PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for HVAC systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Interface with Testing And Balancing Agency.
   4. Furnish and install sealants relating to installation of systems installed under this Division.
   5. Furnish and install Firestop Penetration Systems for HVAC system penetrations as described in Contract Documents.

B. Products Supplied But Not Installed Under This Section:
   1. Sleeves, inserts, supports, and equipment for mechanical systems installed under other Sections.

C. Related Sections:
   1. Section 03 3053: Exterior concrete pads and bases for mechanical equipment.
   2. Section 05 0523: Quality and requirements for welding.
   3. Section 07 8400: Quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   4. Section 07 9213: Quality of sealants used at building exterior.
   5. Section 07 9219: Quality of acoustical sealants.
   6. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
   7. Section 26 2913: Magnetic starters and thermal protective devices (heaters) not factory mounted integral part of mechanical equipment.
   8. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
   9. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

A. Product Data:
   1. Manufacturer's catalog data for each manufactured item.
      a. Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
      b. Include name, address, and phone number of each supplier.

B. Shop Drawings:
   1. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
2. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.

3. Drawing of each temperature control panel identifying components in panels and their function.

4. Other shop drawings required by Division 23 trade Sections.

C. Closeout:
   1. Operation And Maintenance Manual Data:
      a. Modify and add to requirements of Section 01 7000 as follows:
         1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
         2) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.
         3) Provide operating instructions to include:
            a) General description of each HVAC system.
            b) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
            c) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.
         4) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
            a) List of HVAC equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
            b) Manufacturer's maintenance instructions for each piece of HVAC equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
            c) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
            d) Manual for Honeywell T7350 thermostat published by Honeywell.
         5) Include copies of approved shop drawings and copies of warranties required in individual Sections of Division 23.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
   2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.

B. Identification:
   1. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.
   2. Materials shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Accept valves on site in shipping containers with labeling in place.

B. Storage:
   1. In addition to requirements specified in Division 01:
a. Stored material shall be readily accessible for inspection by Architect until installed.
b. Store items subject to moisture damage, such as controls, in dry, heated spaces.
c. Provide temporary protective coating on cast iron and steel valves.
d. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Handling: Protect bearings during installation. Thoroughly grease steel shafts to prevent corrosion.

1.5 WARRANTY

A. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

B. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.

C. If HVAC sub-contractor with offices located more than 150 miles 240 km from Project site is used, provide service / warranty work agreement for warranty period with local HVAC sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

1.6 SYSTEM START-UP

A. Off-Season Start-up:
   1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
   2. Notify Owner seven days minimum before scheduled start-up.
   3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner’s representatives in operation and maintenance of system.
   4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.

B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
   1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.
   2. Make adjustments to insure that:
      a. Equipment alignments and clearances are adjusted to allowable tolerances.
      b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.
      c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
      d. Miscellaneous alignings, tightenings, and adjustments are completed so systems are tight and free from leakage and equipment performs as intended.
   3. Motors and accessories are completely operable.
   4. Inspect and test electrical circuitry, connections, and voltages to be properly connected and free from shorts.
   5. Adjust drives for proper alignment and tension.
   6. Make certain filters in equipment for moving air are new and of specified type.
   7. Properly lubricate and run-in bearings in accordance with Manufacturer's directions and recommendations.

1.7 OWNER'S INSTRUCTIONS

A. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of mechanical systems utilizing Operation And Maintenance Manual when so doing.
1. Minimum Instruction Periods:
   a. HVAC: Eight hours.
   b. Temperature Control: Four hours.
   c. Refrigeration: Four hours.
2. Minimum Instruction Periods:
   a. HVAC and Refrigeration: Four hours.
   b. Temperature Control: Two hours.
3. Conduct instruction periods after Substantial Completion inspection when systems are properly
   working and before final payment is made. None of these instructional periods shall overlap
   another.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Pipe And Pipe Fittings: Use domestic made pipe and pipe fittings on Project. Weld-O-Let and Screw-
   O-Let fittings are acceptable.

B. Sleeves:
   1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga 2 mm galvanized
      sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
   2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall
      be schedule 80 black steel pipe with welded plate.

2.2 MANUFACTURED UNITS

A. Valves: Valves of same type shall be of same manufacturer.

B. Hangers, Rods, And Inserts
   1. Galvanized and UL approved for service intended.
   2. Hangers and accessories shall be Grinnell numbers specified or equals approved by Architect
      before installation.
      a. Support horizontal piping from clevis hangers or on roller assemblies with channel supports,
         except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have
         double nuts.
      b. Support insulated pipes with clevis hanger equal to Grinnell Fig 260 or roller assembly equal
         to Grinnell Fig 171 with an insulation protection shield equal to Grinnell Fig 167. Gauge and
         length of shield shall be according to Grinnell design data.
      c. Except uninsulated copper pipes, support uninsulated pipes from clevis hanger equal to
         Grinnell Fig 260. Support uninsulated copper pipe from hanger equal to Grinnell Fig CT-65
         copper plated hangers and otherwise fully suitable for use with copper tubing.
   3. Support rods for single pipe shall be in accordance with following table:

<table>
<thead>
<tr>
<th>Rod Diameter</th>
<th>Pipe Size</th>
<th>Rod Diameter</th>
<th>Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 inch</td>
<td>2 inches and smaller</td>
<td>10 mm</td>
<td>50 mm and smaller</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>2-1/2 to 3-1/2 inches</td>
<td>13 mm</td>
<td>63 mm to 88 mm</td>
</tr>
<tr>
<td>5/8 inch</td>
<td>4 to 5 inches</td>
<td>16 mm</td>
<td>100 mm to 125 mm</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>6 inches</td>
<td>19 mm</td>
<td>150 mm</td>
</tr>
<tr>
<td>7/8 inch</td>
<td>8 to 12 inches</td>
<td>22 mm</td>
<td>200 mm to 300 mm</td>
</tr>
</tbody>
</table>

   4. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance
      with following table:

<table>
<thead>
<tr>
<th>Number</th>
<th>Diameter</th>
<th>Number of Pipes per Hanger for Each Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3/8 Inch</td>
<td>2 Inch 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>1/2 Inch</td>
<td>Three 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>5/8 Inch</td>
<td>Six 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>5/8 Inch</td>
<td>Nine 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>Rods</td>
<td>Number of Pipes per Hanger for Each Pipe Size</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td>50mm 63mm 75mm 100mm 125mm 150mm 200mm</td>
<td></td>
</tr>
<tr>
<td>2 5/8 Inch</td>
<td>Two   Two   Two   Two   Two   Two   Two</td>
<td></td>
</tr>
<tr>
<td>10 mm</td>
<td>Two   0     0     0     0     0     0</td>
<td></td>
</tr>
<tr>
<td>13 mm</td>
<td>Three Three Two   0     0     0     0</td>
<td></td>
</tr>
<tr>
<td>16 mm</td>
<td>Six   Four   Three Two   0     0     0</td>
<td></td>
</tr>
<tr>
<td>19 mm</td>
<td>Nine   Seven Five   Three Two   Two   0</td>
<td></td>
</tr>
<tr>
<td>22 mm</td>
<td>Twelve Nine Seven Five   Three Two   Two   Two</td>
<td></td>
</tr>
</tbody>
</table>

a. Size trapeze angles so bending stress is less than 10,000 psi 69 Mpa.

5. Riser Clamps For Vertical Piping: Equal to Grinnell Figure 261.

6. Concrete Inserts:
   a. Equal to Grinnell Figure 282.
   b. Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
   c. Continuous inserts shall be Equal to Unistrut P-3200 series.

7. Steel Deck Bracket: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

2.3 MANUFACTURERS

A. Contact Information:
   5. Michigan Hanger Company, Niles, OH (800) 333-0852 or (330) 544-4700.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. <Insert approved HVAC subcontractors>.

B. Approved HVAC Sub-Contractor shall be pre-approved and included in Construction Documents by Addendum.

3.2 EXAMINATION

A. Site Inspection:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
   2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

B. Drawings:
   1. HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over HVAC Drawings.

3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

C. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

3.3 PREPARATION

A. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

B. Changes Due To Equipment Selection:
   1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
   2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
   3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.
   4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

3.4 INSTALLATION

A. Interface With Other Work:
   1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
   2. Electrical: Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
   3. Testing And Balancing:
      a. Put HVAC systems into full operation and continue their operation during each working day of testing and balancing.
      b. Make changes in pulleys, belts, fan speeds, and dampers or add dampers as required for correct balance as recommended by Testing And Balancing Agency and at no additional cost to Owner.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
   1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps, filters, starters, motors, control components, and to clear openings of doors and access panels.
   2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to interferences anticipated and encountered.
3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.

4. Determine exact route and location of each pipe and duct before fabrication.
   a. Right-Of-Way:
      1) Lines that pitch shall have right-of-way over those that do not pitch. For example, steam, steam condensate, and drains shall normally have right-of-way.
      2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
   b. Offsets, Transitions, and Changes in Direction:
      1) Make offsets, transitions, and changes in direction in pipes and ducts as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
      2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Piping:
   1. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
      a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
      b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
         1) Arrange so as to facilitate removal of tube bundles.
         2) Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
            a) Make connections of dissimilar metals with di-electric unions.
            b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
      3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
      4) Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
      5) Install piping to insure noiseless circulation.
      6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
      c. Do not install piping in shear walls.
   2. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
      a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
      b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
      c. Make changes in direction with proper fittings.
      d. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
      e. Supports For Horizontal Piping:
         1) Support metal piping at 96 inches 2 400 mm on center maximum for pipe 1-1/4 inches 31 mm or larger and 72 inches 1 800 mm on center maximum for pipe 1-1/8 inch 28 mm or less.
         2) Support thermoplastic pipe at 48 inches 1 200 mm on center maximum.
         3) Provide support at each elbow. Install additional support as required.
      f. Supports for Vertical Piping:
         1) Place riser clamps at each floor or ceiling level.
         2) Securely support clamps by structural members, which in turn are supported directly from building structure.
         3) Provide clamps as necessary to brace pipe to wall.
g. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
h. Expansion of Thermoplastic Pipe:
   1) Provide for expansion in every 30 feet 9 meters of straight run.
   2) Provide 12 inch 300 mm offset below roof line in each vent line penetrating roof.
3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
   a. Sleeves through floors shall extend 1/4 inch 6 mm above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
   b. Sleeves through floors and foundation walls shall be watertight.
4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
   a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
   b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.

F. Sealants:
   1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
   2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.5 REPAIR / RESTORATION

A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
   1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
   2. Surface finishes shall exactly match existing finishes of same materials.

3.6 FIELD QUALITY CONTROL

A. Site Tests:
   1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.
   2. Replace material or workmanship proven defective with sound material at no additional cost to Owner. Repeat tests on new material, if requested.

3.7 CLEANING

A. Clean exposed piping, ductwork, and equipment.

B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.

C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.
3.8 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

B. Do not operate pieces of equipment used for moving supply air without proper air filters installed properly in system.

C. After start-up, continue necessary lubrication and be responsible for damage to bearings while equipment is being operated up to Substantial Completion.

END OF SECTION