SECTION 230500
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Mechanical sleeve seals
   2. Sleeves
   3. Escutcheons
   4. Equipment installation requirements common to equipment sections
   5. Supports and anchorages
   6. HVAC demolition
   7. Grout
   8. Painting and finishing

1.03 DEFINITIONS

A. Basis of Design: Manufacturer or product (as applicable) which represents and establishes minimum requirements, capacities, characteristics, features, options, and technical specifications. Whether listed specifically or not in the contract documents basis of design products establish minimum requirements. Any and all characteristics of the “Basis of Design” Equipment are enforceable under the contract. Installing Contractor is responsible for any additional costs incurred by submitting or providing equipment other than Basis of Design products, including, any piping, electrical, ducting, controls, or other system changes and all necessary reengineering/redesign costs.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. The following are industry abbreviations for plastic materials:
   1. PE: Polyethylene plastic.
   2. PVC: Polyvinyl chloride plastic

H. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

I. Accessible: Exposed or located behind easily openable or removable elements including ceiling tile and access doors.

J. Contractor: Contractor party to Owner-Contractor Agreement and subcontractors responsible for Work under this Division.

K. Controls Contractor: Subcontractor responsible for Work under Section 230900.

L. Architect: I&S Group, inc. DBA ISG.

M. Engineer: I&S Group, inc. DBA ISG.

N. Owner: Minneapolis Public Housing Authority

O. Provide: Furnish and install in complete and operating condition.

P. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by Contractor to illustrate materials, equipment, and portions of Work.

Q. Samples: Physical examples illustrating materials, equipment and workmanship to establish standards for judging Work.

R. Shop Drawings: Drawings, diagrams, schedules and other data specially prepared to illustrate some portion of Work.

S. Work: Totality of obligations imposed on Contractor.

1.04 QUALITY ASSURANCE

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

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Regulatory Requirements: Compliance with applicable national, state, and local codes and referenced industry standards and specifications including:
   1. State and Local Building Codes
   2. State and Local Mechanical Codes
   3. State and Local Plumbing Codes
   4. National Fire Protection Association Codes (NFPA)
   5. American Society of Mechanical Engineers Unfired Pressure Vessel Code
   6. American National Standards Institute (ANSI)
   7. National Electrical Code (NEC)
   8. Occupational Safety and Health Administration (OSHA)

E. Agency Approvals: Demonstrated by seal, label, or stamp whenever these specifications, referenced standards, or regulatory agencies require materials and equipment to conform to requirements of an inspection and testing agencies.

F. Standard for Materials and Workmanship: New materials, free of defects, installed in accordance with manufacturer's current published recommendations, in neat manner, and in accordance with recognized standard industry practice.

G. Equipment Nameplates: Permanently attached to each major equipment component including manufacturer's name, model and serial numbers, and address.

H. Noise and Vibration: Limited to levels not objectionable to occupants and not detrimental to Owner operations, by balancing rotating and reciprocating equipment, and use of vibration isolating and noise abating products and installation procedures.

I. Layout of Work:
   1. Install equipment and run pipes parallel with and at right angles to lines of building unless shown otherwise on Drawings.
   2. Lay out Work and be responsible for lines, elevations and measurements required for installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Provide for proper storage of materials and equipment and assume complete responsibility for losses and damage.

C. Storage Area Limits: Within Contract limit lines of building site, and coordinated with General Contractor and Owner's representative.

D. Existing Conditions: Verified, investigated to determine unknown conditions prior to beginning Work.

1. Visit premises and determine existing conditions before bidding. Additional compensation will not be authorized because of conditions determinable prior to bidding without excavation, demolition, or precise measurement.
    a. Notify Owner's maintenance staff and involved utility companies before digging.
    b. Use whatever special methods and equipment are required to accurately locate utilities existing in areas to be excavated.
    c. Use extreme caution in digging to avoid damage to existing utilities and structures. Use hand digging to finally locate utilities where locations cannot be accurately determined.
    d. Instructions from Engineer requested when:
        1) Utilities encountered during construction are not shown on Drawings.
        2) Utilities are at different locations than shown on Drawings.
        3) Utilities are at different elevations than shown on Drawings.
        4) Utilities have sizes different than shown on Drawings.
    e. Active Services: Braced and supported where required to maintain their operation.
    f. Inactive Services: Removed when encountered.
    g. Interruption of Services: Only when unavoidable; and during times approved by Owner and serving utility companies.
    h. Repair damage caused during excavation.

1.06 COORDINATION

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

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

C. Coordinate requirements for access panels and doors for items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."

1.07 REFERENCES

A. American Gas Association: 1515 Wilson Blvd., Arlington, VA 22209.

B. American National Standards Institute, 1430 Broadway, New York, NY 10018.

C. American Society of Mechanical Engineers, 345 E. 47th St., New York, NY.

D. American Society for Testing Materials, 1916 Race St., Philadelphia, PA 19103.

E. Building Officials and Code Administrators International, Inc., 4501 W. Flossmoor Rd., Country Club Hills, IL 60477-5795.

F. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

G. Underwriters' Laboratories, Inc., 333 Pfingsten Rd., Northbrook, IL 60062.

1.08 DECLARATIONS

A. Divisions 21, 22, 23 and Drawings are complimentary and together define scope of Work for mechanical systems. All Specification Divisions and All Drawings, including Mechanical,

Architectural, Structural and Electrical are complimentary and together define the scope of Work for the project.

B. Mechanical Drawings are diagrammatic, and are not intended to be scaled.

C. Offsets, Fittings, and Accessories are not shown when precluded by Drawing production techniques or scales.
   1. Provide accessories and offset fittings required for completed installation of fully functioning systems.

D. Clarifications: Requested from Engineer when Contractor is uncertain of requirements.

E. Dimensions: Taken from Architectural and Structural drawings, certified equipment drawings and from structure itself before fabricating Work.

F. Space Requirements: Verified and coordinated with other trades prior to fabrication and installation of Work.

1.09 SUBMITTALS

A. Administrative Procedures: In conformance with Division 01.
   1. Exceptions to Specifications: Noted and justified with submittals.
   2. Contractor's Failure to Note Exceptions may result in rejection of submittal or in rejection of Work after installation.
   3. Approval of Exceptions will be based on Engineer's judgment that alternative materials, methods and procedures are equivalent or superior to specification requirements.
   4. Engineer's Rejection of Exceptions will be final.

B. Product and Equipment Shop Drawings:
   1. Organization: In brochures for each specification section.
   2. Contents: Clearly identified indicating specific types of equipment and materials to be furnished.:
      a. Technical Information: As necessary to communicate construction standards and details, demonstrate conformance to technical requirements of Drawings and Specifications and permit coordination with Work of other trades and subcontractors:
         1) Manufacturer’s names, model numbers.
         2) Performance capabilities of equipment.
         3) Materials of construction.
         4) Special construction and fabrication techniques.
         5) Dimensioned drawings.
         6) Utility requirements.
         7) Installation and service clearance requirements.
         8) Explicit notation and justification of exceptions to specifications.
      b. Administrative Information: Provided on brochure and item cover pages.
      c. Brochure Cover Page Information:
         1) Date
         2) Project name.
         3) Specification section number and title.
         4) Subcontractor name and signature.
         5) Approval stamps and signatures from requiring agencies.
         6) Minimum 4" by 6" white space reserved for engineer’s use.
      d. Item Cover Page Information:
         1) Equipment item number (corresponding to Drawings).
         2) Itemization of related submittal documents.\
         3) Minimum 4" by 6" white space reserved for engineer’s use.

C. Record Drawings:
   1. Drawings at Project Site: Maintained in conformance with Division 01:
   2. Location Changes of Concealed Items: Recorded for valves, pipes, ducts, and other items requiring inspection, repair, and maintenance when final location is different than shown on Drawings.

3. Location and Elevation of Buried Items: Recorded when different than shown on Drawings.
4. Equipment Rooms Layout Changes: Recorded for equipment, piping, and ductwork that are installed in locations different than shown on Drawings.
5. Format:
   a. Quantity: 2 copies.
   b. Substantial Changes: Redraw on new sheets.

D. Operation and Maintenance Manuals:
1. Provide O&M manuals as specified here, coordinate with equipment manufacturer.
2. Quantity: 2 copies.
3. Procedure:
   a. Collect manufacturer's literature, assemble information required by other Sections, and prepare additional information needed to provide complete manuals organized as described below.
   b. Submit for review by Engineer prior to conduct of training sessions.
4. Format: 8-1/2" by 11" loose leaf pages in 3-ring binders, indexed and tabbed and 2 CD copies.
5. Organization: In two parts, bound in as many volumes as required for convenient use and reference.
   a. Part I – HVAC Systems: Information and materials written by the Contractors and their manufacturers representative with assistance from the commissioning authority with a separate tab for each system organized as in the following example:
      1) Air Handling Unit – 1:
         (a) Control Diagram & Sequence of Operations (from temperature controls contractor).
      2) Air Handling Unit – 2:
         (a) Control Diagram & Sequence of Operations (from temperature controls contractor).
         (b) Variable Volume Box Control Diagram (from temperature controls contractor).
      3) Rooftop Unit – 1:
         (a) Control Diagram & Sequence of Operations (from temperature controls contractor).
      4) Energy Recovery Unit – 1:
         (a) Control Diagram & Sequence of Operations (from temperature controls contractor).
         (b) Variable Volume Box Control Diagram (from temperature controls contractor).
   b. Part II – HVAC Equipment: Will largely consist of information provided by the equipment vendors organized into divisions of generic classifications of equipment each tabbed separately as in the following example:
      1) Organization Example: Edited to limit data to models of equipment utilized on this project.
         (a) Chillers.
         (b) Unitary rooftop equipment.
         (c) Air handling units.
         (d) Energy recovery units.
         (e) Return fans.
         (f) Exhaust fans.
         (g) Boilers.
         (h) HVAC pumps.
         (i) Terminal heating equipment.
      2) Content: Information for Each Equipment Type (if applicable i.e., minor equipment may not have all listed information available)
         (a) Service, dealer and installing contractor contact information.

(b) Complete Parts lists.
(c) Safety devices.
(d) Operating pre-startup checklists.
(e) Operating startup procedures.
(f) Normal and abnormal operating parameters such as temperatures, pressures and speeds.
(g) Detection and/or alarm signals.
(h) Routine maintenance through one full year cycle of operation.
(1) Provide 4 additional copies laminated in 11/17 poster sheets for use by the building maintenance staff.
(i) Trouble shooting procedures.
(j) Essential Owner parts inventory.
(k) Approved shop drawings.

c. Part III – Non HVAC Equipment: As required in other specification sections and will largely consist of information provided by the equipment vendors organized into divisions of generic classifications of equipment each tabbed separately.
1) Organization: Separately tabbed by each type of equipment.
2) Content: Information for Each Equipment Type (if applicable i.e., minor equipment may not have all listed information available)
3) Service, dealer and installing contractor contact information.
4) Complete Parts lists.
5) Safety devices.
6) Operating pre-startup checklists.
7) Operating startup procedures.
8) Normal and abnormal operating parameters.
9) Detection and/or alarm signals.
10) Routine maintenance through one full year cycle of operation.
(a) Provide 4 additional sets laminated in 11/17 poster sheets for use by the building maintenance staff.
11) Trouble shooting procedures.
12) Essential Owner parts inventory.
13) Approved shop drawings.

1.10 SEQUENCING AND SCHEDULING

A. Perform Work in discrete, consecutive phases as established by Construction Manager. Coordinate all staging, and phasing with construction manager throughout work schedule.

B. Interruption of Owner's Operations:
1. When Work under earlier phases is completed, and areas involved are occupied, Owner operations, activities, and functions in those areas shall not be hampered, degraded, obstructed or otherwise caused to be modified by Work occurring in later phases.
2. Owners' operations, activities and functions in existing areas scheduled for remodel during later phases shall not be hampered, degraded, obstructed or otherwise caused to be modified by Work occurring in earlier phases.

C. Duct and Pipe Systems:
1. Operation During Construction: Maintain operation of air distribution and piping systems serving Owner occupied areas at acceptable levels of performance.
2. Temporary Connections: Made to equipment wherever necessary to ensure continued function.

1.11 WARRANTY

A. Special Warranties: As described elsewhere in this Division, extending and supplementing warranties contained in General Conditions.

1.12 MAINTENANCE

A. Maintenance Service: During warranty period for defective workmanship and material.

1. Emergency Service: Provide 24-hour response.
2. Normal Service: Non-emergency service may be performed during normal working hours.

1.13 SPECIFICATION LANGUAGE

A. These specifications are written using imperative and streamlined forms.

B. Imperative language is directed to Contractor, unless specifically noted otherwise.
   1. Example imperative form statement followed by equivalent indicative form statement:
      a. “Provide full face plates on devices.”
      b. “Full face plates shall be provided on devices by the Contractor.”

C. The words "shall be" are included by inference where a colon (:) follows underlined text within sentences and phrases, and preceding lists.
   1. Example streamlined form statements followed by equivalent statements:
      a. Cabinet: Factory mounted.
         1) Minimum Size: 24” high, 18”wide, 10”deep.
         2) Material: 10 gauge steel.
         3) Finish: Backed enamel.
         4) Door: Flush mounted.
         5) Hardware: Tamper proof.
         6) Gaskets: Watertight.
         7) Lock: Master keyed.
   2. Cabinet shall be factory mounted. Minimum size of cabinet shall be 24” high, 18”wide, 10”deep. Cabinet material shall be 10 gauge steel. Cabinet finish shall be baked enamel. Cabinet door shall be flush mounted. Cabinet door hardware shall be tamper proof. Cabinet door gaskets shall be watertight. Cabinet door lock shall be master keyed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. General Requirements:
   1. Manufacturers' Names and Model Designations are essential parts of technical specifications and equipment schedules, and define requirements that are not otherwise described in these Documents. Elements of the building design which are affected by but not directly a part of the mechanical system components, are designed based upon the manufacturer’s names and model designations listed in the technical specifications and equipment schedules. This includes but is not limited to the design of the structural support, penetrations of construction, electrical connections, piping connections, ductwork connections, and aesthetic appearance.
   2. Substitutions: Per Division 00

2.02 PIPE, TUBE, AND FITTINGS

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

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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

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

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw , and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.08 MACHINERY DRIVE AND ACCESSORIES

A. Sheaves:
1. Single Belt Drive: Adjustable pitch drive sheaves with matched, fixed, companion driven sheaves.
2. Multiple Groove Sheaves: Fixed pitch.
3. Speed Changes for Fixed Sheaves: Accomplished by replacing sheaves when required by system balancing procedures.
4. Material: Cast iron.

B. Belts: Standard FHP, A, B, C and D sections.
1. Small Applications: FHP belt drives may be used for motors less than three horsepower.
2. Larger Applications: Sized as follows according to motor speed and horsepower rating.
a. 1160 RPM Motor Speed:
1) Up to 10 Horsepower: B.
2) Up to 60 Horsepower: C.
3) Up to 300 Horsepower: D.
b. 1750 RPM Motor Speed:
1) Up to 5 Horsepower: A.
2) Up to 15 Horsepower: B.
3) Up to 125 Horsepower: C.
c. Belt Selection: Match belts and size for 150% of motor nameplate horsepower.
d. Belts for A-B Sheaves: Use B section belts.

C. Belt Guard: Provide belt drives with suitable and adequate belt guards that comply with applicable codes, enclosing both driving and driven pulleys, securely fastened in place with removable covers at each shaft center.

D. Direct Drive Couplings: Steel, flexible type.

2.09 ACCESS DOORS/PANELS IN GENERAL CONSTRUCTION

A. Size: 16" x 16" minimum where valves and similar related items are within easy reach of operator, and at least 24" x 24" when passage through opening is required to reach devices requiring maintenance and manual operation.

B. Panels in Fire Rated Construction: Approved for that use.

C. Panels in Acoustical Ceilings: Arranged to conform to Architectural panel patterns.

D. Responsibility: Provided by General Contractor. Coordinate with General Contractor locations and sizes for access panels/doors.

2.10 SPECIAL TOOLS AND EQUIPMENT

A. Turn over to Owner special tools and equipment that are required for assembly, setting, adjustment, and maintenance of equipment furnished under Division 23.

PART 3 EXECUTION

3.01 HVAC DEMOLITION

A. Refer to Division 01 Sections "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
4. Equipment to Be Removed: Disconnect and cap services and remove equipment.

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

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

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

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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

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

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

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

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

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

e. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealers" for materials and installation.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Division 07 Contractor shall maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Coordinate to ensure that pipe penetrations with are sealed with fire top materials. Refer to Division 07 Section "Firestopping".

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

S. Products Installed but not Furnished Under This Section:
1. Products Furnished by Controls Contractor:
a. Temperature control valves.
b. Piping wells for control devices.
c. Differential pressure switches and transmitters.
d. Flow metering devices.

3.03 PIPING JOINT CONSTRUCTION

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

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

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

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

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

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

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

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

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

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.04 PIPING CONNECTIONS

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

3.05 EQUIPMENT INSTALLATION REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

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

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.06 CONCRETE

A. Bases: By concrete contractor

B. Curbs: Coordinate so that min 4" high concrete curbs are installed around duct penetrations through floors.

C. Coordination: Coordinate requirements for concrete from the architectural drawings with concrete contractor including field dimensions based on equipment provided.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. By this contractor. Refer to Division 05 Section "Metal Fabrications" for structural steel specifications.

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

C. Field Welding: Comply with AWS D1.1.

3.08 INSTALLATION AND ARRANGEMENT OF THE WORK

A. Component Removal: Facilitated by arranging work to permit removal of coils, heat exchanger bundles, boiler tubes, fan shafts and wheels, filters, belt guards, sheaves and drives, and other replaceable parts.

B. Service Access: Maintained by arranging pipes, ducts, and equipment to permit ready access to valves, traps, starters, motors, control components and opening of access doors and of access panels.

C. Offsets, Transitions and Changes in Direction in Pipes and Ducts: Made as required to maintain proper headroom and pitch of sloping lines.

D. Piping in Finished Areas: Concealed except where otherwise noted on Drawings.

E. Equipment Installation: In accordance with manufacturer's recommendations, unless otherwise approved by Engineer in writing.

F. Procedure for Resolution of Space Conflicts: Where conflicts between trades occur and departures from Documents are necessary, consult with other affected trades, reach agreement on proposed changes, and obtain Engineer’s approval before proceeding .

3.09 SLEEVES CUTTING AND PATCHING

A. Prepared Openings: Major openings in building structural elements required for mechanical work are generally shown on Structural Drawings.
   1. Coordination Responsibility: Verify required openings are shown and that they are of correct size and at correct location. Notify Engineer of discrepancies.

B. Openings After Erection of General Construction:
   1. Coordination Responsibility: Verify that openings cut in existing construction are accomplished at locations and in manners approved by Structural Engineer.

C. Sleeves: Set for pipes whether or not openings are shown on Structural Drawings before erection of structure or while structure is being erected. Maintain sleeves in place throughout construction.
   1. Sleeve Size: Large enough to allow continuous insulation through sleeve.

2. Sleeve Materials:
    a. Pipe Sleeves: Schedule 40 steel pipe.
        1) Wall and Partition Penetrations: Installed flush with finished surface.
        2) Floor Slab Penetrations:

D. Concealed Locations: Extended 2” above floor.

E. Exposed in Finished Spaces: Installed flush with finished floor.

F. Exposed in Upper Floor Equipment Rooms: Extended 4" above finished floor.
    a. Pipe Sleeve Alternative: Neoprene "Link-Seal" as manufactured by Thunderline Corporation.
    2. Sleeve Caulking: Full thickness of walls, floors, and roofs.
        a. Non-fired Rated Construction:
            1) Bare Pipes: Caulk with oakum. Make floor penetrations water tight.
            2) Insulated Pipes: Caulk with polyurethane caulking compound around 360 degree calcium silicate galvanized metal jacketed insert sized same thickness as adjoining insulation.
            3) Sleeves for Pipes Requiring Vibration Isolation: Refer to Section 230548 for vibration sleeves on certain piping.
        b. Fire Rated Construction: By General Contractor in conformance with Division 07.
        c. Smoke Separations: By General Contractor in conformance with Division 07.

G. Escutcheons: Finish exposed pipe with chrome plated floor, wall, and ceiling escutcheons, Crane No. 13BC, minimum 1/32" thick. Fasten to pipe with set screw.

H. Cutting and Patching: Performed as necessary for Work, and in conformance with architectural sections.

I. Cutting Structural Components: Done only with written consent of Structural Engineer and in strict compliance with his directions. Coordinate with and refer to structural drawings for planned provided openings.

J. Cutting and Patching: Done only by skilled tradesmen.

K. Reviewing Authority: Architect and Owner, who shall judge workmanship on restored surfaces.

3.10 WELDING

A. Welder Certification: By National Weld Test Bureau, Hartford Steam Boiler and Inspection Co. or other similar acceptable bureau or agency.
    1. Qualifying Demonstrations: Conducted using welders assigned to project upon Engineer’s request.
    2. Sample welds: Submitted for inspection upon Engineer’s request.

B. Pipe Welding: In conformance with Section 230500.

C. Miscellaneous Welding: In conformance with American Welding Society "Code for Arc-Welding in Building Construction", Section 4-Workmanship.

3.11 PAINTING

A. Touch-Up Painting: Clean, repair and touch-up factory painted mechanical equipment that becomes rusted or damaged during the construction period

B. Painting of HVAC systems, equipment, and components in accordance with Division 09 “Painting and Coating."

3.12 ELECTRICAL EQUIPMENT AND WIRING

A. Motors: Furnished by driven equipment manufacturers in conformance with Section 230513 and mechanical equipment specifications.
    1. Mounting: By subcontractor furnishing driven equipment unless factory mounted.
    2. Power Wiring: Under Division 26.
    3. Control Wiring: By Controls Contractor.

B. Magnetic Motor Starters: Furnished under Division 16 unless specified to be furnished with mechanical equipment.
   1. Mounting: Under Division 26 unless factory mounted.
   2. Power Wiring: Under Division 26.
   3. Control Wiring: By Controls Contractor.

C. Motor Speed Controllers (VFDs or VFCs): Furnished by Controls Contractor unless specified to be furnished with mechanical equipment.
   1. Mounting: By Division 26 unless factory mounted.
   2. Power Wiring: Under Division 26.
   3. Control Wiring: By Controls Contractor.

D. Electric Control Devices for Mechanical Equipment: Furnished by Controls Contractor unless specified to be furnished with equipment.
   1. Devices: Automatic and manual including thermostats, relays, time clocks, push-button and selector switches, level switches, damper actuators, valve actuators, and control power transformers.
   2. Mounting: By Controls Contractor unless factory mounted.
   3. Wiring: By Controls Contractor.

3.13 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

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

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

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

G. Place grout around anchors.

H. Cure placed grout.

3.14 WORK IN EXISTING BUILDINGS

A. Comply with requirements of Division 01.

B. Disposition of Removed Materials:
   1. Do not reuse removed materials unless explicitly permitted by Documents.
   2. Removed Materials: Contractors property unless specified otherwise.

C. Disposition of Removed Equipment:
   1. Removed Equipment: Contractors property unless specified otherwise.

D. Existing Construction: Protected from damage during adjacent demolition Work.

E. Procedures for Interruption of Owner's Operations:
   1. Permission: Obtained from Owner before disruption of existing facility occurs.
   2. Scheduled: Between hours of 6 PM and 6 AM unless otherwise approved by Owner.
   3. Duration: Limited to time periods approved by Owner by assigning adequate sized crews and using overtime compensation.

F. New Work: Protected as each piece is completed and delivered in clean and new condition at final completion.
   1. Pipe and Duct Openings: Closed with temporary caps or plugs during installation.
   2. Fixtures and Equipment: Covered and protected against damage.
   3. Completion: Deliver Work in clean and "new" condition at final completion.

3.15 CLEANING AND PLACING IN OPERATION

A. Project Site: Kept in clean and orderly condition during construction. Promptly remove waste, unusable material, and surplus material.

B. Finished Work: Protected against damage until final acceptance.

C. Nameplates: Keep nameplates of equipment clean.

D. Lubrication Fittings: Extended when inaccessible as required to permit use.

E. Initial Maintenance: Before final acceptance.
   1. Clean strainers and permanent filters.
   2. Provide new disposable filter elements.
   3. Perform initial lubrications in conformance with manufacturer’s recommendations and instructions.
   4. Clean out drains.

F. Final Cleaning: Upon completion of work.
   1. Clean equipment surfaces of foreign material, leaving work in neat and clean order and in complete working condition.

3.16 TRAINING

A. General: Instruct Owner's personnel in proper operation and maintenance of mechanical systems.

B. Classroom Sessions: Used to introduce Owner's operation, maintenance, and management personnel to manuals, drawings, and other documents and aids available to operate and maintain mechanical equipment and systems; video recorded and submitted to Owner on DVD.

C. Factory Specialists: Used in area of major equipment and systems to present sessions on their specific equipment and systems.

D. Hands-On Training: Provided by this contractor concurrent with commissioning.

END OF SECTION 230500