall be made at the equipment nozzle connections and shall not be made until final equipment alignment has been completed.

6. Piping shall be installed so as to allow expansion and contraction without placing excessive stresses in piping, anchors, or equipment.

7. Authorization by the Campus shall be obtained prior to welding or attaching temporary pipe supports, scaffolding, lugs, and structural shapes to the building steel or equipment in questionable locations. These items shall be removed when installation is complete. Temporary welds shall be removed by cutting. Breaking of welds is prohibited. Weld metal remaining on the steel surfaces shall be removed by grinding to produce a surface equal to the original surface in the immediate area. The ground surface shall be visually examined to insure that the area is free of cracks and undercuts. Undercutting of structural steel shall be repaired by welding and grinding smooth. Temporary welds shall not be permitted on the surface of previously erected adjacent piping, pipe supports, or vessels. The surface of adjacent piping shall be protected from strikes and weld spatter.

8. Except where the Drawings show otherwise, minimum headroom clearance shall be 6’ – 8” under piping in buildings and under access platforms and walkways.

9. The use of pliers or pipe wrenches for tightening nuts or tubing connectors is prohibited. Proper cutting, forming, and assembling tools shall be used in the erection of all tubing. Tubing shall not be cut with a hacksaw.

10. Drains shall be piped to the nearest floor drain or contaminated water return; no drain shall spill on the floor.

11. Horizontal drainage lines shall be laid to a uniform pitch of 1/4 inch per foot, if practical, but in no case less than 1/8 inch per foot, except when the Drawings specifically show otherwise.

12. Bending of pipe shall not be permitted, unless specifically shown on the Drawings or permitted by the Piping Specifications.

13. The Contractor shall be responsible for the repair of all leaks detected during the pressure tests specified herein.

14. Insulation shall not be applied over piping prior to completion of testing. Welds or other type joints shall not be painted prior to completion of testing.

15. Cold pulling or jacking of pipe to bring weld ends into alignment or to obtain clearances for equipment removal shall be held to a minimum. Pulls resulting in pipe movements greater than 3/8 inch shall be approved by the Consultant before proceeding.

16. Throughout the entire system there shall be as few joints as possible.

17. Where interferences are found in the field, such as between piping, conduit, air and cable ducts, and electrical boxes, it shall be the responsibility of the Contractor to resolve the problem with the Consultant before proceeding with the work.

18. The Contractor shall be responsible for checking and confirming size, location, and flange drilling of all piping, valves, and material furnished to him by the Campus for installation in pipe lines herein specified.

19. All bolts in flanged construction shall be uniformly tightened with proper wrenches. Hammering and bumping shall be prohibited. Care shall be taken to obtain uniform pressure on the gasket and to avoid overstressing to the bolts, dishing of the flanges, and compression of the gasket beyond its proper limits.

20. Piping shall be checked inside and outside before installation to see that it is clean. Loose material, including rust, mill scale, and foreign matter, shall be removed.

21. Particular care shall be used in assembling the piping to prevent loose materials from getting into the piping system or equipment during erection of the piping. Every precaution shall be taken to keep the piping clean and free from internal dirt and debris.

22. All openings for pipe connections, all equipment access openings, and all open-ended pipes not being worked on during installation or in use otherwise shall be covered with temporary covers made of plywood, sheet metal, or plastic.

23. Proper cutting, forming, and assembling tools shall be used in the erection of tubing. Tubing shall not be cut with a hacksaw.

24. Terminals:

    a. Where the piping connects to equipment or piping furnished in place by Others, such connections shall be made by the Contractor, who shall properly complete the connections in each case.

    b. All material, accessories, and fabrication for such piping shall conform to the requirements specified herein. Extreme care and judgment shall be used in routing small pipe, tubing, and conduit which is shown only diagrammatically on the Contract Drawings. Sufficient clearance shall be provided under and/or around hatchways, galleries, monorails, removable slabs, temporary end walls, and clearance required for access to equipment and valves, for maintenance, operation, inspection, and the like. Routing of small pipe and tubing shall be subject to review and acceptance by the Campus. The Contractor shall relocate, at his own expense and without cost to the Campus, any such small piping and tubing which does not conform to these requirements.

B. Field-Routed Piping:

1. Piping size 2” NPS and smaller shall be routed in the field according to this Specification and the Schematics or P & ID Contract Drawings. Connections to larger piping and equipment are shown on the Piping Drawings. Materials shall conform to the Piping Specifications.

2. Pipe shall be routed in the most direct manner without interfering with other piping, equipment, electrical cable trays, or the like. Piping should follow the general physical routing of larger piping to give a neat appearance, minimize interference with future piping.

3. Piping shall be located so as not to interfere with operation or maintenance of the equipment. Valves requiring frequent operation shall be readily accessible.

4. If vapor pockets are unavoidable, high point vents shall be installed equipped with a valve so that the line may be filled and tested. Low points shall have a valve drain. Vent and drain size shall be minimum 3/4 inch NPS.

5. Care shall be taken to locate lines so that there is clearance for any required insulation.

6. Pipe shall be adequately supported so that thermal growth is not restricted and deflection of the pipe due to the weight of the contents and insulation is minimized.

C. Planning and checking has been done to minimize as far as possible, interferences or conflicts between new piping and new or existing obstructions. However, prior to beginning the erection of each line, the Contractor shall ascertain that no interference will be encountered, thereby precluding the necessity of disassembling of partially or completely erected systems for rerouting to clear obstructions which may exist. Where any interference is encountered, the Contractor shall obtain the approval of the Consultant for a routing to clear the interference. After such approval has been obtained, the Contractor shall proceed with erection. In no case shall the Contractor be entitled to extra compensation for taking down or dismantling work which has been erected or pre-fabricated except such pre-fabrication that has been called for in the specification or on the drawings, or unless specifically authorized in writing by the Consultant.

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

1. Cut sleeves to length for mounting flush with both surfaces.

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

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 1/2-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install galvanized steel pipe for sleeves smaller than 6 inches in diameter.

2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and

make watertight seal.

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 Inches and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 Inches and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 PAINTING AND FINISHING

A. Painting of mechanical systems, equipment, piping, and components shall be by the Contractor in accordance with Section 23 05 53 – Identification for HVAC Piping and Equipment.

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

END OF SECTION

SECTION 23 05 00 - BASIC PIPING MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary General Conditions and other Division 01 through 41 Specification Sections and Contract Addenda apply to this Section.

B. Requirements of the following Specification Sections apply to this Section:

1. Section 23 05 23 - VALVES

2. Section 23 05 50 - GASKETS

1.2 DESCRIPTION OF WORK

A. This Section specifies piping materials and installation methods common to more than one section of Division 23 and includes basic piping installation instructions.

B. Pipes and pipe fittings furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division 23 Sections and in general shall comply with the requirements of this Section.

C. All work shall be performed in accordance with the fabrication, installation, installer, and inspection requirements of the latest edition of ASME B31.1.

D. Weld Testing and Inspection will be performed by an independent testing agency provided by the Contractor. The Contractor shall coordinate all test scheduling and procedures with the Campus and the Consultant.

1.3 SUBMITTALS

A. Product Data: Submit the following:

1. Manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Indicate country of origin and fabrication.

2. Piping schedule showing manufacturer, ASTM number, ASTM type, ASTM grade, pipe or tube weight, fitting type, and joint type for each piping system. Indicate country of origin and fabrication.

3. The piping and accessories submittal shall clearly describe what components are going to be used for each piping group.

4. Records and reports required for certain pipe groups as specified in individual piping group specifications.

B. Quality Control and Welding Quality Control Submittals: Submit the following:

1. ISO 9001 and Independent Test Reports: As specified in Quality Assurance below.

2. Welder Qualification Data: Copies of certification of welders performing work on this project.

3. Welding Procedures: Shall include QW-482 "Suggested Format for Welding Procedure Specification (WPS)" and QW-483 "Suggested Format for Procedure Qualification Record (PQR)" as specified in Welding Quality Assurance below for different weld types.

4. Welders' Certificates: Shall include QW-484 "Suggested Format for Manufacturer's Record of Welder or Welding Operator Qualification Tests (WPQ)" for all welders for all weld types as specified in Welding Quality Assurance below.

5. Welder Identification List identifying each welder, their welding qualifications, and thier current welding continuity log.

6. Hot Tap Procedures and Components: Must include verification of coordination with Contractor’s valve selection, weld procedures, and actual physical geometry of installation(s) for this project.

C. Piping Tests: Submit the following:

1. Hydrostatic Testing Records: The Contractor shall maintain a constantly updated log (as described in this Section) available to the Consultant and Campus at all times. The Contractor shall submit a final log to the Campus for his records.

2. ASME Section I Inspection Records: Provide for all Section I Code piping as specified in this Section.Welder Identification List.

3. Visual Examination Examiners Qualifications: Provide as specified in this section.

4. Radiographic Exammation Examiner's Qualifications: Provide as specified in this section.

5. Independent Testing Agency Information: The Contractor and the Independent Testing Agency shall provide a signed statement that the testing agency has no affiliation with the contractor, and can serve as an independent agency to provide testing as specified.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with the latest editions of the publications of the following Agencies to the extent referenced in this Specification:

1. ANSI - American National Standards Institute.

2. ASHRAE – American Society of Heating, Refrigeration, and Air-Conditioning Engineers

3. ASME - American Society of Mechanical Engineers

4. ASTM - American Society for Testing and Materials

5. AWS - American Welding Society

6. NFPA - National Fire Protection Association

7. PFI - Pipe Fabrication Institute

8. UL - Underwriter's Laboratories, Inc

B. All piping systems with the exception of storm sewer, and sanitary piping shall be designed, fabricated, erected, and tested in accordance with ASME B31.1.

C. Special Precautions

1. Torch cutting will be permitted only with the specific written approval of the Owner.

2. Any cutting method, which may create sparks, must include "Fire Watch". Submit "Fire Watch" procedure for approval.

3. Draining operations must not damage building components or endanger human health.

D. Country of Fabrication:

1. All piping, fittings, and piping accessories not manufactured, fabricated, and/or assembled in the United States of America or Canada must be manufactured, fabricated, and/or assembled by an ISO 9001 registered corporation.

2. Submit ISO 9001 registration certificates for all corporations where the piping, fittings, and piping accessories are not manufactured, fabricated, and/or assembled in the United States or Canada.

3. For all piping, fittings, and piping accessories not fabricated in the United States or Canada, submit an independent test report for all materials to be provided.

4. No piping, fittings, and piping accessories manufactured, fabricated, and/or assembled in China, including Taiwan, are permitted to be provided in this Contract.

1.5 WELDING QUALITY ASSURANCE

A. Welding Procedures: In the form of a submittal, the Contractor shall record in detail and shall qualify the Welding Procedure Specifications for every welding procedure that he proposes. Procedures shall be developed for all metals included in the work. The procedures for making transition welds between different materials or between plates or pipes of different wall thickness shall be qualified. Qualification for each welding procedure shall conform to the requirements of ASME B31.1, and to this specification. The method for each system shall be fully described including the number of beads, the volts, the amperes, and the welding rod for various pipe thicknesses and materials. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by approved welding procedures, unless otherwise indicated or specified. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be clearly referenced to the type of welding required for this project. These procedures shall be the same as those used for all pipe welder qualification tests, all shop welds, and all field welds. The Contractor shall provide Procedure Qualification Records for all proposed Welding Procedure Specifications (WPS).

B. Welding Procedure Submittals: Submit the following:

1. Welding Procedure Specifications: Provide for each weld type. The Contractor shall use ASME Form E00006, QW-482 "Suggested Format for Welding Procedure Specification (WPS)".

2. Procedure Qualification Records: Provide for each weld type. The Contractor shall use ASME Form E00007, QW-483 "Suggested Format for Procedure Qualification Record (PQR)".

C. Welder Qualification:

1. WPQs: Provide welder qualifications for each welder for each weld type. The Contractor shall use ASME Form E00008, QW-484 "Suggested Format for Manufacturer's Record of Welder or Welding Operation Qualification Tests (WPQ)." The WPQs shall be performed under the witness of an independent agency. The witness shall be a representative of an independent testing agency, Authorized Inspector, or consultant, any of which must be approved by the

National Certified Pipe Welding Bureau. The qualifying test segment must be a 2 inch nominal pipe size with wall thickness within range of the WPS. Tests position shall be "6G" per ASME Section IX.

2. Evidence of Continuity: Welder qualifications must be current. If the qualification test is more than 6 months old, provide record of welding continuity for each welder. Record of welding continuity shall show that the welder in question has performed welding to the procedure in question without a 6 month continuous span of inactivity since the date that the welder qualification test was passed for the submitted welding procedure. Record of welding continuity shall include, at a minimum, the welder's employer name and address, the date the welder qualification test was passed, and the dates indicating welding continuity including welding procedure for each date.

D. Weld Records:

1. For all welding within the scope of ASME B31.1, the Contractor shall submit to the Engineer for approval an administrative procedure for recording, locating, monitoring, and maintaining the quality of all welds to be performed on the project. This quality control document record shall include but not be limited to drawings and schedules identifying location of each weld by individual number, identification of welder who performed each weld by individual welder's name, stamp number, date and WPS used.

2. After achieving qualification, but before being assigned work, each qualified person shall be assigned an identifying number by the Contractor that shall be used to identify all of his welds. A list of qualified persons with their respective numbers shall be submitted by the Contractor and shall be maintained accurately with deletions and additions reported promptly.

3. Upon completing a joint, the welder shall mark the pipe not more than 6 inches from the weld with the identifying number and the last two digits of the year in which the work was performed. Identification marks shall be made by using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Engineer that does not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3-foot intervals. Identification by die stamps or electric etchers will not be allowed. The markers are to be provided by the Contractor. Substituting a map of welds with welders' names shall not be acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Pipe Storage: Upon the receipt of each shipment of pipe on the job, the Contractor is responsible for maintaining the marking and for the storage of all pipe in such a manner that the ASTM material specifications and method of manufacture (seamless, etc.) of each piece of pipe will be clearly discernible at the time of its installation in the system. If at the time of its installation any piece of pipe is not readily identifiable, it will be subject to rejection, or arbitrary downgrading by the Engineer to the lowest grade which has been received on the job to that date.

B. Provide factory applied plastic end caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, and clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

C. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

D. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

E. All edges prepared for field welding shall be protected against corrosion during shipment, storage, and installation with one coat of rust-inhibiting coating (deoxaluminate) applied after inspection and cleaning.

PART 2 - PRODUCTS

2.1 GENERAL

A. Code: The fabrication and erection of all piping shall conform to the latest edition and all current revisions of ASME Code for Power Piping B31.1 and Section I of ASME Boiler and Pressure Vessel Code as defined in their scopes. In addition, the fabrication and erection of all piping shall conform to all applicable Federal, State, and Local laws.

B. Piping Materials: Provide all pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade, or class is not indicated, provide proper selection as determined by the intended service use, comply with governing regulations and industry standards, and obtain approval from the Engineer prior to any work.

C. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, or equipment connection in each case. Where not otherwise indicated, comply with Contract specifications, governing regulations, and industry standards for selections as determined by the intended service use and install in

accordance with pipe manufacturer's recommendations.

2.2 PIPING MATERIAL SPECIFICATION TABLE

A. General: Refer to table A1, which is provided at the end of this section. Piping materials related to the project are covered in the table. For other piping specialties and associated accessories please refer to the following specification sections:

1. Gasket groups are specified in detail in Section 23 05 50 - GASKETS.

2. Valve groups are identified and specified in Section 23 05 23 - VALVES.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly. Clean all foreign matter from both inside and outside of pipe before installation.

3.2 INSTALLATIONS

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leak-proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 0.05 inches misalignment tolerance.

B. Piping Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location arrangement and restrictions of the piping systems. Location and arrangement of piping layout shall take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Contract Drawings.

E. Locate groups of pipes parallel to each other, spaced to permit applying full insulation, servicing of valves and instrumentation, and thermal expansion of piping systems.

F. Install drains at low points in mains, risers, and branch lines per Drain and Air Vent Detail on Contract Drawings. All components shall conform to the piping systems described in this Section and to Section 23 05 23 - VALVES. The location of the high

point vents and low point drains shall be approved by the Engineer.

G. Wall, Roof, and Gratings Penetrations: Refer to Section 23 05 91 - PIPE SLEEVES and Section 23 05 92 - PIPE SLEEVE SEALS.

H. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical rooms or electronic equipment spaces and enclosures. In no instance shall piping be routed directly above electrical equipment.

I. Shop Prefabrication:

1. Where shop prefabrication is performed, any adjustments necessary due to inaccuracies in equipment setting and dimensions or location of existing obstructions shall be done at no additional cost to the Owner. No shop fabrication sketches under this article will be checked by the Engineer, but Contractor shall submit drawings to the Engineer for information.

2. All shop fabrication shall be fabricated to dimensional tolerances in accordance with Pipe Fabrication Institute Standard ES-3.

J. Connections To Pumps, Tanks, and Equipment:

1. Contractor shall erect and support piping in a manner that shall not put undue strain on pumps, tanks, or equipment.

2. The procedure for connection of piping to equipment shall be as follows:

a. After the equipment has been set and grouted, the Contractor shall run the pipe to the equipment without making any tight connections to flanges.

b. Flat faced flanges and full face gaskets shall be used on piping connecting to equipment with flat faced flanges. Raised faces of standard flanges may be machined off flat to accomplish this. Bolting for these joints shall be per ASME B31.1.

c. Flanges shall be checked by the Engineer or Owner's Representative to assure that no strain is placed on the equipment. If pipe is not in correct alignment, the Contractor shall remove piping and correct. The correction in alignment shall not be made while the pipe is connected to the equipment.

3. After alignment is found correct, the Contractor shall bolt up the flanges.

4. When required by the Engineer after the equipment has been in service, tested at operating temperatures, and with the lines and equipment still hot, the Contractor shall loosen flange connections to pumps, tanks, and equipment, and

check for alignment, position, expansion, and strain applied to the equipment; make any adjustments necessary, and obtain approval of the Engineer before reconnecting.

K. Cold Springing: Lines shall be cold sprung only where specified on the Contract Drawings. Dimension adjustment of shop fabrication drawings, for the purpose of providing cold springing allowance where required, shall be the sole responsibility of the Contractor.

3.3 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections. Weld-o-lets and sock-o-lets may be used in lieu of fittings for branch take-offs from mains 2 inches NPS or larger provided that the branch take-off is two or more sizes smaller than the main and is not larger than 4 inches NPS. No "stub-ins" are permitted. Weld-o-lets and sock-o-lets outside of these guidelines are forbidden.

B. Pipe Elbows: Provide pipe elbows where depicted on the Contract Drawings. Use long radius elbows except where specifically designated on the Contract Drawings. Where turns less than 45 degrees are required, a standard long radius elbow shall be cut down and welded in position; mitered joints are not acceptable.

C. Reducers: Shall be in accordance with the piping system specification. No mitered fitting are allowed. Horizontally placed reducers in steam piping shall be eccentric type with flat on bottom. Horizontally placed reducers in natural gas piping and pump suctions shall be eccentric type with flat on top.

D. Remake leaking joints using new materials only.

E. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air).

F. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.4 JOINTS

A. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Immediately before erecting the piping, all threads on pipe and all fittings shall be thoroughly cleaned of cuttings, dirt, oil, or other foreign matter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.

B. Welded Joints:

1. General:

a. Weld pipe joints only when ambient temperature is above 0 degree F where possible.

b. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.

c. Use pipe clamps or tack-weld joints with 1 inch long welds; 4 welds for pipe sizes to 10 inches, 8 welds for pipe sizes 12 inches to 20 inches.

d. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.

e. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

f. If piping component ends are bored, such boring shall not result in the finished wall thickness after welding less than the minimum design thickness.

g. The inside diameters of piping components to be butt-welded shall be aligned as accurately as is practicable within existing commercial tolerances on diameters, wall thickness and out of roundness. Alignment shall be preserved during welding. The internal misalignment of the ends to be joined shall not exceed 0.05 inch.

2. Welding Processes

a. All welding on metal piping systems shall be performed using qualified welding procedures and qualified welders and welding operators in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

b. All welding shall be performed by a process that is compatible with the work being welded and the working conditions. Shielded metal-arc welding (SMAW) shall not be used on work less than 3/16 inch thick.

c. Welding shall be performed by using only one of the following processes:

1) Shielded Metal Arc Welding (SMAW), also know as "Stick" Welding

2) Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc Welding

3) Submerged Arc Welding (SAW)

d. Where a specific welding process is called for in the piping group, it shall govern.

e. All stainless steel work less than 3/16 inch thick shall be welded by the gas tungsten-arc (GTAW) process with the back side purged with argon. Work thicker than 3/16 inch shall have a root pass by the GTAW process with the back purged with argon and the balance of the weld may be completed by SMAW process or any other suitable process.

3. Welding Grooves:

a. The ends of steel pipe and fittings to be erected with butt welded joints shall be beveled to form welding grooves in accordance with ANSI B16.25, except where otherwise noted in these Specifications, or on the Contract Drawings.

b. Welding grooves for butt welded joints in pipe of unequal wall thickness shall be beveled in accordance with ASME Code for Pressure Piping B31.1-latest edition, latest revision and section that is applicable.

4. Backing Rings: Backing rings or consumable inserts shall not be used.

5. Cleaning of Welding: All slag or flux remaining on the bead of welding shall be completely removed before laying down the next successive bead and at the completion of the weld. All completed welds shall be wire brushed a minimum of 2 inches on both sides and coated with one coat of high temperature (minimum rated 500 deg. F) primer prior to being insulated.

6. Preheating of Welded Joints: Pipe adjacent to joints before and during welding shall be preheated by any suitable method in accordance with the qualified welding procedure and in all cases shall be in accordance with ASME B31.1, Paragraph 131.

7. Weld Quality:

a. All welds shall have full penetration and complete fusion with a minimum of weld metal protruding on the inside of the pipe.

b. The finished weld contour shall be uniform, with the toe or edge of the weld merging smoothly into the base material. Butt welds shall have a

slight reinforcement build-up gradually from the toe or edge toward the center of the weld. The limitation on butt weld reinforcement shall be in accordance with ASME B31.1, Table 127.4.2 and shall apply separately to both inside and outside surfaces of the joint. Fillet welds may be slightly concave on the furnished surface.

8. Identification of Welders: Refer to Welding Quality Assurance paragraph of Part 1 of this Section.

9. Postheat Treatment of Welded Joints In Carbon and Ferritic Alloy Steel Pipe:

   a. Postheat treatment of welded joints in carbon and ferritic alloy steel piping shall be in accordance with ASME B31.1 or as specified in the piping group or on the Contract Drawings except the cooling rate for stress relieving shall not exceed 200 degrees F per hour down to 600 degrees F. In each case, the temperature given is a minimum and where a higher temperature is called for in the welding procedure, the welding procedure shall govern.

   b. Stress relieving is to be by one of the following methods:

      1) Electrical resistance or induction coil heating is the preferred method for field use. The temperature shall be recorded by pyrometer from the start of the heating operation until 600 degrees F. is reached during cooling.

      2) The gas, natural or liquid petroleum, torch stress relieving procedure may be used only where approved by Engineers. A temperature record shall be maintained from the start of the heating operation until 600 degrees F. is reached during cooling. Two measuring thermocouples shall be placed 180 degrees apart at the centerline of the weld and two measuring thermocouples each placed 90 degrees away from the centerline thermocouples at a distance from the centerline of the weld equal to three times the wall thickness.

      3) Furnace postheat treatment may be employed when desirable to treat several welded or formed assemblies simultaneously. Temperature range, heating conditions, holding time, and cooling conditions shall be as outlined above but shall satisfy the requirements for the thickest section, etc. of the load. When this method is used, pipe and pipe assemblies shall be adequately supported to minimize distortion.

C. Socket Welding Joints: Where socket welding valves or fittings are used, the pipe shall be spaced with a minimum of 1/16 inch clearance between the end of the pipe and the

socket so that no stresses will be imparted to the weld due to "bottoming" of the pipe in the socket. The fit between the socket and the pipe shall conform to applicable standards for socket weld fittings and in no case shall the inside diameter of the socket exceed the outside diameter of the pipe by more than 0.075 inches.

D. Non-ferrous Pipe Joints:

1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ASME B31.1.

2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

E. Flanged Joints:

1. Match flanges within piping system and at connections with valves and equipment where specified. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

2. All slip-on flanges are to be welded on front and back. Welding neck flanges shall be bored to match the attached pipe.

F. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions.

G. Plastic Pipe/Tube Joints: Comply with manufacturer's instruction and recommendations, and with applicable industry standards.

H. Grooved End Connections - Are not permitted on this project.

3.5 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water, air, or steam unless otherwise specified in the pipe group specifications or directed by the Engineer before proceeding with required tests. Piping shall be flushed using a triple flush procedure. Inspect each run of each system for completion of joints, supports, and accessory items.

3.6 PIPING TESTS - HYDROSTATIC

A. All non boiler external piping shall be hydrostatically tested in accordance with the ASME B31.1 Power Piping Code.

B. General: Provide temporary equipment for testing, including pump and gages. The gage shall be accurate to within 3 psig and shall be calibrated within three months of the test as recorded on an initialed sticker on the gage. Test piping system before insulation is installed. Pressure testing shall be performed following the completion of postweld heat treatment, nondestructive examinations, and all other fabrication, assembly, and erection activities required to provide the system or portions thereof subjected to the pressure test with pressure retaining capability. Remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time. The Contractor shall provide air vents at all high points in the system to purge air pockets while the system is filling.

C. Test Pressure:

1. The hydrostatic test pressure shall be as defined in the ASME B31.1 Power Piping Code. The design pressure is listed in Table A1 under the design conditions column.

2. The test pressure shall be continuously maintained for a minimum time of 2 hours. During this 2 hour period, no pressure drop shall be measured. After the 2 hour period, if necessary, the pressure may then be reduced to design pressure and held for such time as may be necessary to continue to conduct the examinations for leakage. Examinations for leakage shall be made of all joints and connections. The piping system shall show no visual evidence of weeping or leaking. After any leaks are found and corrected, the test shall be repeated.

D. Test Blinds:

1. If during the field testing of piping it becomes necessary to insert test blinds in any part of this piping, the Contractor shall provide test blinds at no additional cost to the Owner.

2. Test blinds shall be equipped with a long handle.

3. The Contractor shall submit a written description of the location of test blinds before testing.

4. The Contractor shall remove all test blinds after testing.

E. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

F. Records:

1. It is the sole responsibility of the Contractor to keep accurate, updated records of all hydrostatic testing. The Contractor shall submit a final log of all hydrostatic testing for the Owner's records.

2. The Contractor shall maintain a constantly updated list of the following for all hydrostatic tests:

   a. Date and time of test.

   b. Hydrostatic test pressure.

   c. Piping system tested.

   d. Extent of piping system tested so that it can be clearly identified up to what point a piping system has been tested.

   e. Test results. All failures shall be indicated with the cause explicitly stated.

   f. Signed witnesses of each test which shall be one employee of the Contractor and by the Engineer.

3.7 PIPING TESTS - VISUAL EXAMINATION

A. General: Visually examine pipe welds as indicated in "Nondestructive Testing Requirements Index" in this Section. Visual examination of welds shall be performed by the party indicated in PIPING INDEX TABLE A1 at the end of this section. Contractor to ensure that the Contractors quality program is being adhered to. A specified amount of welds shall be visually examined by an independent testing agency whose cost is borne by the Contractor.

B. Acceptance Standards:

1. The acceptance standards for visual examination shall be as defined in ASME B31.1, and are only summarized here for convenience. The ASME B31.1 Power Piping Code shall be referred to for the full text and requirements of acceptance standards for visual examination. The following indications are unacceptable:

   a. Cracks-external surface.

   b. Undercut on surface which is greater than 1/32 inch deep.

   c. Weld reinforcement greater than that specified in Table 127.4.2 of ASME B31.1.

   d. Lack of fusion on surface.

e. Incomplete penetration (applies only when inside surface is readily accessible).

f. Any other linear indications greater than 3/16 inch long.

g. Surface porosity with rounded indications having dimensions greater than 3/16 inch or four or more rounded indications separated by 1/16 inch or less edge to edge in any direction. Rounded indications are indications which are circular or elliptical with their length less than three times their width.

2. In addition, acceptance will also be based on the proper lay-out, materials, and methods, as specified.

C. Failed Welds:

1. All welds not passing visual examination shall be repaired or replaced at no additional expense to the Owner.

2. Do not begin to repair or replace the weld until the weld report has been submitted to the Engineer and the Engineer gives approval for repairing the weld with the method that the Contractor proposes.

3. Re-inspection of the failed welds shal be performed by the independent testing agency and the cost for re-inspection shall be the responsibility of the Contractor.

D. Reporting:

1. When the independent testing agency is specified to perform the visual examinations, the report of each weld examination shall be submitted to the Engineer within two working days of the examination. Reports preformed for visual examinations by the Contractor are not required to be submitted, but shall be kept available for review at any time by the Engineer.

2. Each weld report shall include the following:

a. Date of weld examination.

b. Type of examination.

c. Examiner's name.

d. Welders' names including all persons who worked on the weld and their work involved.

e. Piping system.

f. Weld location.

g. Weld procedure and materials.

h. Materials and dimensions of items that were welded.

i. Visual examination results.

E. Examiner's Qualifications:

1. All persons performing visual examinations and evaluating examinations shall be certified according to AWS QC1 whether an employee of the independent testing agency or the Contractor.

2. Credentials and certification of all examiners must be submitted and approved prior to an examiner performing the initial examination.

F. Visual Examination Requirements:

1. Welds designated for visual examination shall be examined as follows:

a. Before welding - for compliance with requirements for joint preparation, alignment and fit-up, cleanliness, condition of welding equipment, quality and condition of base and filler materials to be used, and preheat, when required.

b. During welding - for cracks, conformance to the qualified welding procedure, quality of individual weld passes, interpass temperature, placement and sequencing of individual weld passes, and backgouged surfaces.

c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, size of fillet welds, finished weld appearance, weld size, weld length, dimensional accuracy of weldment, and monitor post weld heat treatment.

2. Records of visual examinations must be kept as described in this Section.

3. If a weld is designated to be examined by ultrasonic examination by an independent testing agency, the weld shall also be visually examined by the Contractor.

4. Shop fabricated welds may be examined in the shop prior to arrival at the project site provided all other conditions of this Section are satisfied.

G. Examiner's Scope:

1. General: As specified in the "Nondestructive Testing Requirements Index" located at the end of this Section, visual examinations shall be performed directly by the Contractor and an independent testing agency.

2. Independent Testing Agency:

   a. As specified in "Nondestructive Testing Requirements Index" a specific number of welds for each piping system shall be visually examined by an independent testing agency.

   b. The Contractor shall be responsible for obtaining and paying for the services of the independent testing agency, unless specifed in the index table attached to this section (Table A1) . For the purposes of bidding, the Contractor shall assume that the welds to be visually examined by the independent testing agency shall be the largest pipe diameter for new piping indicated on the Contract Drawings for the pipe group and shall be located in the most difficult place to reach for the pipe group. The Contractor is responsible for providing access to the welds for the independent testing agency.

   c. The welds to be examined shall be random. The Engineer shall designate the specific welds that will be examined by the independent testing agency as the job is in progress. The Contractor shall coordinate with the Engineer to ensure that these requirements are met.

   d. At the Engineer's request, the Contractor shall inform the Engineer of which welder is going to perform a specific weld.

3. Contractor Personnel:

   a. As specified in the "Nondestructive Testing Requirements Index" those welds not scheduled for visual examination by the independent testing agency or for ultrasonic examination shall be visually examined by the Contractor.

   b. Visual examinations to be performed by the Contractor may be performed and interpreted by an employee or employees of the Contractor, provided that each individual is certified as specified. As an option, the Contractor may obtain the services of an independent testing agency to perform these examinations.

   c. A welder who has performed any work with regard to a specific weld shall not perform the visual examination of the same weld.

3.8 PIPING TESTS - RADIOGRAPHIC EXAMINATION

A. General: Project piping will be radiographically examined by an independent testing agency as indicated in the "Non destructive Testing Requirements Index", located in this Section. Where RT is designated, butt welds and welded branch connections for sizes over NPS 2 shall be examined per the requirements specified herein. Radiographic (gamma ray) testing shall be performed by an independent testing agency.

B. Acceptance Standards: Shall be in accordance with Paragraph 136.4.5 of ASME B31.1. The Engineer may, at his sole discretion, elect to waive some of the acceptance standards on a case by case basis.

C. Radiographic Examination Requirements:

1. The Contractor shall be responsible for obtaining and paying for the services of the independent testing agency, unless specifed in the index table attached to this section (Table A1). For the purposes of bidding and when a limited number of welds are specified to be tested (not 100%), the Contractor shall assume that the welds to be radiographically examined by the Independent Testing Agency shall be the largest pipe diameter for new piping indicated on the Contract Drawings and shall be located in the most difficult place to reach. The Contractor is responsible for providing access to the welds for the Independent Testing Agency.

2. When a limited number of welds are specified (not 100%), the welds to be examined shall be random. The Engineer shall designate the specific welds that are to be randomly tested as the job is in progress. The Contractor shall coordinate with the Engineer to ensure that these requirements are met.

3. Contractor should notify the Engineer when welds that require scaffolding are complete so that the Contractor will not have to re-build scaffolding to gain access to the welds.

4. Shop fabricated welds will be examined in the field.

D. Failed Welds:

1. All welds not passing radiography examination shall be repaired or replaced at no expense to the Owner.

2. Do not begin to repair or replace the failed weld until the weld report has been submitted to the Engineer and the Engineer gives approval for repairing the weld with the method that the Contractor proposes. Repair shall be performed using the qualified welding procedures applicable to the original weld.

3. All failed welds discovered by radiographic examination shall be re-examined by radiographic examination after the weld is repaired or replaced at no additional cost to the Owner.

4. For every weld found defective by means of radiographic examination, an additional 10% of the total number of welds per system shall be tested including the two welds besides the repaired weld shall be examined by radiographic examination at no additional cost to the Owner. Testing shall continue in this manner until al welds in the 10% being tested pass the test. At the discretion of the Engineer, the additional examinations may be on the same piping system with the same nominal diameter, may be of the same welder for the failed weld, and shall be selected randomly by the Engineer.

3.9 TESTING REQUIREMENTS INDEX: THE NONDESTRUCTIVE TESTING REQUIREMENTS INDEX IS LISTED TABLE A1:

A. General: The index listed above lists testing required in addition to the ASME B31.1 Code and is for non-boiler external piping.

END OF SECTION

SPECIFICATION SECTION 23 05 00 - TABLE A1 PIPING INDEX

PIPING INDEX

SYSTEM	DESIG.	CONDITIONS		PIPE SIZE	MATERIAL	JOINTS	FLANGES[1],[2]	FITTINGS[1]	UNIONS	BOLTING MATERIALS	VALVES[3]			GASKET	INSULATION[4]		HYDROSTATIC PER B31.1	NON-DESTRUCTIVE PER B31.1			COMMENTS
		OPERATING	DESIGN								SHUT-OFF	THROTTLING	CHECK		GROUP	FINISH		RADIOGRAPHIC	MAG PARTICLE	VISUAL	
HIGH TEMP. HOT WATER SUPPLY & RETURN	HTHWS, HTHWR	320 PSIG @ 380 DEG F	400 PSIG @ 400 DEG F	2 INCH AND SMALLER	ASTM A106, GR B, SCH 40, CARBON STEEL	SOCKET WELD	ANSI CL 300 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A216 GR. WCB	ANSI CLASS 3000 FORGED STEEL SOCKET WELDED IN ACCORDANCE WITH ASME B16.11. MATERIAL PER ASTM A105	SEE FITTINGS	BOLT - ASTM A193 GRADE B5 OR B7 NUT - ASTM A194	3GB10W	3GB10W	3CK10W	HP	C	C	100% BY CONTRACTOR	N/A	100% BY OWNER USING INDEPENDENT TESTING AGENCY	100% BY OWNER USING INDEPENDENT TESTING AGENCY	
				2-1/2 INCH THROUGH 12 INCH	ASTM A106, GR B, SCH 40, CARBON STEEL	BUTT WELD	ANSI CL 300 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A216 GR. WCB	SCHEDULE 40, BUTT WELD PER ASME B16.9, MATERIAL SHALL BE ASTM A234	UNIONS SHALL BE MADE WITH FLANGES	BOLT - ASTM A193 GRADE B5 OR B7 NUT - ASTM A194	3BF21F	N/A	N/A	HP	C	C		100% BY OWNER USING INDEPENDENT TESTING AGENCY	N/A		
				12 INCH AND LARGER	ASTM A106, GR B, SCH STD, CARBON STEEL	BUTT WELD	ANSI CL 300 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A216 GR. WCB	SCHEDULE STD, BUTT WELD PER ASME B16.9, MATERIAL SHALL BE ASTM A234	UNIONS SHALL BE MADE WITH FLANGES	BOLT - ASTM A193 GRADE B5 OR B7 NUT - ASTM A194	3BF21F	N/A	N/A	HP	C	C			N/A		
FUEL OIL, SUPPLY, RETURN	FOS, FOR	160 PSIG @ 70 DEG F	300 PSIG @ 100 DEG F	2 INCH AND SMALLER	ASTM A106, GR B, SCH 40, CARBON STEEL	SOCKET WELD	ANSI CL 300 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A216 GR. WCB	ANSI CLASS 3000 FORGED STEEL SOCKET WELDED IN ACCORDANCE WITH ASME B16.11. MATERIAL PER ASTM A105	SEE FITTINGS	N/A	3GT11W	3GB11W	3CK11W	N/A	N/A	N/A	100% BY CONTRACTOR	N/A	N/A	100% BY CONTRACTOR USING INDEPENDENT TESTING AGENCY	
NATURAL GAS	NG	15 PSIG @ 60 DEG F	150 PSIG @ 100 DEG F	2 INCH AND SMALLER	ASTM A53, GR B, ERW, SCH 40, CARBON STEEL	THREADED	ANSI CL 150 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A105	ANSI CLASS 150, THREADED, MALLEABLE IRON PER ASME B16.3. MATERIAL PER ASTM A197	SEE FITTINGS	BOLT - ASTM A193 GRADE B8A NUT - ASTM A194	1BL10S	N/A	1CK10S	A	N/A	N/A	100% BY CONTRACTOR	N/A	N/A	100% BY CONTRACTOR USING INDEPENDENT TESTING AGENCY	
				2-1/2 INCH THROUGH 12 INCH	ASTM A53, GR B, ERW, SCH 40, CARBON STEEL	BUTT WELD	ANSI CL 150 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A105	SAME THICKNESS AS PIPE, BUTT WELD PER ASME B16.9, MATERIAL PER ASTM A 234, GR WPB	UNIONS SHALL BE MADE WITH FLANGES	BOLT - ASTM A193 GRADE B8A NUT - ASTM A194	10P20F	N/A	N/A	A	N/A	N/A		N/A	N/A		
WATER, BLOW-OFF	BO	320 PSIG @ 380 DEG F	400 PSIG @ 400 DEG F	2 INCH AND SMALLER	ASTM A106, GR B, SCH 80, CARBON STEEL	SOCKET WELD	FLANGES ARE NOT PERMITTED	ANSI CLASS 3000 FORGED STEEL SOCKET WELDED IN ACCORDANCE WITH ASME B16.11. MATERIAL PER ASTM A105	SEE FITTINGS	N/A	3GT10W	3GB10W	N/A	N/A	C	C	100% BY CONTRACTOR	N/A	100% BY OWNER USING INDEPENDENT TESTING AGENCY	100% BY OWNER USING INDEPENDENT TESTING AGENCY	
COMPRESSED AIR AND INSTRUMENT AIR	CA/IA	100 PSIG @ 70 DEG F	200 PSIG @ 150 DEG F	2 INCH AND SMALLER	TYPE L DRAWN COPPER PER ASTM B-88	SOLDERED	USE UNIONS	WROUGHT COPPER IN ACCORDANCE WITH ANSI 16.22, ANSI/ASME B1.20.1	WROUGHT COPPER IN ACCORDANCE WITH ASME 16.22	N/A	1BL10SD	N/A	1CK10SD	N/A	N/A	N/A	100% BY CONTRACTOR	N/A	N/A	100% BY CONTRACTOR USING INDEPENDENT TESTING AGENCY	
				2-1/2 INCH THROUGH 3 INCH	ASTM A53, GR B, TYPE E, SCH 40, CARBON STEEL	BUTT WELD	ANSI CL 150 WELDNECK, R.F. PER ASME 16.5. MATERIAL SHALL BE ASTM A105	SAME THICKNESS AS ATTACHED PIPE, BUTTWELD PER ASME B16.9. MATERIAL SHALL BE ASTM A234, GR WPB	UNIONS SHALL BE MADE WITH FLANGES	BOLT - ASTM A193 GRADE B8A NUT - ASTM A194	N/A	N/A	N/A	A	N/A	N/A		N/A	N/A		
VENTS AND DRAINS	VENT/ED	PIPING MATERIALS SHALL MATCH SYSTEM BEING VENTED/DRAINED															100% BY CONTRACTOR	N/A	N/A	100% BY CONTRACTOR USING INDEPENDENT TESTING AGENCY	

NOTES:

1. INSIDE DIAMETER OF FLANGE/FITTING SHALL MATCH MATING PIPE INSIDE DIAMETER.
2. MACHINE TO FLAT FACE IF MATING FLANGE IS FLAT FACE.
3. REFER TO SECTION 23 05 23 VALVES FOR VALVE CLASSIFICATION DESCRIPTIONS.
4. REFER TO SECTION 23 07 00 HVAC INSULATION FOR INSULATION CLASSIFICATION DESCRIPTIONS.

PART 2 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Specification Sections apply to this Section:

1. Section 23 05 00 - BASIC PIPING MATERIALS AND METHODS

2. Section 23 62 00 - PIPING SYSTEM SPECIALTIES

3. Section 23 06 00 - PIPE HANGERS AND SUPPORTS

1.2 DESCRIPTION OF WORK

A. The extent and type of valves required by this Section shall be as indicated on the Contract Drawings and/or specified in other Division 23 Sections.

B. Valves furnished as part of factory-fabricated equipment shall conform to the requirements of this Section unless otherwise stated.

C. Strainers and other special valves are specified in Section 23 62 00 - PIPING SYSTEM SPECIALTIES.

1.3 SUBMITTALS

A. Shop Drawings and Product Data: In accordance with Division 01, submit the following:

1. Manufacturer's technical product data, including installation instructions, for each type of valve. Include pressure drop curve or chart for each type and size of valve.

2. Submit valve schedule showing manufacturer's figure number for corresponding valve symbol used to specify valves on this specification. List all valve sizes to be supplied for each valve symbol.

3. Manufacturer's assembly-type (exploded view) shop drawings for each type of valve and valve actuator indicating dimensions, weights, materials, and methods of assembly of components.

4. Technical data for electric valve actuators that indicate all features specified.

5. Manufacturer's technical product data indicating the service rating of each valve type. In addition, this information shall indicate the maximum hydrostatic test pressure that the valve can take when only one side of the valve is being

pressurized. The indicated hydrostatic pressure shall be good for not only the structural integrity of the valve, but should also take into consideration its continued effectiveness for providing tight shut-off service as a valve without requiring any modifications or maintenance.

6. List country of manufacturer, fabrication, and assembly for all valves and valve components.

7. Submit ISO 9001 and Independent Test reports if applicable per Quality Assurance paragraph below.

1.4 QUALITY ASSURANCE

A. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

B. Country of Fabrication

1. All valves and valve components not manufactured, fabricated, and/or assembled in the United States of America or Canada must be manufactured, fabricated, and/or assembled by an ISO 9001 registered corporation.

2. Submit ISO 9001 registration certificates for all corporations where valves and valve components are not manufactured, fabricated, and/or assembled in the United States or Canada.

3. For all valves and valve components not fabricated in the United States or Canada, submit an independent test report for all materials to be provided.

4. No valves or valve components manufactured, fabricated, and/or assembled in China including Taiwan are permitted to be provided in this Contract.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation For Transport: Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rust and corrosion.

2. Protect valve ends against damage to threads, flange faces, and weld-end preps.

3. Set valves in best position for handling. Set globe and gate valves closed to prevent rattling; set ball and plug valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.

4. Storage: Use the following precautions during storage:

a. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

b. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. Outdoor storage of valves shall not be permitted.

5. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVE FEATURES

A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by the manufacturer for installation requirements. Comply with ASME B31.1.

B. Valve Design: Provide gate valves with only outside screw and yoke (OS&Y) stems. If non-rising stem valves are needed due to operational constraints, Utilities Division shall verify the constraints, shall review the submittals of the installation, and shall approve the installation of a non-rising stem valve.

C. Pressure and Temperature Ratings: As specified according to the individual valve specifications.

D. Sizes: Same size as upstream pipe, unless otherwise indicated.

E. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem, for valves other than quarter turn.

2. Lever handles, on quarter-turn valves 3 inch and smaller, except for plug valves. Provide plug valves with square heads. For valves greater than 3 inch, provide gear operator with handwheel.

3. Chain-wheel operators, for all valves installed 6 feet or higher above finished floor. Extend chains to an elevation of 5 feet above finished floor. Refer to Paragraph 2.5.

4. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

5. By-pass and Drain Connections: Provide valved by-pass where indicated on the Contract Drawings. Comply with MSS SP-45 bypass and drain connections.

6. Neck extensions and right angle drives where indicated and where required for access to the operator.

2.2 VALVE IDENTIFICATION SYSTEM DESCRIPTION

A. General: A system has been established which identifies the specific valves for each piping system identified in the Contract Drawings. The specific valve specification is linked by the service number as depicted in the "Valve Index" listed in this Section.

B. Valves are identified on the Contract Drawings by symbol. Size is indicated by the upstream size.

C. Valves are specified in this Section according to the "Valve Index". In general, the following is a description of the format:

1. The first symbol, consisting of one or more numerals, indicates the valve group specification that applies to this valve.

2. The second symbol, consisting of one or more letters, indicates the type of valve in accordance with the following listing:

a. GB = Globe Valve

b. BF = Butterfly Valve

c. BL = Ball Valve

d. CK = Check Valve

e. GT = Gate Valve

f. P = Plug Valve

3. The third symbol consists of one numeral. The numeral indicates the size group

a. 1 = Small Group

b. 2 = Large Group

4. The fourth symbol consists of one numeral. The numeral indicates valve modifications. Zero indicates standard type, while any other number indicates modifications to the valve.

a. 0 = Standard Type (no modifications)

b. # = Modifications (see valve specifications herein)

5. The fifth symbol, consisting of a letter, indicates the type of connection to the valve as follows:

   a. F = Flanged Ends

   b. S = Screwed Ends

   c. W = Weld Ends, Butt, or Socket

   d. C = Solvent Cemented

   e. SD = Soldered

6. For example: For a 10 inch HPS shutoff valve, refer to 3BF21F which indicates a valve of Valve Group 3, Butterfly Type, Non-Standard, and with flanged ends. Refer to Section Paragraph 2.3.C for the specification of this valve.

7. There may be some instances where it is desirable to substitute an item, such as a valve or gasket at a particular location, in place of the one specified in the groups listed in the Index. In that event, the item will be clearly indicated and specified on the Contract Drawings, and such an indication is to take precedence over the item specified in the valve group specifications. All other terms of that group specification are to be observed.

2.3 VALVE GROUPS: THE FOLLOWING PAGES CONTAIN THE "VALVE INDEX"

A. Valve Group 1

1. Check Valves:

   a. Symbol: 1CK10S - 2 Inches and Smaller: Class 150 UL listed horizontal swing check valve, carbon steel body and cover, screwed ends, stainless steel seat and disc, screwed cover, integral seat, body and cover material to conform to ASTM A105. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

   b. Symbol: 1CK10SD - 3 Inches and Smaller: Class 125 horizontal swing check valve, cast bronze body and cover, soldered ends, bronze seat and disc, integral seat, body and cover material to conform to ASTM B61 or B62. The valve shall conform to ASME B16.18, MSS SP-80.

2. Ball Valves:

   a. Symbol: 1BL10S - 2 Inches and Smaller - Screwed: 250 pound UL listed ball valve, carbon steel body and ball to ASTM A216, Grade WCB, replaceable Teflon seats and seals, screwed ends, lever operated with stops at full open

and full closed positions. The valve shall conform to MSS SP-110. The valve shall have Underwriters' Laboratories approval for gas service.

b. Symbol: 1BL10SD - 3 Inches and Smaller - Soldered: 125 pound WSP ball valve, two piece body, bronze body and ball to ASTM B62, full port, replaceable Teflon seats and seals, soldered ends, lever operated with stops at full open and full closed positions.

B. Valve Group 3

1. Gate Valves:

a. Symbol: 3GT10W - 2 Inches and Smaller: Class 600 or 800 gate valve, forged or cast carbon steel body and bonnet, socket weld ends; 13 percent chromium stainless steel seat rings, disc and stem; bolted or union bonnet, solid wedge disc, renewable or integral stellite or cobalt based alloy hard faced seat rings, outside screw and yoke, rising stem, body and bonnet materials to conform to ASTM A105 or A216, Grade WCB. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

b. Symbol: 3GT11W - 2 Inches and Smaller: Class 600 or 800 gate valve, forged or cast carbon steel body and bonnet, socket weld ends; 13 percent chromium stainless steel seat rings, disc and stem; bolted or union bonnet, solid wedge disc, renewable or integral stellite or cobalt based alloy hard faced seat rings, outside screw and yoke, rising stem, body and bonnet materials to conform to ASTM A105 or A216, Grade WCB. Valve shall be rated for use with fuel oil systems. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

2. Globe Valves:

a. Symbol: 3GB10W - 2 Inches and Smaller: Class 600 or 800 globe valve, forged or cast carbon steel body and bonnet, socket weld ends, 13 percent chromium stainless steel disc and stem; stellite seat ring; bolted bonnet, plug or semi-plug type disc, renewable or integral hard faced seat ring, outside screw and yoke, rising stem, body and bonnet material to conform to A105 or A216, Grade WCB. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

b. Symbol: 3GB11W - 2 Inches and Smaller: Class 600 or 800 globe valve, forged or cast carbon steel body and bonnet, socket weld ends, 13 percent chromium stainless steel disc and stem; stellite seat ring; bolted bonnet, plug or semi-plug type disc, renewable or integral hard faced seat ring,

outside screw and yoke, rising stem, body and bonnet material to conform to A105 or A216, Grade WCB. Valve shall be rated for use with fuel oil systems. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

3. Check Valves

   a. Symbol: 3CK10W - 2 Inches and Smaller: Class 600 or 800 horizontal or vertical swing check valve; forged carbon steel body; socket weld ends; 13 percent chromium stainless steel disc; renewable or integral stellite seat ring; body material to conform to ASTM A105. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

   b. Symbol: 3CK11W - 2 Inches and Smaller: Class 600 or 800 horizontal or vertical swing check valve; forged carbon steel body; socket weld ends; 13 percent chromium stainless steel disc; renewable or integral stellite seat ring; body material to conform to ASTM A105. Valve shall be rated for use with fuel oil systems. Working pressure and temperature ratings shall comply with ANSI B16.34 (Standard Class).

4. Butterfly Valves:

   a. Symbol: 3BF21F - 2 Inches and Larger: High performance butterfly style, ANSI Class 300 carbon steel body conforming to ASTM A105 or A216, Type WCB position indicator for sizes 2” through 24”. Provide gear operator for valves 3" and larger. Provide chain wheel for all sizes as necessary. Triple seated, offset seat with eccentric disc, lug style, with 316 stainless steel disc, 17-4 PH stainless shaft, and metal seats. Valve and valve seat shall be designed and rated for high-temperature hot water service at pressure and differential pressures (both ways) to 400 PSIG high-temperature hot water. Rating of valve shall be bi-directional ANSI Class V. Valves shall be pre-set at the factory for zero leakage - valve operators must be factory installed so they are ready for installation and the closed position is set. Valve shall be manufactured by Vanessa, Zwick, or Velan. Cv shall not exceed 41 for 2", 120 for 3", 230 for 4", 1500 for 8", 2400 for 10", and 3600 for 12" .

C. Valve Group 10

1. Lubricated Plug Valves:

   a. Symbol: 10P20F - 2-1/2 Inches and larger: 250 pound WOG lubricated plug valve, cast steel body and plug, flanged ends, screwed or bolted gland, short pattern, sizes 4 inches and smaller wrench operated, sizes 6 inches and larger enclosed gear operated faced and drilled to 150 pound ANSI

B16.5, face to face dimension shall conform to ANSI B16.10. The valve shall have Underwriters' Laboratories approval for gas service.

2.4 VALVE INDEX: THE "VALVE INDEX" IS LOCATED IN THE PIPING INDEX TABLE A1 IN SECTION 23 05 00 - BASIC PIPING MATERIALS AND METHODS.

2.5 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.
4. Description: Lockable valve actuation assembly with sprocket rim, brackets, and chain.
    a. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
    b. Attachment: For connection to butterfly valve stems.
    c. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
    d. Chain: Hot-dip, galvanized steel, Brass, or Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage. In cases where higher rated raised face steel flanges are mated to lower rated flat face cast iron flanges, remove raised face from steel flange before bolting together.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Replace defective valves with new valves.

3.2 VALVE INSTALLATIONS

A. General Application: Refer to the Contract Drawings and piping system specification sections for specific valve applications and arrangements.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install by-pass and drain valves per MSS SP-45 or as indicated on the Contract Drawings.

E. Install three-valve bypass around each control valve and throttling valve as indicated on the Contract Drawings.

F. Unless otherwise indicated on the Drawings, stems of valves in horizontal lines shall be pointed up, if possible. If this is not practical, the stem may be pointed in a horizontal position. Valves shall not be installed with stems pointed down. All valves shall have a readily accessible location. The Contractor shall be responsible to determine valve stem locations on field-routed piping prior to fabrication of the piping. When welding valves to piping, the Contractor shall insure that the valves are in the open position and shall take extreme care not to overheat and damage the seat area. All valves shall be installed in accordance with the manufacturer’s instruction manual. Any valves damaged during installation shall be replaced with new, identical valves at the Contractor’s expense.

G. Install valves in a position to allow full stem movement.

H. Installation of Swing Check Valves: Install for proper direction of flow and in horizontal position or vertical position with flow direction upwards, and with hinge pin level.

I. Insulation: Where insulation is indicated for the service, insulate valves in accordance with Section 23 07 00 - HVAC INSULATION. Provide valves with extended stems, arranged in manner to receive insulation.

3.3 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads including anti-sieze compound on bolts. Anti-sieze compound shall be rated for temperatures to 600 deg F. Tighten bolts gradually and uniformly with a torque wrench.

C. In cases where higher rated steel raised face flanges mate to lower rated cast iron flat face flanges, remove raised face from steel flange before bolting together.

D. Use gaskets as specified in Section 23 05 50 - GASKETS.

3.4 ADJUSTING, CLEANING, PAINTING AND IDENTIFICATION

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

END OF SECTION

SECTION 23 05 50 - GASKETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Specification Sections apply to this Section:

1. Section 23 00 10 – BASIC HVAC REQUIREMENTS

2. Section 23 05 00 – BASIC PIPING MATERIALS AND METHODS and all related specific piping specification Sections.

1.2 DESCRIPTION OF WORK

A. The extent and type of gaskets required by this Section shall be as indicated on the Contract Drawings and/or specified in other Division 23 sections.

1.3 SUBMITTALS

A. Product Data: In accordance with Division 01 requirements, submit the following:

1. Manufacturer's technical product data, including materials of construction, thickness, pressure and temperature rating, manufacturer's model number, and storage requirements.

1.4 DELIVERY AND STORAGE

A. Transport, Storage, and Handling:

1. Ensure that the gasket is kept on its backing board, horizontally, until immediately prior to assembly. Inspect the gasket for proper type, style, and material. Immediately notify the Campus's Project Manager and the Engineer if any defects or mechanical damage is present.

2. Keep gaskets in dry area protected from weather.

3. Do not prepare gaskets until ready for installation.

4. Do not reuse gaskets.

PART 2 - PRODUCTS

2.1 GASKET GROUPS

A. Gasket Group A: Gaskets shall be non-asbestos, compressed sheet, nitrile binder with a rated maximum operating temperature and pressure of 700 degrees F and 1200 psi, respectively. Gaskets shall be 1/8 inch thick and conform to the flange face on which they are used. Acceptable products from acceptable manufacturers include: Sepco Style No. 6234, manufactured by Sepco Corporation; 1599-TR, Hwy. 31, Pelham, AL 35124, Phone Number (800) 242-6514; Sur-Seal Style No. NA 700, manufactured by Sur-Seal Gasket and Packing, Inc.; 6156 Wesselman Road, Cincinnati, OH 45248; Phone Number (800) 345-8966.

B. Gasket Group HP: Gaskets shall be spirally wound, Type 304 stainless steel with non-asbestos graphite filler material and carbon steel outer ring. Gaskets shall be 1/8 inch thick and conform to the flange face on which they are used.

C. Acceptable products from acceptable manufacturers include:

1. Flexitallic Style CG with Flexicarb filler and 316L winding, manufactured by Flexitallic Inc., 6915 Hwy. 225, Deer Park, TX 77536; Phone Number (281) 479-3491; or approved equal.

2. Sur-Seal Style No. 9000, manufactured by Sur-Seal Gasket and Packing, Inc.; 6156 Wesselman Road, Cincinnati, OH 45248; Phone Number (800) 345-8966

3. Type CR, manufactured by Thermoseal Inc, 2350 Campbell Road, Sidney, OH 45365; Phone Number (937-498-2222)

2.2 GASKET REQUIREMENTS INDEX

A. Refer to the “PIPING INDEX – TABLE A1”, which has been provided at the end of Section 23 05 00 – BASIC PIPING MATERIALS AND METHODS.

PART 3 - EXECUTION

3.1 FLANGE CONDITIONS

A. Examine the flange assembly to ensure that all seating surfaces are true, clean, and free from imperfections. Verify that the flange faces have similar concentric, phonographic finishes and that they are correct for the gasket type and material being used. Immediately notify the Campus’s Project Manager and the Engineer if the conditions are not correct.

B. The contractor shall ensure that flanges are free of surface damage such as tool marks or casting and machining abnormalities and have sufficient flange face flatness to ensure even compression and sealing of the gasket material. If surface blemishes exist that exceed the gasket manufacturers guidelines, the Contractor shall provide flange face re-machining or replace the flange in its entirety as the Contractors expense.

3.2 INSTALLATION

A. Match flanges within piping system and at connections with valves and equipment where specified.

B. Examine the studs or bolts and matching nuts to ensure that they are the correct material. Inspect for damage that includes galling, pitting, thread damage, or cracking. Where necessary to meet the gasket manufacturers' compression requirements, replace the damaged materials.

C. Lubricate all stud or bolts threads and nut faces to reduce and control friction between load bearing surfaces. Use a lubricant that is recommended by the gasket manufacturer.

D. Clean flange faces and install gaskets.

E. Locate gasket centrally without the use of gasket compounds or excessive force. For vertical installation, follow the gasket manufacturers recommended retention procedures.

F. Tighten bolts to provide uniform compression of gaskets. The Contractor shall follow the manufacturer's recommended bolting-up sequence to ensure proper gasket compression.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Mechanical identification shall be provided for all new work in accordance with the requirements of this Specification Section.

B. Types of identification devices specified in this Section include the following:

1. Pipe Identification and Contents Markers.

2. Equipment Identification Plates

3. Valve Identification Tags

C. This Section specifies the color schemes for painting piping. Refer to Division 9 for painting specifications.

D. Mechanical identification furnished as part of factory-fabricated equipment is specified as part of equipment assembly in other Division 23 sections.

E. Identification requirements for electrical work is not part of this specification, refer to Division 26 specification sections.

1.3 SUBMITTALS

A. Product Data and Samples: In accordance with Division 01 requirements, submit the following:

1. Manufacturers technical product data and installation instructions for each type of identification device specified. Include a list of all piping systems indicating proposed nomenclature.

2. Samples of each color, lettering style, and graphic representation required for:

a. Pipe Identification and Contents Markers.

b. Equipment Identification Plates

c. Valve Identification Tags

B. Maintenance Data: Include product data and identification schedules in the appropriate operation and maintenance manuals. Coordinate with Section 23 05 23 - Valves.

1. Valve Schedule: Provide three (3) copies of the valve schedule to the Campus after completion of the valve tagging.

a. The schedule shall be updated with as-built data for installed valves. The Contractor shall provide the hard copies listed above as well and an updated Microsoft Excel file delivered in CD format. Provide two (2) CD's, one for the Campus, and one for the Engineer.

b. Each copy of the valve schedule shall be 3-hole punched, 8 ½" x 11", loose-leaf paper, and shall be mounted in a suitably sized three-ring binder with cover sheet.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide the specified items from firms regularly engaged in the manufacture of identification devices of the types and sizes specified, whose products have been in satisfactory use in similar service for not less than (5) years.

B. Codes and Standards:

1. ANSI Standards:

a. ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

b. ANSI Z535.1 - Safety Color Code. Paint colors are provided in this Section but specified in Division 09.

1.5 SPARE PARTS

A. Furnish a minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 2) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain the stencils after completion of stenciling and include used stencils in the extra stock, along with the required stock of stenciling paints and applicators.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Install identifying devices before installing concealment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for approval.

1. Pipe, Equipment, Instrument, and Valve Identification Materials

a. Brady Worldwide, Inc

b. Marking Services, Inc

c. Seton Identification Products

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections.

B. For each identification type, provide all tags from same manufacturer with same text, style, color, shape, and other identification features.

2.3 PIPE IDENTIFICATION AND CONTENTS MARKERS (STENCIL)

A. Provide a laser-cut stencil marking system for all pipe contents and flow direction identification markers unless other marking systems are specifically identified in this section. The stencil marking system shall include a wording stencil and a background stencil. The background stencil shall also contain the flow arrow. Two background stencils shall be provided for each stencil size. The background stencils shall have bi-directional flow indication arrows. The installing contractor shall only paint one of the arrows to mark the flow direction if the flow is one-directional.

B. Stencil shall be reusable and shall be constructed from 0.020” thick plastic material. Oilboard stencil material shall not be permitted. The stencil shall be able to wrap around the pipe contour easily to provide continuous stencil to surface contact.

C. Letter height shall comply with ANSI A13.1 standard letter sizes. Background Stencil shall be large enough to fully contain all letters and symbols in the wording stencil.

1. 1/2-Inch thru 1 1/4-Inch 1/2-Inch

2. 1 ½-Inch thru 2-Inch 3/4-Inch

3. 2 ½-Inch thru 6-Inch 1 1/4-Inch

4. 8-Inch thru 10-Inch 2 1/4-Inch

5. Over 10-Inches 3 1/2-Inch

D. Stencil Paint: Stencil paint shall be exterior grade enamel paint using either a brushing application or spray-can application. Paint shall be permanent, quick-drying, high-contrast, and weather resistant.

E. Colors shall comply with ANSI/ASME A13.1 – 2007 standards:

System	Letter Color & Arrow Color	Background
High Temperature Hot Water (HTHW)	White	Black
Blow-off Water (BO)	White	Green
Air, Instrument / Compressed (IA, CA)	White	Blue
Natural Gas (NG)	White	Brown
Fuel Oil (FO)	Black	Yellow
Equipment Vents & Drains	White	No Stencil
“Asbestos Free” (All Insulated Systems)	White	Blue (No Arrow)

2.4 PIPE IDENTIFICATION AND CONTENTS MARKERS (VINYL COIL)

A. Description: The Contractor shall provide pipe markers on all piping system sizes 1-1/2” and below, where stenciling is difficult to perform due to limited pipe wall area, and on all non-painted and non-insulated piping systems. Pipe markers shall indicate line contents, direction of flow, and that insulation is asbestos free. Line contents shall match service. Obtain approval from Engineer for identification of each service.

B. Material: Fade-resistant, vinyl material with vinyl adhesive. All markers shall have a service temperature of -40 degrees F to 175 degrees F and be rated for outdoor service.

C. Arrangement: Rectangular pipe contents indication marker shall appear on both sides of the pipe with a flow direction arrow roll wrapping 360 degrees around at both ends of the pipe contents indication marker. For external diameters less than 1-1/2", provide full-band marker extending 360 degrees around pipe.

D. Color coding shall match the requirements for stenciling provided in this Section.

E. Shape: Contents markers shall have minimum ¾-Inch high letters.

2.5 PIPE IDENTIFICATION AND CONTENTS MARKERS (LESS THAN ¾-INCH DIAMETER)

A. The Contractor shall provide fully legible pipe tags when Stenciling or Vinyl Tags are unable to be supplied. The direction of flow is not required to be shown on this size

pipe. Tags shall meet the same material and size specifications required for valve identification tags however only the system and pipe size need to be displayed.

2.6 VALVE IDENTIFICATION TAGS (TYPE 1)

A. Not Used

2.7 VALVE IDENTIFICATION TAGS (TYPE 2)

A. Material, Size, and Shape: 19 Gauge, Stainless Steel, 3" x 3" square in size. Thickness shall be no less than 0.025 inch thick.

B. Lettering: Symbol letters and numerals shall be laser-etched into the tag and shall be of the size and position indicated in the Specification Appendix on Instrument Detail Sheet ID-T1. The text etching shall be durable and black to provide contrasting visibility.

C. Fastening: For valves, attach through punched hole on tag to valve body or yoke, not the valve handwheel, with No. 14, type 316 stainless steel, Jack Chain. For other field devices, attach with No. 14, type 316 stainless steel, Jack Chain where practical. Secure chain to item with a single 1/8", stainless steel, Quick Link.

1. Acceptable Chain Manufacturers: Erico International Corporation, Hale Brothers Co., Inc., and Perfection Chain Products, Inc.

D. Description: For the purpose of identifying manual valves, control valves, flow meters, and pressure regulating valves the Contractor shall provide on each item an identification tag.

1. Manual valve tags shall have the following information laser engraved on one side.

a. Line No. 1 – Valve Tag Number

1) Contractor shall create valve numbering scheme. Number all valves.

b. Line No. 2 – Service Designation

1) The service designation shall match the service as indicated in Table A1 provided in Section 23 05 00 - BASIC PIPING MATERIALS AND METHODS.

c. Line No. 3 – Operational Information

1) Indicate operational information as provided in Section 23 05 23 - Valves. If operational information is not provided, leave space blank and proceed to the next line.

d. Line No. 4 – Valve Specification

1) Indicate the valve type identification symbol specified in the "Valve Index" in Section 23 05 23 - Valves.

2. Control valve and pressure regulating valve tags shall indicate the valve tag number i.e. "FCV-01100", valve service designation, and valve failure position. The fourth line is not required.

3. All valves shall be identified, even those provided as part of a package for a piece of equipment.

2.8 EQUIPMENT IDENTIFICATION PLATES

A. Description: The Contractor shall provide unique plastic equipment identification plates for specific pieces of equipment as listed in this Section. Identification plate shall list equipment name and number and shall include motor name and motor equipment number if applicable.

1. Equipment Nameplates shall match equipment descriptions as provided in the contract drawings. Where plans conflict with the schematics, the schematics shall be followed.

B. Lettering: Letters and numerals shall not be less than 3/8 inch high and shall be engraved into the plate.

C. Color, Size, and Shape: Blue plate with white letters. Rectangular shape minimum 5" wide by 3" high by 1/16" thick.

D. Fastening: Nameplates shall have a punched hole in both sides. Fasten with Monel wire around the piece of equipment or hanging off of the equipment.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, install identification after completion of covering and painting. In addition, provide pipe markers only after each line has been complete, erected, purged, tested, and/or painted.

B. Valve Schedule

1. Maintain valve schedule throughout the project and capture any and all field changes. Provide an as-built valve schedule in compliance with Part 1 – Submittals.

3.2 PIPE SYSTEM IDENTIFICATION

A. General: Provide pipe markers on every system including pipe contents and flow direction. Provide "Asbestos Free" insulation markers for all pipes that are insulated under this contract. Locations of all markers shall be subject to final approval by the Engineer.

B. Location:

1. Location: Locate pipe markers in a conspicuous manner at a minimum of every 40 feet as follows:

a. Upstream and downstream each control valve and pressure regulating station.

b. Near each valve station and control device.

c. Near each branch.

d. On both sides where pipe passes through walls, floors, or ceilings within 4 feet of the barrier.

e. Near major equipment origination and termination points (tanks, pumps, etc.).

f. Near the inside and outside of concealed points.

g. Outdoors at each major elevation.

2. Where pipes run parallel to each other, identify each pipe in the same general location.

3.3 VALVE SYSTEM IDENTIFICATION

A. Manual Valve Identification Tags:

1. Provide an identification tag for every manual valve, no matter what size, including gate, globe, ball, check, plug, diaphragm, angle, butterfly, and stock which indicates the valve information specified in Part 2 of this Specification Section.

2. Location: Attach tag to valve body or yoke, not the valve handwheel.

B. Control Valve, Pressure Regulating Valve, Meters, and Steam Trap Identification Tags:

1. Provide an identification tag for every control valve and pressure regulating valve, including valve type, and valve type number. Numbering scheme shall be as

indicated by the Valve Table provided in Section 23 05 23 and as specified in Part 2 of this Specification Section.

2. In addition to the separate valve identification tag, each control valve shall have a stainless steel nameplate indicating:

   a. Manufacturer's Name.

   b. Pressure Rating.

   c. Type.

   d. Serial Number.

   e. Inner Valve Size and Type.

   f. Valve Action.

   g. Valve Travel.

   h. Control Signal Pressure.

   i. Valve Tag Number (From Contract Schematics).

3.4 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices

C. Painting and Insulating: Do not paint or insulate over any identification tags. Tags shall be installed after all painting is completed or shall be covered during painting. Any painted tags shall be replaced by the Contractor as no cost to the Owner

END OF SECTION

SECTION 23 05 71 - MECHANICAL DEMOLITION, RELOCATION, AND ALTERATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. Temporary Generator Manufacturer – The temporary generator manufacturer is the manufacturer and the local representative of the generator being provided under this project.

1.3 DESCRIPTION OF WORK

A. Provide demolition, removal, relocation, rerouting, and reconnection for existing mechanical facilities, as required, shown on contract Drawings and specified herein, to accomplish alteration and restoration and to accommodate new construction.

B. Work shall include, but shall not be limited to, draining, disconnecting, relocating, removing, and dismantling, in a neat and workmanlike manner, which allows reuse by the Campus, the items and/or their appendages as indicated on the Contract Drawings.

1.4 SUBMITTALS

A. The contractor shall submitt the following in accordance with Division 1 requirements:

1. “Fire Watch” Procedure (If required under “Special Precautions”).

B. Submit a phasing & scheduleing plan as required by Division 1 sections. The plan shall include a description of the extent of all shutdowns and interuptions required.

1.5 QUALITY ASSURANCE

A. Reference Standards - Comply with the following:

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

2. NFPA 51B: Fire Prevention in Use of Cutting and Welding Processes.

3. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

4. "Demolition Safety Manual" published by the National Association of Demolition Contractors (NADC).

B. Special Precautions

1. Torch cutting of mechanical equipment will be permitted only with the specific written approval of the Campus.

2. Any cutting method, which may create sparks, must include "Fire Watch". Submit "Fire Watch" procedure for approval.

3. Draining operations must not damage building components or endanger human health.

PART 2 PRODUCTS

2.1 GENERAL

A. For materials required for this Work, comply with the applicable specification sections in Division 23.

PART 3 EXECUTION

3.1 GENERAL

A. Provide alteration and demolition of mechanical facilities as required by the Contract Documents. The drawings are diagrammatic and do not show the exact location of all existing mechanical work.

B. Do not begin the work until time schedules and manner of operations have been approved by the Campus. All interruptions of existing services shall be included in the schedules as approved by the Campus and so identified.

C. Verify the location of all existing mechanical equipment, piping, fittings, valves, ductwork, insulation, controls, and other mechanical facilities prior to demolition. Provide for the removal, relocation, rerouting, and reconnection of this work and any related work as required because of demolition methods or sequences employed. Obtain the permission of the Campus prior to commencing any work.

D. Comply with the installation procedures specified in the applicable Specification Sections in Division 23.

E. Where existing equipment must remain in service during construction, provide rerouting and reconnection of mechanical services as required to maintain continuous service.

F. Maintain system continuity and operation of piping, ductwork, or conduit, whether modified, spliced, extended, relocated, or newly constructed.

G. Remove, from the site, existing materials and equipment not intended for reuse in the work, and dispose of properly. Existing piping, conduit, and similar items to be abandoned that are not embedded in walls or floor slabs shall be completely removed. Cap open ends at all walls and floors.

H. No materials and equipment will be salvaged for future use by the Campus unless specified on the Contract Drawings.

I. Protect existing equipment (to be reused) from possible damage during demolition work.

J. If the Contractor is unsure as to the disposition of any portion of the demolition, he must request clarification from the Engineer prior to removal. In the event that the Contractor removes materials and equipment not intended for removal, he shall replace those materials and equipment in a similar condition prior to removal at no cost to the Campus.

3.2 HAZARDOUS MATERIALS REMOVAL

A. Contractor to report any additional suspected ACM to the Owner immediately.

3.3 PIPING REMOVAL

A. All welded piping shall be cut off square at the locations indicated on the drawings. No cutting will be required where the demolition ends at a flanged valve or equipment. All openings of any remaining valves, piping, sensors, instrumentation, or fittings shall be closed off with weld caps or blind flanges to prevent debris from entering the existing systems.

B. All threaded piping shall be disconnected at the location indicated on the drawings. All openings of remaining valves, piping, fittings, and equipment shall be closed off with pipe plugs or pipe caps as required to prevent debris from entering the existing systems.

C. All pipe hangers, supports, supporting, and miscellaneous steel and/or anchors shall be removed with the piping.

3.4 PROTECTION FROM FREEZING

A. It is intended that all indoor areas remain protected from damage due to freezing temperatures. Provide temporary heating equipment to serve this purpose.

B. When portions of an existing piping system are removed, and this removal causes loss of operation to another piece of equipment due to open (disconnected) piping, then the Contractor shall cap piping to retain operation of various systems.

C. Where the removal of equipment will leave an area unprotected from freezing, the Campus shall be notified by the Contractor prior to removal so appropriate steps can be taken to protect the area.

3.5 MECHANICAL EQUIPMENT REMOVAL

A. Remove all mechanical equipment shown, including (but not limited to) the equipment's supply and return piping, steam and condensate piping, drainage piping, other utility piping, valves, insulation, hangers, support steel, controls, and all line and low voltage wiring, unless indicated otherwise on the drawings. All electrical work shall be removed, including wiring between equipment and wiring to power source and/or point of origin.

B. Where equipment is supported by steel and/or structural supports, remove these supports.

C. Remove existing equipment indicated to be relocated in a manner that allows re-use. Make repairs to or replace relocated equipment for proper system operation.

3.6 INSULATION REMOVAL

A. All pipe and equipment insulation shall be removed, together with all piping, fittings, valves and equipment designated for demolition.

3.7 CONTROL WIRING REMOVAL

A. Disconnect and remove control wiring and associated conduit as directed on the Contract Drawings.

3.8 FUEL OIL PIPING AND EQUIPMENT REMOVAL

A. All fuel oil piping and equipment shall be removed and disposed of by the Contractor as indicated on the Contract Drawings. The Contractor shall use extreme caution in removing fuel oil pipe and equipment as to ensure that fuel oil does not spill on to the ground and potentially into drains. The Contractor shall secure all drains in areas where fuel oil equipment is to be removed. Any fuel oil spills resulting from demolition and/or improper installation shall be cleaned up at the expense of the Contractor. The Campus shall be notified immediately of any fuel oil spills/leaks that occur during demolition and new work construction. All fuel oil pipe shall be disposed of by the Contractor in accordance with State and Federal regulations. All fuel in fuel oil piping to be removed shall be removed by the Contractor. The Contractor shall assume all existing pipes

designated as having a fuel oil related service are full of oil.

END OF SECTION

SECTION 23 05 91 - PIPE SLEEVES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Specification Sections apply to this Section:

1. Section 23 05 92 – PIPE SLEEVE SEALS

2. Section 23 06 00 – PIPE HANGERS AND SUPPORTS

1.2 DESCRIPTION OF WORK

A. Provide pipe sleeves where piping passes through metal gratings, trench covers, interior walls, partitions, exterior walls, roofs, and concrete floor.

1.3 SUBMITTALS

A. Shop Drawings and Product Data: In accordance with Section Division 1, submit the following:

1. Manufacturer's product data for all materials to be used.

2. Pipe sleeve schedule indicating system, location, and size of pipe sleeve.

1.4 QUALITY ASSURANCE

A. Openings for piping shall be large enough to allow lateral thermal movement of the piping. The calculations made by the requirements of Section 23 06 00 - PIPE HANGERS AND SUPPORTS shall indicate the minimum required clearance.

B. If it is observed for any new piping system that the pipe insulation (or pipe wall, if there is no insulation) is touching the pipe sleeve when the pipe is heated, the Contractor shall provide a larger pipe sleeve at no additional cost to the Campus.

PART 2 PRODUCTS

2.1 FOR ROOF PENETRATIONS

A. Provide pipes penetrating the roof with schedule 40 steel pipe sleeves of size that permit a flow of air between the pipe and the sleeve. Typical details are shown on the Contract Drawings.

B. Coordinate with the requirements of Section 23 06 00 - PIPE HANGERS AND SUPPORTS.

PART 3 EXECUTION

3.1 INSTALLATION

A. Extend wall and partition sleeves through and cut flush with each surface, unless otherwise indicated or specified.

B. Locate piping in sleeve to allow for movement. Do not allow steel sleeves to touch copper piping at any time.

C. After piping has been installed (and insulated if required), fill the annular spaces between piping and sleeves with materials as specified in Section 23 05 92 - PIPE SLEEVE SEALS.

END OF SECTION

SECTION 23 05 92 - PIPE SLEEVE SEALS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Specification Sections apply to this Section:

1. Section 23 05 91 - PIPE SLEEVES

1.2 DESCRIPTION OF WORK

A. Provide sealing of the annular space between pipe sleeves and the bare or insulated piping passing through interior walls, partitions, exterior walls, roofs and other penetrations for cold piping only which does not experience any significant thermal growth where the design temperature is below 160 deg. F.

1.3 SUBMITTALS

A. Shop Drawings and Product Data: In accordance with Division 01, submit the following:

1. Manufacturer's product data for all pipe sealants used.

1.4 REFERENCE STANDARDS - COMPLY WITH THE FOLLOWING:

A. American Society for Testing and Materials (ASTM):

1. ASTM E84 Surface Burning Characteristics of Building Materials.

2. ASTM E119 Fire Tests of Building Construction and Materials.

3. ASTM E814 Fire Tests of Through-Penetration Fire Stops.

4. ASTM C920 Elastomeric Joint Sealants.

B. National Fire Protection association (NFPA):

1. NFPA 251 Standard Methods of Fire Tests of Building Construction and Materials.

C. Underwriters Laboratories, Inc. (UL):

1. UL 1479 Fire Tests of Through-Penetration Fire Stops.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS - FOR NON-FIRE-RATED CONSTRUCTION

A. Provide mineral fireproofing filler material in thicknesses required for each pipe sleeve.

B. Provide polyethylene foam backup strip for filler material.

C. Provide butyl elastomer flexible vapor barrier sealant for sealing both ends of pipe sleeve.

D. Manufacturers

1. Mineral Fireproofing - Thermafiber by USG Acoustical Products Company.

2. Polyethylene Foam - Ethafoam by Dow Chemical Company.

3. Butyl Elastomer - Foster 95-44.

E. Specific equipment manufacturers and their model numbers are cited in this Section to establish the desired performance and quality for that equipment. Product by other manufacturers are acceptable if they comply with all features in this Section, and that this compliance can be documented through independent testing. If independent test results are unavailable, independent testing may be required by the Owner at no cost to the Owner.

2.2 PRE-INSULATED FIRE WALL AND ROOF DECK PENETRATION FIRE BARRIER KITS

A. Pre-insulated fire barrier kits shall be furnished and installed by the Contractor on all steel pipe and copper tubing penetrating roof decks.

B. Bare pipe: All steel pipe and copper tubing penetrating fire walls or decks shall be encircled by sheet metal sleeves sized for maximum one inch annular spacing between pipe and sleeve. Spacing shall be packed on each end with UL-rated ceramic fiber strip insulation.

C. Insulated pipe: Same as for bare pipe, but with the addition of a 360 degree cylinder of waterproofed calcium silicate insulation encasing the pipe and covered with galvanized sheet metal shielding, all sized to extend to a minimum of one inch beyond fire wall or roof deck.

D. Sleeve and packing shall have the same fire rating as the partition construction in which they are installed.

E. Manufacturers:

1. Pipe Shields, Inc. Fire Barrier Kits - Models F100 through F9200 Series.

2. 3M

PART 3 EXECUTION

3.1 INSTALLATION

A. For Pipe Sleeves Receiving Non-Fire-Rated Seals (Watertight Pipe Sleeves)

1. Provide mechanical type rubber link type as detailed and as manufactured by Thunderline Corporation

2. Size the link seal as recommended by the manufacturer and as required for the intended service.

3. The link seal shall be installed so that tightening bolts are accessible for maintenance.

4. For insulated piping systems provide a six (6) inch long removable portion in front of the tightening bolts for maintenance. Do not extend insulation through the sleeve.

5. Pack the void between the pipe and the sleeve with oakum and caulk on the non servicing side of the sleeve.

B. For Pipe Sleeves Receiving Fire-Rated Non- Watertight Seals

1. Wedge filler material between bars or insulated pipe and sleeve over the full length of the pipe sleeve.

2. Recess the filler material 1/4 inch back from the end of the sleeve.

3. Trowel or gun a continuous bead of sealant for a complete seal over the filler material at both ends of sleeve.

END OF SECTION

SECTION 23 06 00 - PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 23 Sections apply to this Section:

1. Section 23 05 00 – BASIC PIPING MATERIALS AND METHODS
2. Section 23 62 00 – PIPING SYSTEM SPECIALTIES
3. Section 23 05 23 – VALVES
4. Section 23 07 00 – HVAC INSULATION

1.2 DESCRIPTION OF WORK

A. This Section provides the specification for pipe hangers and supports of all piping systems associated with this project. This includes all ASME B31.1 piping systems and ASME B31.9 piping systems. The Engineer has performed an ASME B31.1 thermal stress analysis on the HTHW System. The Contractor shall provide the spring hangers and anchors detailed in the Contract Drawings and shall provide all supports for these systems to satisfy ASME B31.1 requirements of supporting the weight of the piping systems. For all other piping systems, the Contractor shall design and provide pipe support systems to satisfy ASME B31.1 and ASME B31.9 code requirements for all design conditions such as dead loads (weight of pipe, insulation, etc.), thermal loads (due to thermal expansion), and other loads (earthquake, etc.).

B. The Contractor shall design and provide an engineered pipe hanger system for all pipe systems of this project as specified in this Section.

C. This Section provides the specification for the following components:

1. Horizontal-piping hangers and supports.
2. Vertical-piping clamps.
3. Hanger-rod attachments.
4. Building attachments.
5. Saddles and shields.

6. Miscellaneous materials.

D. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 Sections.

1.3 SUBMITTALS

A. Shop Drawings, Product Data, and Quality Assurance Submittals: In accordance with Division 01, submit the following:

1. Pipe hanger and support schedule for the pipe systems, including isometric drawings of the piping system. Schedule shall list all pipe supports.

2. Product data, including installation instructions for each type of hanger and support component. This information shall consist of copies of the manufacturer's catalog data for the items provided in the pipe hanger assembly drawings and shall indicate dimensions, materials of construction, maximum recommended load if applicable, any operating instructions, approximate weight, and MSS SP-69 approval. Together with the pipe system isometric drawings and the manufacturer's catalog data, the assembly of the complete system should be clearly identifiable.

1.4 QUALITY ASSURANCE

A. For all pipe support related welding performed on site, qualify welding processes and welding operators in accordance with AWS D1.1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. MSS Standard Compliance

1. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

2. Select and apply pipe hangers and supports, complying with MSS SP-69.

3. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

4. Terminology used in this Section is defined in MSS SP-90.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging, marking, shipping, receiving, and storage shall be performed per the recommendations of Paragraph 9 of MSS SP-89.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American Society of Mechanical Engineers (ASME)

1. B31.1 Power Piping Code
2. BPVC Boiler Pressure Vessel Code

C. American Society for Testing and Materials (ASTM)

1. ASTM Carbon Structural Steel
2. ASTMC150 Portland Cement
3. ASTMC404 Aggregates for Masonry Grout

D. American Welding Society (AWS)

1. AWSD1.1 Structural Welding Code Steel

E. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

1. SP-58 Pipe Hangers and Supports Materials, Design and Manufacturer
2. SP-69 Pipe Hangers and Supports - Selection and Application
3. SP-89 Pipe Hangers and Supports - Fabrication and Installation Practices
4. SP-90 Guidelines on Terminology for Pipe Hangers and Supports

PART 2 PRODUCTS

2.1 GENERAL

A. The Contractor shall provide all necessary hangers, beam clamps, hanger rods, turnbuckles, bracing, rolls, plates, brackets, saddles, and other accessories necessary to support the pipes from the buildings, pipe bridges, stanchions and structures. Drilling, welding, cutting, and other operations required to attach the piping to such structures shall be part of the Contract. Channels, angles, small beams, and other structural steel items necessary to span between building beams or columns to support one or more pipe hangers and used solely for that purpose shall be furnished by the Contractor and the cost thereof included in the Contract.

B. All pipe lines shall be provided with complete hanger assemblies. Included shall be the pipe hanger, washers, nuts, turnbuckles, rods, strap, clip angles, beam clamps, and

through bolts. Pipe hangers for all pipe lines shall comply with MSS SP-58, SP-69, and SP-89.

C. Pipe lines to be supported include all new piping and tubing, existing piping that requires temporary supporting due to structural related work, and existing piping where required due to new piping connecting to existing piping.

2.2 HANGER DESIGN SERVICES

A. The Contractor shall design an engineered pipe hanger system for all other pipe systems of this Contract. A detailed analysis is not required to be submitted, however, the Contractor shall perform calculations to the detail necessary to convince himself that the pipe system is adequate for the service. For all pipe hangers, supports, anchors, guides, etc., the Contractor shall submit pipe system isometric drawings. Provide proposed equipment manufacturer, manufacturer's model number and size, construction, finish, quantities and/or lengths. Indicate pipe group, line size, insulation thickness.

B. The design conditions utilized to generate the hanger system design shall be taken from the piping system specification in Section 23 05 00 - BASIC PIPING MATERIALS AND METHODS.

C. Piping Connecting to Existing Systems

1. The Contractor shall be responsible for verifying that existing supports are acceptable where tie-ins to existing piping occur. The Contractor shall consider all additional material required as part of this Contract.

2. In order to perform calculations of the movement and support of the piping systems, it is recognized that the Contractor will have to identify existing piping and supports not currently shown on the Contract Drawings.

2.3 GENERAL DESIGN GUIDELINES

A. All supports and parts shall conform to the latest requirements of the ASME Code for Pressure Piping B31.1, and MSS SP-58, MSS SP-69, and MSS SP-89, except as supplemented or modified by the requirements of this Section.

B. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible.

C. Weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

D. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping and prevent excessive stress resulting from transferred weight being introduced into the pipe or connected equipment.

E. Variable Support Hangers (Where Indicated on the Drawings)

1. Where transfer of load to adjacent hangers or equipment is not critical, and where the vertical movement of the piping is less than 3/4 inch, variable spring hangers may be used, provided the variation in supporting effect does not exceed 25 percent of the calculated piping load through its total vertical travel.

2. For non-critical, low temperature systems, where vertical movements up to 2 inches are anticipated, an approved pre-compressed variable spring design similar to Anvil Fig. B-268 may be used. Where the vertical movement is greater than 2 inches, a variable spring hanger similar to Anvil Fig. 98 may be used. Where movements are of a small magnitude, spring hangers similar to Anvil Fig. 82 may be used.

3. Each variable spring shall be individually calibrated at the factory and furnished with travel stops. Spring coils must be square to within 1 degree to insure proper alignment. Each spring coil must be purchased with a Certified Manufacturer's Test report (C.M.R.T.) and be of domestic manufacture.

F. Hanger Rods and Supports

1. All rigid rod hangers shall provide a means of vertical adjustment after erection.

2. All pipe supports shall allow liner expansion as necessary. Guides shall be applied as described below. Roller chair shock absorbing type shall be used at all other locations.

3. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing.

4. Where horizontal piping movements are such that hanger rod angularity from the vertical is greater than or equal to 4 degrees from the cold to hot position of the pipe, the hanger pipe and structural attachments shall be offset in such manner that the rod is vertical in the hot position.

5. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

G. Pipe Anchors, Guides, and Other Concerns

1. All pipe anchors and guides shall be of welded steel construction designed with a safety factor of not less than five.

2. The Contract Drawings for this project indicate the location of all anticipated anchors required to control excessive forces and moments on equipment, over stressing of pipe material, and/or extreme malpositioning of hanger rods caused by thermal expansion for HTHW piping only.

3. The Contractor shall recognize the necessity and provide anchors, guides, and sway braces to prevent extreme malpositioning of hanger rods, over stressing of pipe, and/or excessive forces and moments on equipment caused by hydraulic surge in the lines. These anchors, guides, and sway braces are not indicated on the Contract Drawings. The Contractor shall anticipate that such are necessary and shall allow for same in his proposal. He shall also provide them in the systems included in his scope for evaluation as specified.

4. After flushing and start up of all pipelines, each shall be observed to locate excessive movement and then shall be guided or anchored by the Contractor at this time.

5. Where the piping system is subject to shock loads, such as seismic disturbances or thrusts imposed by the actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices of approved design, such as Anvil Fig. 200 or approved equal shock and sway suppressor.

6. Supports, guides, and anchors shall be so designed that excessive heat will not be transmitted to the building steel. The temperature of supporting parts shall be based on a temperature gradient of 100 deg. F per inch distance from the outside surface of the pipe.

H. Thin wall Stainless Steel, Fiberglass, and Copper Lines: Thin wall stainless steel, fiberglass, and copper lines shall be supported by clevis or clamp type hangers with a stainless steel bearing plate secured in place between the hanger and the pipe. The bearing plate shall be 12 inches long, cover 1/4 of the pipe circumference, and be made 1/8 inch thick stainless steel bent to fit the pipe bottom. The maximum spacing of pipe hangers on thin wall aluminum, stainless steel, and copper lines shall be no more than:

1. 1/2 inch through 1-1/4 inch = 8 feet

2. 1-1/2 inch through 4 inch = 10 feet

3. 5 inch and larger = 12 feet

I. Painting: Prime paint all hangers for interior locations and provide galvanized coating for all exterior locations. Refer to Section 09 91 23 PAINTING.

2.4 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. Hangers shall be so spaced as to prevent sag and permit proper drainage. Hanger spacing shall be in accordance with MSS SP-69. Provide a hanger at elbows (within 2 feet) and terminations.

B. Horizontal pipe attachments shall be selected in accordance with Table 1 of MSS SP-69. Selection of components must strictly adhere to the allowable temperature ranges listed and the presence of insulation.

C. Pipe Clamps: Double bolt pipe clamps when used on insulated hot pipe shall match the pipe outer diameter. Insulation shall be applied so as to cover both clamp and pipe.

D. Clevis Hangers

1. Clevis hangers used on uninsulated lines shall match the pipe outer diameter. Clevis hangers used on insulated cold lines shall be so sized that the inner diameter of the hanger matches the outer diameter of the piping insulation.

2. Oversized clevis hangers 4 inches and larger shall have a Schedule 40 pipe sleeve over the horizontal bolt (that is clevis hangers sized to fit over the insulation of lines). Adjustable steel clevis type pipe hangers are preferred rather than clamp hangers for uninsulated pipe. All except clamp type hangers on insulated lines shall have sufficient width to clear the pipe covering aluminum jacket.

E. Brackets used for supporting piping shall be of welded steel construction with a design safety factor of not less than five.

2.5 PIPING, CONDUITS, AND SUPPORTS, GENERALLY

A. Piping and conduits, except electrical conduits run in floor construction, shall be run parallel with the lines of the building, unless otherwise shown or noted on the Contract Drawings. Electrical conduits shall not be hung on hangers with any other service pipes. The different service pipes, valves, and fittings shall be so installed that after the covering is applied there will not be less than one inch clear space between the finished covering and other work and between the finished coverings of parallel adjacent pipes. Hangers on different service lines, running parallel with each other and parallel to the lines of the building. Exact location of electrical outlets, piping, ducts, and conduits shall be coordinated among the trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Engineer's satisfaction and at no expense to the Owner.

2.6 VERTICAL-PIPING CLAMPS

A. Provide Factory-fabricated vertical-piping clamps complying with MSS SP-58 selected by Installer to suit vertical piping systems in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

2.7 HANGER-ROD ATTACHMENTS

A. Provide factory-fabricated hanger-rod attachments complying with MSS SP-58 selected by Installer to suit horizontal-piping hangers and building attachments in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

2.8 BUILDING ATTACHMENTS

A. Provide factory-fabricated building attachments complying with MSS SP-58 selected by Installer to suit building substrate conditions in accordance with MSS SP-69 and manufacturer's published product information. Select site of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

2.9 SADDLES AND SHIELDS

A. Provide factory fabricated saddles or shields under piping hangers and supports for all insulated piping. Saddles and shields shall be sized for exact fit to mate with pipe insulation and shall comply with MSS SP-58 and selected by Installer in accordance with MSS SP-69 and manufacturer's published product information.

B. Pipe covering protection saddles for use at support points on all 100 degrees to 750 degrees insulated pipe lines shall be commercial steel plate type. The saddle shall be tack welded to the pipe and extend out past the insulation O.D.

2.10 SPRING HANGERS AND SUPPORTS

A. Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58 selected by Installer to suit piping systems in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

2.11 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

B. Cement Grout: Portland Cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

2.12 PIPE SLIDES AND GUIDES

A. Pipe Slides and Guides: Provide factory-fabricated slides and guides, of heavy fabricated steel. Provide guides of length recommended by manufacturer to allow calculated travel.

PART 3 EXECUTION

3.1 INSPECTION

A. The installation, adjustment, and inspection of all hangers systems shall be performed by the Contractor in accordance with Paragraph 10 of MSS SP-89.

B. During renovation and installation of equipment, the Contractor shall be responsible for the temporary support of all piping systems where necessary due to the phasing of construction. Temporary support systems shall be in accordance with the requirements of this Section.

3.2 PREPARATION

A. Proceed with installation of permanent hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work but after the pipe hanger submittal has been reviewed by the Engineer, the Installer shall meet at project site with Contractor, installer of each component of associated work, installers of other work requiring coordination with work of this Section, and Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with this Section.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps, and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Install supports with maximum spacing complying with MSS SP-69 and to permit normal pitch of pipe with

deflection and bending stress maintained at a minimum. PVC piping shall have a support interval of four feet for all pipe sizes.

B. During the hydrostatic testing of any line with spring hangers designed for fluids lighter than water, travel stops or locks must be installed on the hangers or temporary solid rod supports must be provided during the entire time the line is filled with water to support its additional weight and thereby prevent overloading the springs. When tests are completed, the stops, locks, or solid rods must be removed and the hanger springs set for their cold loads.

C. On the first occasion that any line is brought to operating temperature, the Contractor shall immediately reset each spring hanger to its hot load position and lock the adjusting nut or screw.

D. Install building attachments to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

F. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

G. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.4 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.1 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.1 and with AWS Standards D1.1.

3.5 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so that no roughness shows after finishing and so that contours welded surfaces to match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve proper slope of pipe.

3.7 PAINTING

A. All outdoor piping shall be painted by hot dipped galvanized.

B. All indoor pipe shall be primed and painted.

C. Refer to specification section 09 91 23 for paint to be applied.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

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

B. Requirements of the following Specification Sections apply to this Section:

1. Section 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

2. Section 23 05 00 – BASIC PIPING MATERIAL AND METHODS

3. Section 23 06 00 – PIPE HANGERS AND SUPPORTS

1.2 DESCRIPTION OF WORK

A. Scope: Extent of the piping system and equipment required to be insulated by this Section is indicated in this Section, on the Contract Drawings, and other Division 23 Sections.

B. Types: Types of mechanical insulation systems specified in this Section include the following:

1. Pipe insulation.

2. Insulation jackets.

3. Insulation accessories.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Provide insulation conforming to the following standards:

1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM standards, including:

2. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:

3. Underwriter's Laboratory Inc.

B. Do not provide materials with flameproofing treatments subject to deterioration due to the effects of moisture or high humidity, where applicable.

C. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index specified herein, and smoke-developed index specified herein, as tested by ASTM E 84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

D. The work shall be done only by mechanics thoroughly experienced in pipe insulation, and the quality of workmanship shall be the best attainable.

1.4 SUBMITTALS

A. Shop Drawings, Product Data, and Samples: In accordance with Division 01, submit the following:

1. Manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, flame spread and smoke developed ratings, thickness, and furnished accessories for each mechanical system requiring insulation. Furnish necessary test data certified by an independent testing laboratory. Provide manufacturer's certification that insulation or any other materials provided shall not accelerate stress corrosion of stainless steel pipe per ASTM C795.

2. Submit manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

3. Insulation application schedule indicating equipment or piping systems sizes, insulation material, thickness, insulation vapor barriers, jackets, types of insulated fittings, accessories, and methods for each insulated system.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Storage and Handling: Protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

C. Outside storage of insulating materials is prohibited.

D. Insulating materials and accessory materials shall be packed in shipping containers so constructed as to ensure safe delivery of the materials in a satisfactory condition. The

shipping containers shall be legibly marked with the name of the manufacturer, material, size, type, thickness, density, and quality contained in each container.

E. The Contractor shall provide a storage area for weather protection of all insulation materials and accessory materials after their arrival at the job site.

F. Installed insulation which has not been weather-proofed shall be protected from inclement weather by an approved waterproof sheeting installed by the Contractor. Any wet or damaged insulation shall be removed and replaced by the Contractor at no additional cost.

PART 2 PRODUCTS

2.1 INSULATION GENERAL REQUIREMENTS

A. General: Provide insulation conforming to the referenced publications and the specified temperature ranges and approved manufacturers products.

2.2 INSULATION IDENTIFICATION SYSTEM

A. A system has been established which identifies the specific insulation type, insulation thickness, and insulation finish for each service indicated in the Contract Drawings. Insulation type, insulation thickness, and insulation finish are linked by the service letter(s) as indicated by this section. The specific insulation type and insulation finish is listed in PIPING INDEX TABLE A1 in Section 23 05 00 - BASIC PIPING MATERIALS AND METHODS. See that Section for an example. In addition, the insulation thickness only is listed in the "Insulation Thickness Schedule" which appears in this section.

B. Where insulation is scheduled for a pipe system below, insulation is required regardless of whether or not the letter designation for the insulation group is specifically called out on the pipe line description in the Contract Drawings. In some cases, a different amount of insulation may be required for a piping line than what is specified in the indexes. In these cases, the required insulation group will be changed and called out on the pipeline description on the Contract Drawings and its corresponding thickness shall prevail.

2.3 INSULATION THICKNESS SCHEDULE

A. Nominal insulation thickness shall be as follows:

Insul Group	**A**	**B**	**C**	**J**
Pipe Temperature (Degrees F.)				
Pipe Size (inches)	100 to 199	200 to 299	300 to 399	40 to 100
1/2	1	1	1-1/2	1
3/4	1	1	1-1/2	1

1	1	1	2	1
1-1/4	1	1-1/2	2	1
1-1/2	1-1/2	1-1/2	2	1
2	1-1/2	2	2-1/2	1
2-1/2	1-1/2	2	2-1/2	1
3	1-1/2	2-1/2	3	1
4	1-1/2	2-1/2	3	1
6	1-1/2	3	3	1
8	1-1/2	3	3	1
10	1-1/2	3	4	1
12	1-1/2	3	4	1
14	1-1/2	3	4	1

2.4 PIPE INSULATION GROUP SPECIFICATIONS

A. General: Provide pipe insulation as specified below as dictated by the PIPING INDEX TABLE A1 in Section 23 05 00 - BASIC PIPING MATERIALS AND METHODS. Provide removable/reusable blankets in accordance with Insulation Group "R".

B. Groups "A" - "C" - Mineral Wool Pipe Insulation: Aluminum jacket (pipe insulation finish group 'C') shall be applied for any high traffic area up to 7 feet above floor and platforms including catwalks; otherwise pipe insulation shall provided with an all-service jacket. All-service jacketing shall be color matched to existing system color schemes. Aluminium jacketing shall not be painted.

1. Provide mineral preformed pipe insulation form in accordance with ASTM C547.

2. Insulation shall have a continuous service temperature rating of not less than 850 degrees F. The insulation thickness shall be as specified in the Paragraph "Insulation Thickness Schedule" of this Specification.

3. Thermal conductivity shall be no greater than 0.46 BTU-in per hour - deg. F - sq. ft. at 400 deg. F mean temperature in accordance with ASTM C335.

4. Provide fittings:

a. Fittings and valves shall be insulated with the same insulation system and built-up to the same thickness as the insulation for the adjoining pipe in accordance with insulation manufacturer's instructions.

b. Industrial PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil- thick, high-impact, ultraviolet-resistant PVC, basic of design Zestion 300.

1) Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.

2) Adhesive: As recommended by insulation material manufacturer.

c. All joints shall be made rain or drip proof. Longitudinal joints shall be located on the side of the pipe with the open edge of the lap turned down to shed water. Circumferential joints on pipes that do not have enough slope to get a good shingle effect to keep water out of the joint shall have the inside end of the lap beaded or sealed with a permanently elastic mastic type sealant designed for this service.

d. Fittings, valves and other irregular shaped items shall be insulated with fibers built up to the same thickness as the adjoining insulation and then fitted with an off-white, premolded, PVC jacket. All seams on the PVC jacket shall be sealed. These seals shall be accomplished by the use of sealing mastic or by the use of a pressure sensitive, color matched tape as recommended by the manufacturer. For cold systems, the circumferential joint at the ends of the jacket shall be sealed to the vapor barrier of the adjoining insulation.

e. At hangers and support points, the Contractor will supply and install a premolded high density fiberglass insulation segment with an attached vapor barrier. The Contractor shall fit his insulation to this segment. For cold systems, the Contractor shall seal the vapor barrier to his insulation.

f. Since the efficiency of this insulation for cold systems is dependent upon obtaining and maintaining an absolutely vapor tight barrier, all precautions shall be taken to not rupture the vapor barrier at any point by the use of screws, staples, etc.

C. Acceptable Manufacturers and Products

1. Group "A" - "C" - Mineral Wool Insulation

Johns-Manville/Schuller International, Inc. PO Box 62500 Littleton, Colorado 80162-5005 Phone Number: 800-654-3100
Owens-Corning Corp One Owens Corning Pkwy

Toledo, Ohio 43659 Phone Number 419-247-5000
Partek Insulation 908 S. E Partek Drive Phoenix City, AL 36867 Phone Number: 800-752-2738

D. Group "J" - Pipe Insulation:

1. Pipe insulation shall be glass fiber. The insulation material shall consist of inorganic glass fibers, bonded with a thermosetting resin. Insulation shall conform to ASTM C 795.

2. Utilize preformed pipe insulation as much as possible. Preformed pipe insulation shall be in compliance with ASTM C547, Class 1, rigid insulation. Thermal conductivity, according to ASTM C335, shall be a minimum of 0.24 BTU-in/hr-sq ft degrees F at 100 degrees F mean temperature and below 0.29 BTU-in/hr-sq ft degrees F at 200 degrees F mean temperature.

3. When tested in accordance with ASTM E84, NFPA 255, and UL 723, as plain insulation or on a composite basis (insulation, jacket, and adhesive), insulation shall not exceed 25 flame spread and 50 smoke developed.

4. Insulation shall be rated for continuous temperatures to 850 degrees F. Insulation shall be provided with all-service jacket.

5. The thickness shall be as specified in the Paragraph "Insulation Thickness Schedule". Fittings and valves shall be insulated with glass fiber and built-up to the same thickness as the insulation for the adjoining pipe in accordance with insulation manufacturer's instructions.

6. Provide insulation from one of the following manufacturers and product trade names:

Manufacturer	Trade Name of Product
Johns-Manville/Schuller International, Inc. P.O. Box 625005 Littleton, Colorado 80162-5005 Phone Number 800-654-3103	MICRO-LOCK FIBERGLASS PIPE INSULATION
Owens-Corning Corp FIBERGLAS HEAVY DENSITY One Owens Corning Pkwy Toledo, Ohio 43659	FIBERGLASS HEAVY DENSITY

Phone Number 419-247-5000	
Knauf Fiber Glass One North Revmont Drive Shrewsbury NJ 07701	FIBERGLASS HEAVY DENSITY

E. Group “R” – Removable/Reusable Insulation

1. Insulating material shall be tailor-made removable/reusable blankets. The blankets shall be made with a high temperature fiberglass mat without the use of chemical binders and suitable for temperatures up to 1200 degrees F.

2. All blanket and covers shall be constructed and designed to permit a conductivity of no more than 92 Btu/sq ft/hour and a surface temperature of not more than 135 degrees F. in still air at an ambient temperature of 80 degrees F. The minimum blanket insulation thicknesses shall be as follows:

   a. 130 to 300 degrees F. 1-1/2 inch thick

   b. 301 to 400 degrees F. 2-1/2 inch thick

3. Single layer blanket construction may be used for metal temperatures up to 600 degrees F. For metal temperatures over 600 degrees F., double layer construction must be used. The joints for double construction between blankets of the inner layer and those of the outer layer shall be offset from one another.

4. The inner liner material for hot surface temperatures up to 500 degrees F. shall be silicone coated glass 32 ounce. For hot surface temperatures between 500 and 1000 degrees F., the blanket insulation material shall be enclosed on all sides with a knitted wire mesh. The knitted wire mesh shall be 304 stainless steel wire, 0.011” knitted into a tubular fabric with a mesh size of 60 density.

5. The exterior jacket material shall be silicone glass cloth 32 ounce.

6. All blankets shall be quilted at frequent intervals with quilting fasteners.

7. The blankets shall be made and designed to fit tightly around the outside diameters of the flanges and valves, leaving no gaps when laced. Each blanket shall be constructed with 16 gauge stainless steel wire draw strings that pass through hog rings and are spaced 3/4 inch apart. All mating edges of adjacent blankets shall be fitted with blanket hooks, spaced approximately six (6) inches on centers or as required to provide securement for the stainless steel tie wire that is used to lace adjacent blankets together.

2.5 PIPE INSULATION FINISH SPECIFICATIONS

A. General: Provide pipe insulation finish as specified below and where stated in the PIPING INDEX TABLE A1 in Section 23 05 00 - BASIC PIPING MATERIALS AND METHODS.

B. Group "C" - Insulation Finish

1. Provide aluminum jacket as follows:

a. Apply directly over the insulation an aluminum weatherproof jacket. This jacket shall be manufactured from aluminum alloy 5005 or 3003 half hard, not less than 0.016 inch thick, fabricated with 3/16 inch corrugations running lengthwise of pipeline. The aluminum shall be factory attached to a moisture barrier of kraft paper treated for this service.

b. All joints shall be made rain or drip proof. Longitudinal joints shall be located on the side of the pipe with the open edge of the lap turned down to shed water. Circumferential joints on pipes that do not have enough slope to get a good shingle effect to keep water out of the joint shall have the inside end of the lap beaded or sealed with a permanently elastic mastic type sealant designed for this service.

c. The aluminum jacket shall be secured by aluminum straps 1/2 inch wide by 0.020 inch thick. The straps shall be placed on 12 inch centers (maximum). Each circumferential joint shall have a strap at the midpoint of the lap.

d. On long radius bends, the aluminum jacket shall be in sections cut on the miter, overlapped, and forming a neat snug fit, using sufficient bands and fasteners to hold jacket properly in place.

e. All 30 inch diameter and smaller insulated elbows shall be protected with a prefabricated elbow jacket. The jacket shall be manufactured of high purity 0.024 inch aluminum with a suitable moisture barrier on the interior of the jacket to prevent decomposition of the aluminum. The prefabricated elbow jacket shall be applied directly over the insulated fitting.

2.6 EQUIPMENT INSULATION SCHEDULE

A. General: Provide equipment insulation as specified below. Equipment insulating groups and finishes are also presented below.

EQUIPMENT INSULATION SCHEDULE			
EQUIPMENT	**INSUL THICK**	**INSUL GROUP**	**INSUL FINISH**
Generator Breeching , Insul Design Temp 1000 F	4 inches	P	Aluminium

2.7 EQUIPMENT INSULATION GROUP SPECIFICATIONS

A. General: Provide equipment insulation as specified below and as dictated by the "Equipment Insulation Schedule".

B. Group "P" - Mineral Wool Insulation

1. Provide mineral insulation rigid board form in accordance with ASTM C612.

2. Insulation shall have a continuous service temperature rating of not less than 1200 degrees F. The insulation thickness shall be as specified in the Paragraph "Equipment Insulation Schedule" of this Specification.

3. Thermal conductivity shall be no greater than 0.46 BTU-in per hour - deg. F - sq. ft. at 400 deg. F mean temperature in accordance with ASTM C335.

4. Provide jacket as follows:

a. Apply directly over the insulation an aluminum weatherproof jacket. This jacket shall be manufactured from aluminum alloy 5005 or 3003 half hard, not less than 0.016 inch thick, fabricated with 3/16 inch corrugations running lengthwise of pipeline. The aluminum shall be factory attached to a moisture barrier of kraft paper treated for this service.

b. All joints shall be made rain or drip proof. Longitudinal joints shall be located on the side of the pipe with the open edge of the lap turned down to shed water. Circumferential joints on pipes that do not have enough slope to get a good shingle effect to keep water out of the joint shall have the inside end of the lap beaded or sealed with a permanently elastic mastic type sealant designed for this service.

c. The aluminum jacket shall be secured by aluminum straps 1/2 inch wide by 0.020 inch thick. The straps shall be placed on 12 inch centers (maximum). Each circumferential joint shall have a strap at the midpoint of the lap.

d. On long radius bends, the aluminum jacket shall be in sections cut on the miter, overlapped, and forming a neat snug fit, using sufficient bands and fasteners to hold jacket properly in place.

e. All 30 inch diameter and smaller insulated elbows shall be protected with a prefabricated elbow jacket. The jacket shall be manufactured of high purity 0.024 inch aluminum with a suitable moisture barrier on the interior of the jacket to prevent decomposition of the aluminum. The prefabricated elbow jacket shall be applied directly over the insulated fitting.

C. Acceptable Manufacturers and Products

1. Group "P" - Mineral Wool Insulation

Johns-Manville/Schuller International, Inc. PO Box 62500 Littleton, Colorado 80162-5005 Phone Number: 800-654-3100
Owens-Corning Corp One Owens Corning Pkwy Toledo, Ohio 43659 Phone Number 419-247-5000
Partek Insulation 908 S. E Partek Drive Phoenix City, AL 36867 Phone Number: 800-752-2738

PART 3 EXECUTION

3.1 GENERAL INSULATION INSTALLATION

A. General: Install insulation material with smooth and even surfaces. Unless otherwise specified, install insulation materials, accessories, and finishes in accordance with the manufacturer's published recommendations.

B. Fire Precaution: Care shall be exercised by the Contractor that no cutting, welding, or open flames are permitted in the areas where flammable mastics or other materials are used. The precaution period shall extend until the material has cured sufficiently so that no further fire hazard exists.

C. Insulation Release: Before insulation is applied to any piping or equipment, the Contractor shall obtain from the Engineer a written release stating that the item is ready for insulation.

D. Manufacturer's Recommendations: All materials specified herein shall be installed in full accordance with the manufacturer's recommendations for the best performance and durability of his product, notwithstanding any requirements or omissions herein with respect to preparation of equipment before insulating or method of application.

E. Expansion Joints In Insulation: Where necessary, the Contractor shall furnish suitable expansion joints in the insulation to prevent cracking or wrinkling due to expansion and contraction of the surface being insulated.

F. Surface Condition: Do not apply insulation materials until all surfaces to be covered are clean and dry, all foreign materials, such as rust, scale, and dirt have been removed, and surfaces have been painted. Insulation shall be clean and dry when installed and during the application of any finish.

G. Moisture and Vapor Seal: Provide a complete moisture and vapor seal wherever insulation terminates against metal hangers, anchors and other projections through insulation on cold surfaces for which a vapor seal is specified.

H. Asbestos Containing Material:

1. No Contractor, Subcontractor, or Supplier shall furnish any asbestos containing material.

2. Provide "Asbestos Free" identification labels for insulated piping and equipment as specified in Section 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

3.2 INSULATION FOR PIPING

A. General: Installation

1. All sectional pipe insulation shall be applied with staggered girth joints tightly butted together as recommended by the insulation manufacturer. Each section of insulation is to be held in place with separate loops of 16 gauge annealed stainless steel wire placed not more than 12 inches on center.

2. Insulation shall not be applied to any flanged, machined, or welded surfaces until they have passed all field tests, including hydrostatic, and have been released for insulation.

B. Insulation of Valves, Flanges, Fittings, Etc.

1. High maintenance items such as control valves, isolation valves 4 inches and above, flanged joints, strainers and similar type items located in insulated lines shall be insulated with removable/reusable blankets. The Contractor shall insulate all high maintenance items as directed by the Engineer with removable/reusable blankets in accordance with Insulation Group “R” of this Section. The following items are labeled high maintenance items and shall be provided with removable/reusable blankets:

a. HTHW Control Valves.

b. Temperature Control Valves.

c. HTHW Strainer/Filter.

d. Level Control Valve.

e. Flow Meters.

f. HTHW Isolation Valves (Gate & Butterfly) 4 inches and above.

2. In all insulated lines, with the exception of the high maintenance items which are insulated with blankets, the valve bodies, fittings, and flanges shall be insulated with the same material and the same thickness as the pipe insulation using mitered pipe insulation and/or block insulation securely cemented together. Valves shall be insulated up to the yokes. All flange insulation shall be the removable type, but not the replaceable type.

C. Gaps and Terminations: Neatly terminate all insulation at each end of unions and at other points where required and seal. Fill gaps occurring at hangers with insulating cement and finish flush with the adjoining pipe insulation as specified for fittings.

D. Butt pipe insulation against pipe hanger insulation inserts. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 inch wide vapor barrier tape or band.

3.3 INSULATION FOR EQUIPMENT

A. Insulation Supporting Clips and Other Components: Where insulating clips, supports, angles, studs, washers, etc., are not furnished with the equipment, the Contractor shall furnish and install them. The necessity for location of, quantity, and manner of application shall be as approved by the Engineer.

B. Insulation Over Irregular Surfaces: All irregular surfaces, heads, outlets, nozzles, and fittings shall be insulated with the same material and the same thickness as specified for the tank or equipment of which they are a part. Where necessary, the designated insulation shall be applied in a plastic form and trowelled to a smooth finish.

C. Corner Trim for Insulation Finish: Where necessary, the Contractor shall furnish and install metal corner bead and expansion base screen, secured to the poultry wire netting, to obtain a uniform thickness and workmanlike, quality installation.

3.4 PAINTING AND IDENTIFICATION

A. The piping paint shall be per section 09 91 23 - PAINTING.

B. Provide identification labels and tags for all piping systems and equipment as specified in Section 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

C. Do not insulate or paint over factory attached nameplate labels on equipment, valves, and other devices.

END OF SECTION

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Specification Sections:

1. Section 23 00 10 – BASIC HVAC REQUIREMENTS

2. Section 23 03 00 – BASIC HVAC MATERIALS AND METHODS

3. Section 23 06 00 – PIPE HANGERS AND SUPPORTS

1.2 SCOPE OF WORK

A. This Section includes furnishing all materials, labor, and performance of all operations necessary to fabricate all breeching, stacks, and supports as shown on the drawings and herein described.

1.3 SUBMITTALS

A. Shop Drawing and Product Data:

1. Shop drawings detailing fabrication and installation of breeching and stacks including plans, elevations, sections, details of components, and attachments to other construction elements. Detail connections to all pieces of equipment. Clearly identify material type, thickness, and finish for each breeching section. Provide details of access opening. Identify all instrumentation connection points and provide details of instrument connection openings.

2. Expansion Joints and Flexible Connections:

a. Manufacturers product data including dimensions, weights, materials, and accessories.

B. Welder Certificates: Welder certificates signed by the Contractor certifying that welders comply with requirements specified under the quality assurance article.

C. Coordination statement as required by Paragraph 1.4.A.

D. Manufacturer’s catalog sheets, specifications and installation instructions for insulation materials.

E. If the Contractor installs equipment that requires reconfiguration of breeching, he/she shall be responsible for redesign of breeching. Contractor shall submit all design calculations and shop drawings for approval by the Engineer.

1.4 QUALITY ASSURANCE

A. Coordination Statement: The Contractor shall provide a coordination statement indicating that breeching sizes, expansion joints, and their end conditions have been coordinated with actual equipment provided.

B. Qualifications: The persons installing the Work of this Specification Section and their Supervisor shall be personally experienced in the fabrication and installation of breeching and insulation and shall have been regularly employed by a company specializing in the Work of this Section for a minimum of 5 years. The quality of workmanship shall be the best attainable.

C. Comply with American Institute for Steel Construction for breeching fabrication and installation.

D. Comply with AWS D1.1 for welder qualifications, welding details, and workmanship standards.

E. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index specified herein, and smoke developed index specified herein, in accordance with ASTM E 84 and UL 723. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Storage and Handling: Protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

C. Outside storage of insulating materials is prohibited.

D. Insulating materials and accessory materials shall be packed in shipping containers so constructed as to ensure safe delivery of the materials in a satisfactory condition. The shipping containers shall be legibly marked with the name of the manufacturer, material, size, type, thickness, density, and quality contained in each container.

E. The Contractor shall provide a storage area for weather protection of all insulation materials and accessory materials after their arrival at the job site.

F. Installed insulation which has not been weather-proofed shall be protected from inclement weather by approved waterproof sheeting installed by the Contractor. Any wet or damaged insulation shall be removed and replaced by the Contractor at no additional cost.

PART 2 - PRODUCTS

2.1 DESIGN CONDITIONS

A. The size and arrangement of the boiler breeching is as indicated on the Contract Drawings.

B. Flue Gas Characteristics:

1. Maximum Flue Gas Temperature: 1000 deg F.

2. Operating Flue Gas Temperature: 550 deg F.

3. Minimum Flue Gas Temperature: 250 deg F.

2.2 TEMPORARY HTHW GENERATOR STACK

A. Materials: Round breeching shall be fabricated from 1/4 inch thick minimum carbon steel spiral wound pipe.

B. Breeching sections shall be butt welded except at equipment connections and expansion joints. Connections to expansion joints and equipment shall be bolted. All bolted connections shall be gasketed with minimum 1/8-inch thick gasket rated for intended service temperature. All gaskets shall be constructed of non-asbestos containing materials.

C. Standard Schedule STD or minimum 1/4 inch thick spiral wound pipe fittings shall be used for all changes in direction.

D. Provide angle clips for attachment of insulation.

E. Nozzle, ports and connections shall be provided to accommodate instrumentation. Type, size, and configuration of connection shall be coordinated with the instrument supplier.

F. Stack access shall be provided where shown. Final location of breeching access shall be determined by Contractor and approved by the Engineer. The minimum access opening shall be 24-inches by 24-inches. Access opening shall be located where they may easily

be entered. Access openings shall not be located within 12 inches of expansion joints or dampers. Access opening shall be adequately framed to withstand operating conditions. Access door shall bolt to access opening frame and be gas tight.

G. HTHW Generator primary chimney to be anchored to Heating Plant roof steel. Refer to Structural.

H. Stack height to be 10 feet above roof surface

2.3 ROUND FLUE GAS DUCTS

A. General: Provide round flue gas duct of size and arrangeent as indicated on the Contract Drawings from the outlet of the Temporary HTHW Generator to the inlet of the Stack.

B. Materials: Round breeching shall be fabricated from ¼ inch thick minimum carbon steel spiral wound pipe.

C. Breeching sections shall be butt welded except at equipment connections and expansion joints. Connections to expansion joints and equipment shall be bolted. All bolted connections shall be gasketed with minimum 1/8-inch thick gasket rated for intended service temperature. All gaskets shall be constructed of non-asbestos containing materials.

D. Standard Schedule STD or minimum ¼ inch thick spiral wound pipe fittings shall be used for all changes in direction.

E. Provide angle clips for attachment of insulation.

F. Accessories:

1. Provide accessories and specialties of types and sizes required to comply with breeching requirements including proper connection of equipment.

2. Fabricate breeching with support lugs for attachment to building structure.

3. Flange gaskets shall be 1/8 inch thickness for high temperature service to 800 degrees F, constructed of non-asbestos containing materials.

4. Hardware for flanges shall be hot-dipped galvanized bolts, washers, and nuts.

5. Provide stack drain to drain funnel. Refer to Contract Drawings for drain size.

2.4 INSULATION

A. Refer to Section 23 07 00 – HVAC INSULATION for insulation infomation.

PART 3 - EXECUTION

3.1 INSTALLATION OF STACK

A. Provide a crane erection plan at least 3 weeks before the work.

B. Exterior section of stack to be painted with high temperature, corrosion resistant paint.

3.2 CLEANING

A. Thoroughly clean all breeching of loose mill scale rust and dirt. Remove weld flux and spatter and grind smooth any sharp projections.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Wiring connectors.

C. Electrical tape.

D. Heat shrink tubing.

E. Wire pulling lubricant.

F. Cable ties.

1.2 RELATED REQUIREMENTS

A. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 26 0553 - Identification for Electrical Systems: Identification of products and requirements.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.

I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Most Recent Edition, Including All Revisions.

N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

B. Field Quality Control Test Reports.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

I. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

J. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

K. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated on drawings are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

L. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG (unless specifically called out on the Contract Drawings).

M. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

N. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      c. Equipment Ground, All Systems: Green.
      d. Isolated Ground, All Systems: Green with yellow stripe.
      e. Travelers for 3-Way and 4-Way Switching: Pink.

f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
g. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR WIRE

A. Manufacturers:
1. Copper Wire:
a. Service Wire Co
1) ServicePRO-X
b. Cerro Wire LLC
c. Encore Wire Corporation
d. Approved equal

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Wire: Type THHN/THWN-2 or XHHW-2.

2.4 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
6. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

F. Push-in Wire Connectors: Rated 600 V, 221 degrees F.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.5 ACCESSORIES

A. Electrical Tape:
   1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
      a. Product: Scotch Super 33+ or approved equal.
   2. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
      a. Product: Scotch 130C or approved equal.
   3. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant:
   1. Listed and labeled as complying with UL 267.
   2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
   3. Suitable for use at installation temperature.

D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
      b. Increase size of conductors as required to account for ampacity derating.
      c. Size raceways, boxes, etc. to accommodate conductors.

d. Refer to contract drawings for additional information.

8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
9. Provide oversized neutral/grounded conductors where indicated and as specified below.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Exposed Cable Installation (only where specifically permitted):
1. Route cables parallel or perpendicular to building structural members and surfaces.
2. Protect cables from physical damage.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

H. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

M. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

Q. Identify conductors and cables in accordance with Section 26 0553.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

T. Label all conductors as indicated within spec section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for conductors larger than #4. The resistance test for parallel conductors listed as optional is required.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 0519

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 0553.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

B. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.

2. Coordinate work to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.

4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.

5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 3000.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
   1. NFPA 70.
   2. Requirements of authorities having jurisdiction.

2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.

3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.

6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
   1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   2. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated or specified on the Drawings. Supports shall match the materials of the equipment required to be supported.
   3. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

4. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.

2. Comply with MFMA-4.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
    1. Equipment Supports: 1/2-inch diameter.
    2. Busway Supports: 1/2-inch diameter.
    3. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
    4. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
    5. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
    6. Outlet Boxes: 1/4-inch diameter.
    7. Luminaires: 1/4-inch diameter.

F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Manufacturers:
    1. Eaton Corporation
    2. nVent; Caddy
    3. PHP Systems/Design

2. Description: Steel pedestals with rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.

3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

G. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.

2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: See Section 26 0533.13 for additional requirements.

I. Box Support and Attachment: See Section 26 0533.16 for additional requirements.

J. Secure fasteners in accordance with manufacturer's recommended torque settings.

K. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 0529

SECTION 26 0533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Flexible metal conduit (FMC).

C. Liquidtight flexible metal conduit (LFMC).

D. Galvanized steel electrical metallic tubing (EMT).

E. Conduit fittings.

F. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

H. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

I. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

J. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

K. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

L. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.

5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Refer to the Raceway Schedule on the Electrical Drawings for permitted usage and restrictions.

C. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

D. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).

E. Flexible Connections to Vibrating Equipment:

1. Dry Locations: Use flexible metal conduit (FMC).

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).

3. Maximum Length: 6 feet unless otherwise indicated.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

C. Provide conduit, fittings, supports, and accessories required for complete raceway system.

D. Provide products listed, classified, and labeled as suitable for purpose intended.

E. Minimum Conduit Size, Unless Otherwise Indicated:

1. Branch Circuits: 3/4 inch (21 mm) trade size.

2. Branch Circuit Homeruns: 3/4-inch trade size.

F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC OR GRS)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International
2. Nucor Tubular Products
3. Wheatland Tube, a division of Zekelman Industries
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
2. Material: Use steel or malleable iron.
    1. Do not use die cast zinc fittings.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:

1. Manufacturers:
    1. ABB; T&B
    2. Bridgeport Fittings, LLC
    3. Emerson Electric Co; O-Z/Gedney
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
    1. Do not use die cast zinc fittings.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:

1. AFC Cable Systems, a division of Atkore International

2. Electri-Flex Company

3. International Metal Hose

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.
   1. Do not use die cast zinc fittings.

2.6 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International

2. Nucor Tubular Products

3. Western Tube, a division of Zekelman Industries

4. Wheatland Tube, a division of Zekelman Industries

B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.
   1. Do not use die cast zinc fittings.

3. Connectors and Couplings: Use compression/gland or set-screw type.
   1. Do not use indenter type connectors and couplings.

2.7 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

B. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.

3. Conceal conduits unless specifically indicated to be exposed.

4. Conduits in the following areas may be exposed, unless otherwise indicated:
    1. Electrical rooms.
    2. Mechanical equipment rooms.
    3. Within joists in areas with no ceiling.

5. Unless otherwise approved, do not route exposed conduits:

6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

7. Arrange conduit to maintain adequate headroom, clearances, and access.

8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.

9. Arrange conduit to provide no more than 150 feet between pull points.

10. Route conduits above water and drain piping where possible.

11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.

13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    1. Heaters.
    2. Hot water piping.
    3. Flues.

14. Group parallel conduits in same area on common rack.

E. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

4. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.

5. Use conduit clamp to support single conduit from beam clamp or threaded rod.

6. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.

7. Use of wire for support of conduits is not permitted.

8. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

F. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.

3. Use suitable adapters where required to transition from one type of conduit to another.

4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.

5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.

7. Secure joints and connections to provide mechanical strength and electrical continuity.

G. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.

2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.

5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.

6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.

8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.

H. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
    1. Where conduits enter building from outside.
    2. Where service conduits enter building from underground distribution system.
    3. Where conduits enter building from underground.
    4. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
    1. Where conduits pass from outdoors into conditioned interior spaces.

2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

I. Provide grounding and bonding; see Section 26 0526.

J. Identify conduits; see Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 0533.13

SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0533.13 - Conduit for Electrical Systems:

1. Conduit bodies and other fittings.

2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.

4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.

5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.

6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.

8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.

2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

3. Use suitable concrete type boxes where flush-mounted in concrete.

4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.

6. Use shallow boxes where required by the type of wall construction.

7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.

2. Unless dimensioned, box locations indicated are approximate.

3. Locate boxes as required for devices installed under other sections or by others.

4. Locate boxes so that wall plates do not span different building finishes.

5. Locate boxes so that wall plates do not cross masonry joints.

6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.

7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.

8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.

9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    1. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.

I. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 0533.16

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Wire and cable markers.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.

2. Identification for Communications Conductors and Cables: Comply with Section 27 1000.

3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    1. At each source and load connection.

B. Identification for Boxes:

1. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

C. Identification for Devices:

1. Identification for Communications Devices: Comply with Section 27 1000.

2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
   1. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

2.2 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Boxes: Outside face of cover.

2. Conductors and Cables: Legible from the point of access.

3. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

E. Mark all handwritten text, where permitted, to be neat and legible.

F. Provide and affix a typewritten circuit directory card with a clear plastic cover to the inside of each panelboard door. Directory shall include the Panel ID, voltage rating, and current rating of the panel, as well as the circuit names (or spare circuit breakers or spare positions identified) fed by each circuit position on the panel.

3.2 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 0553

SECTION 26 2816.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 2813 - Fuses.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

C. Project Record Documents: Record actual locations of enclosed switches.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE

B. Eaton Corporation

C. Schneider Electric; Square D Products

D. Siemens Industry, Inc

E. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

2. Minimum Ratings:
    1. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

1. Indoor Clean, Dry Locations: Type 1.
2. Outdoor Locations: Type 3R.

2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Heavy Duty Switches:

1. Comply with NEMA KS 1.

2. Conductor Terminations:
   1. Provide mechanical lugs unless otherwise indicated.
   2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   1. Provide means for locking handle in the ON position.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.3 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.4 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2816.16