

DIVISION 23: HEATING, VENTILATING, AND AIR-CONDITIONING**230000 HEATING, VENTILATING, AND AIR-CONDITIONING**

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SECTION 230501**COMMON HVAC REQUIREMENTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Furnish labor, materials, and equipment necessary for completion of work as described in Contract Documents.
- B. It is the intent of these specifications that the systems specified herein are to be complete and operational before being turned over to the owner. During the bidding process, the contractor is to ask questions or call to the engineer's attention any items that are not shown or may be required to make the system complete and operational. Once the project is bid and the contractor has accepted the contract, it is his responsibility to furnish and install all equipment and parts necessary to provide a complete and operational system without additional cost to the owner.
- C. Furnish and install fire stopping materials to seal penetrations through fire rated structures and draft stops.
- D. Includes But Not Limited To:
 - 1. General procedures and requirements for HVAC.
- E. Related Sections:
 - 1. Section 23 0593: Testing, Adjusting, and Balancing for HVAC.

1.3 SUBMITTALS

- A. Substitutions: By specific designation and description, standards are established for specialties and equipment. Other makes of specialties and equipment of equal quality will be considered provided such proposed substitutions are submitted to the Architect for his approval, complete with specification data showing how it meets the specifications, at least 5 working days prior to bid opening. A list of approved substitutions will be published as an addendum.
 - 1. Submit a single copy of Manufacturer's catalog data including Manufacturer's complete specification for each proposed substitution.
 - 2. The Architect or Engineer is to be the sole judge as to the quality of any material offered as an equal.
- B. Product Data, Shop Drawings: Within 30 days after award of contract, submit 10 sets of Manufacturer's catalog data for each manufactured item.
 - 1. Literature shall include enough information to show complete compliance with Contract Document requirements.
 - 2. Mark literature to indicate specific item with applicable data underlined.
 - 3. Information shall include but not be limited to capacities, ratings, type of material used, guarantee, and such dimensions as are necessary to check space requirements.
 - 4. When accepted, submittal shall be an addition to Contract Documents and shall be in equal force. No variation shall be permitted.
 - 5. Even though the submittals have been accepted by the Engineer, it does not relieve the contractor from meeting all of the requirements of the plans and specifications and providing a complete and operational system.

- C. Drawings of Record: One complete sets of blue line mechanical drawings shall be provided for the purpose of showing a complete picture of the work as actually installed.
 - 1. These drawings shall serve as work progress report sheets. Contractor shall make notations neat and legible therein daily as the work proceeds.
 - 2. The drawings shall be kept at the job at a location designated by the Mechanical Engineer.
 - 3. At completion of the project these "as-built" drawings shall be signed by the Contractor, dated, and returned to the Architect.
- D. Operating Instructions and Service Manual: The Mechanical Contractor shall prepare 2 copies of an Operation and Maintenance Manual for all mechanical systems and equipment used in this project. Manuals shall be bound in hard-backed binders and the front cover and spine of each binder shall indicate the name and location of the project. Use plastic tab indexes for all sections. Provide a section for each different type of equipment item. The following items shall be included in the manual, together with any other pertinent data. This list is not complete and is to be used as a guide.
 - 1. Provide a master index at the beginning of the manual showing all items included.
 - 2. The first section of the manual shall contain:
 - a. Names, addresses, and telephone numbers of Architect, Mechanical Engineer, Electrical Engineer, General Contractor, Plumbing Contractor, Sheet Metal Contractor, and Temperature Control Contractor.
 - b. List of Suppliers which shall include a complete list of each piece of equipment used with the name, address, and telephone number of vendor.
 - c. General Description of Systems including –
 - 1) Location of all major equipment
 - 2) Description of the various mechanical systems
 - 3) Description of operation and control of the mechanical systems
 - 4) Suggested maintenance schedule
 - d. Copy of contractor's written warranty
 - 3. Provide a copy of approved submittal literature for each piece of equipment.
 - 4. Provide maintenance and operation literature published by the manufacturer for each piece of equipment which includes: oiling, lubrication and greasing data; belt sizes, types and lengths; wiring diagrams; step-by-step procedure to follow in putting each piece of mechanical equipment in operation.
 - 5. Include parts numbers of all replaceable items.
 - 6. Provide control diagram and operation sequence, along with labeling of control piping and instruments to match diagram.
 - 7. Include a valve chart indicating valve locations.
- E. Include air balance and/or water balance reports.

1.4 SUBMITTALS FOR COMMON HVAC REQUIREMENTS

- A. Samples: Sealer and gauze proposed for sealing ductwork.
- B. Quality Assurance / Control:
 - 1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
 - 2. Specification data on sealer and gauze proposed for sealing ductwork.
- C. Quality Assurance
 - 1. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.
 - 2. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

1.5 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Perform work in accordance with applicable provisions of local and state Plumbing Code, Gas Ordinances, and adoptions thereof. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 - 2. In case of differences between building codes, state laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Architect in writing of such differences.
- B. Applicable Specifications: Referenced specifications, standards, and publications shall be of the issues in effect on date of Advertisement for Bid.
 - 1. "Heating, Ventilating and Air Conditioning Guide" published by the American Society of Heating and Air Conditioning Engineers.
 - 2. "Engineering Standards" published by the Heating, Piping, and Air Conditioning Contractors National Association.
 - 3. "2015 International Building Code", "2015 International Mechanical Code", "2015 International Plumbing Code" and "2015 International Fire Code" as published by the International Conference of Building Officials.
 - 4. "National Electrical Code" as published by the National Fire Protection Association.
 - 5. "2015 International Energy Conservation Code".
- C. Identification: Motor and equipment name plates as well as applicable UL and AGA labels shall be in place when Project is turned over to Owner.

1.6 INSPECTIONS AND PERMITS

- A. Pay for permits, fees, or charges for inspection or other services. Local and state codes and ordinances must be properly executed without expense to Owner and are considered as minimum requirements. Local and state codes and ordinances do not relieve the Contractor from work shown that exceeds minimum requirements.

1.7 ADDITIONAL WORK:

- A. Design is based on equipment as described in the drawing equipment schedule. Any change in foundation bases, electrical wiring, conduit connections, piping, controls and openings required by alternate equipment submitted and approved shall be paid for by this division. All work shall be in accordance with the requirements of the applicable sections.

PART 2 - PRODUCTS FOR COMMON HVAC REQUIREMENTS

- A. Finishes, Where Applicable: Colors as selected by Architect.
- B. Duct Hangers:
 - 1. One inch 25 mm by 18 ga 1.27 mm galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches 2 400 mm apart. Do not use wire hangers.
 - 2. Attaching screws at trusses shall be 2 inch 50 mm No. 10 round head wood screws. Nails not allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Inspection:
 - 1. Examine premises and understand the conditions which may affect performance of work of this Division before submitting proposals for this work.
 - 2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

- B. Drawings:
1. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc, and do not attempt to show complete details of building construction which affect installation. This Contractor shall refer to architectural, structural, and electrical drawings for additional building detail which affect installation of his work.
 - a. Follow mechanical drawings as closely as actual building construction and work of other trades will permit.
 - b. No extra payments will be allowed where piping and/or ductwork must be offset to avoid other work or where minor changes are necessary to facilitate installation.
 - c. Everything shown on the mechanical drawings shall be the responsibility of Mechanical Contractor unless specifically noted otherwise.
 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 mechanical drawings.
 3. Because of small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which 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. Do not scale drawings for locations of equipment or piping. Refer to large scale dimensioned drawings for exact locations.
- C. Insure 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.
1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
 2. If non-specified equipment is used and it will not fit job site conditions, this Contractor assumes responsibility for replacement with items named in Contract Documents.

3.2 PREPARATION

- A. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
 2. 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.
 3. Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

3.3 INSTALLATION

- A. Arrange pipes, ducts, and equipment to permit ready access to valves, unions, traps, starters, motors, control components, and to clear openings of doors and access panels.

3.4 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and assume complete responsibility for losses due to any cause whatsoever. Storage shall not interfere with traffic conditions in any public thoroughfare.
- B. Protect completed work, work underway, and materials against loss or damage.
- C. Close pipe openings with caps or plugs during installation. Cover fixtures and equipment and protect against dirt, or injury caused by water, chemical, or mechanical accident.

3.5 EXCAVATION AND BACKFILL

- A. Perform necessary excavation of whatever substance encountered for proper laying of all pipes and underground ducts.
 - 1. Excavated materials not required for fill shall be removed from site as directed by Engineer.
 - 2. Excavation shall be carried low enough to allow a minimum coverage over underground piping of 5'-0" or to be below local frost level.
 - 3. Excess excavation below required level shall be backfilled at Contractor's expense with earth, sand, or gravel as directed by Engineer. Tamp ground thoroughly.
 - 4. Ground adjacent to all excavations shall be graded to prevent water running into excavated areas.
- B. Backfill pipe trenches and allow for settlement.
 - 1. Backfill shall be mechanically compacted to same density as surrounding undisturbed earth.
 - 2. Cinders shall not be used in backfilling where steel or iron pipe is used.
 - 3. No backfilling shall be done until installation has been approved by the Engineer.

3.6 COOPERATION

- A. Cooperate with other crafts in coordination of work. Promptly respond when notified that construction is ready for installation of work under Division 23000. Contractor will be held responsible for any delays which might be caused by his negligence or failure to cooperate with the other Contractors or crafts.

3.7 SUPERVISION

- A. Provide a competent superintendent in charge of the work at all times. Anyone found incompetent shall be removed at once and replaced by someone satisfactory, when requested by the Architect.

3.8 INSTALLATION CHECK:

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule shall visit the project to inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the project as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying the following:
 - 1. Equipment has been properly installed and lubricated.
 - 2. Equipment is in accurate alignment.
 - 3. Equipment is free from any undue stress imposed by connecting piping or anchor bolts.
 - 4. Equipment has been operated under full load conditions.
 - 5. Equipment operated satisfactorily.
- C. All costs for this installation check shall be included in the prices quoted by equipment suppliers.

3.9 CLEANING EQUIPMENT AND PREMISES

- A. Properly lubricate equipment before Owner's acceptance.
- B. Clean exposed piping, ductwork, equipment, and fixtures. Repair damaged finishes and leave everything in working order.
- C. Remove stickers from fixtures and adjust flush valves.

- D. At date of Substantial Completion, air filters shall be new, clean, and approved by Owner's representative.
- E. Trap elements shall be removed during cleaning and flushing period. Replace trap elements and adjust after cleaning and flushing period.

3.10 TESTS

- A. No piping work, fixtures, or equipment shall be concealed or covered until they have been inspected and approved by the inspector. Notify inspector when the work is ready for inspection.
- B. All work shall be completely installed, tested as required by Contract Documents and the city and county ordinances and shall be leak-tight before the inspection is requested.
- C. Tests shall be repeated to the satisfaction of those making the inspections.
- D. Water piping shall be flushed out, tested at 100 psi and left under pressure of supply main or a minimum of 40 psi for the balance of the construction period.

3.11 WARRANTY

- A. Contractor shall guarantee work under Division 23 to be free from inherent defects for a period of one year from acceptance.
 - 1. Contractor shall repair, revise or replace any and all such leaks, failure or inoperativeness due to defective work, materials, or parts free of charge for a period of one year from final acceptance, provided such defect is not due to carelessness in operation or maintenance.
 - 2. In addition, the Contractor shall furnish all refrigeration emergency repairs, emergency service and all refrigerant required due to defective workmanship, materials, or parts for a period of one year from final acceptance at no cost to the Owner, provided such repairs, service and refrigerant are not caused by lack of proper operation and maintenance.
- B. In addition to warranty specified in General Conditions, heating, cooling, and plumbing systems are to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

3.12 SYSTEM START-UP, OWNER'S INSTRUCTIONS

- 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 7 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. Owner's Instructions
 - 1. Instruct building maintenance personnel and Owner Representative in operation and maintenance of mechanical systems utilizing Operation & Maintenance Manual when so doing.
 - 2. Minimum instruction periods shall be as follows –
 - a. Mechanical - Four hours.
 - b. Temperature Control - Four hours.
 - c. Refrigeration - Two hours.

3. Instruction periods shall occur after Substantial Completion inspection when systems are properly working and before final payment is made.
4. None of these instructional periods shall overlap another.

3.13 PROTECTION

- A. Do not run heat pump, air handling units, fan coil units, or other pieces of equipment used for moving supply air without proper air filters installed properly in system.
- B. The mechanical systems are not designed to be used for temporary construction heat. If any equipment is to be started prior to testing and substantial completion, such equipment will be returned to new condition with full one year warranties, from date of substantial completion after any construction use. This includes, but is not necessarily limited to: Equipment, filters, ductwork, fixtures, etc.

3.14 COMMON HVAC REQUIREMENTS:

- A. **INSTALLATION**
 1. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
 2. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
 3. Hangers And Supports:
 - a. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
 - b. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
 - c. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
 - d. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
 - e. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.
- B. **CLEANING**
 1. Clean interior of duct systems before final completion.

END OF SECTION

SECTION 230502**DEMOLITION AND REPAIR****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Under this section remove obsolete piping and mechanical equipment and relocate, reconnect or replace existing piping affected by demolition or new construction. Remove concealed piping abandoned due to demolition or new construction, or cap piping flush with existing surfaces.

1.3 DRAWINGS AND EXISTING CONDITIONS

- A. All relocations, reconnections and removals are not necessarily indicated on the drawings. As such, the Contractor shall make adequate allowance in his proposal for this work as no extra charges will be allowed for these items.

PART 2 - NOT USED**PART 3 - EXECUTION****3.1 TEMPORARY CONNECTIONS**

- A. Where existing piping must remain in service to supply occupied areas during construction, provide temporary piping, connections, and equipment to maintain service to such areas. All shall be performed in a neat and safe manner to prevent injury to the building or its occupants.

3.2 EXISTING TO BE ABANDONED

- A. All required drilling, cutting, block-outs and demolition work required for the removal and/or installation of the mechanical system is the responsibility of this Contractor.
- B. No joists, beams, girders, trusses or columns shall be cut by any Contractor without written permission from the Architect.
- C. The patching, repair, and finishing to existing or new surfaces is the responsibility of this Contractor, unless specifically called for under sections of specifications covering these materials.
- D. Disconnect all equipment that is to be removed or relocated. Relocate any existing equipment that obstructs new construction.

3.3 EXISTING TO REMAIN IN USE

- A. Where affected by demolition or new construction, relocate, replace, extend, or repair piping and equipment to allow continued use of same. Use methods and materials as specified for new construction.

3.4 MATERIALS AND EQUIPMENT REMOVED

- A. All obsolete materials, piping, and equipment shall become the property of the Contractor and be removed from the site promptly.

END OF SECTION

SECTION 230712**MECHANICAL INSULATION AND FIRE STOPPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install mechanical insulation and fire stopping as described in Contract Documents including but not limited to the following:
 - 1. Refrigerant Piping
 - 2. Fire Stopping

1.3 QUALITY ASSURANCE

- A. Insulation shall have composite (insulation, jacket or facing and adhesive used to adhere facing or jacket to insulation) fire and smoke hazard ratings as tested by Procedure ASTM E-84, NFPA 255 and UL 723 not exceeding: Flame Spread of 25 and Smoke Developed of 50.
- B. Insulation Contractor shall certify in writing, prior to installation, that all products to be used will meet the above criteria.
- C. Accessories, such as adhesives, mastics, cements, and tapes, for fittings shall have the same component ratings as listed above.
- D. Products, or their shipping cartons, shall bear a label indicating that flame and smoke ratings do not exceed above requirements.
- E. Any treatment of jacket or facings to impart flame and smoke safety shall be permanent.
- F. The use of water-soluble treatments is prohibited.

END OF SECTION

SECTION 230720**REFRIGERANT PIPING INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install insulation on above ground refrigerant suction piping and fittings, including thermal bulb, from thermal expansion valve as described in Contract Documents.

1.3 QUALITY ASSURANCE

- A. Insulation shall have flame-spread rating of 25 or less and a smoke density rating of 50 or less as tested by ASTM E-84 method.
- B. Ratings:
 - 1. Upper rating of =210 deg. F.
 - 2. Lower rating of -110 deg. F.
 - 3. UV stabilized for ten year life.
 - 4. Thermal conductivity of 0.24.
 - 5. Water vapor transmission of .03 perms per inch.
 - 6. Material to be polyolefin food grade.

PART 2 - PRODUCTS**2.1 FLEXIBLE FOAMED PIPE INSULATION**

- A. Thickness:
 - 1. 1/2 inch for one inch outside diameter and smaller pipe.
 - 2. 3/4 inch for 1-1/8 through 2 inch outside diameter pipe.
 - 3. One inch for 2-1/8 inches outside diameter and larger pipe (two layers of 1/2 inch).
 - 4. One inch sheet for fittings as recommended by Manufacturer.
- B. Approved Manufacturers:
 - 1. Armaflex
 - 2. Halstead "Insul-tube"
 - 3. Rubatex
 - 4. Therma-Cel

2.2 JOINT SEALER

- A. Approved Manufacturers:
 - 1. Armaflex 520
 - 2. BFG Construction Adhesive #105
 - 3. Therma-Cel 950.

2.3 MANUFACTURED UNITS

- A. Nominal 3/4" wall thickness
- B. Approved Manufacturers:
 - 1. ImcoLock Pipe Insulation

2. or approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations.
- B. Insulation shall be slipped onto pipe prior to connection or applied after pipe is installed, at contractor's option.
- C. Close butt joints and miter joints.
 1. Approved Manufacturers:
 - a. IMCOA's Fuse-Seal joining system
 - b. or factory approved contact adhesive
- D. Insulation shall be installed according to manufacturer's recommended procedures.
- E. Exterior exposed Insulation shall be finished with two coats of factory approved finish. Color shall be selected by the Owner's representative.
- F. Stagger joints on layered insulation.
- G. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
- H. Seal joints in insulation.
- I. Insulate flexible pipe connectors.
- J. Insulate thermal expansion valves with insulating tape.
- K. Insulation exposed outside building shall have "slit" joint seams placed on bottom of pipe.
- L. Insulate fittings with sheet insulation and as recommended by Manufacturer.

END OF SECTION

SECTION 232166**SPLIT SYSTEM HEAT PUMP UNITS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To
 - 1. Furnish and install heat pumps as described in Contract Documents.
- B. Related Sections
 - 1. Section 02776 - Concrete pads
 - 2. Section 23 0501 - Common HVAC Requirements

1.2 SUBMITTALS

- A. Quality Assurance / Control - Equipment check-out sheets

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies - Each unit shall be UL or ETL labeled.

1.4 WARRANTY

- A. Provide five year warranty on compressors beginning from date of start-up. Record start-up date on warranty certificate for each unit.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Heat Pumps
 - 1. Indoor Units -
 - a. Compact wall mounted units.
 - b. Supplementary electric heater, size as scheduled.
 - c. Cabinet finish as selected by Architect.
 - d. Isolate moving parts from cabinets to reduce noise.
 - 2. Outdoor Units -
 - a. Compressor shall be of rotary or scroll design.
 - b. Fans shall be direct driven and discharge horizontally.
 - c. Casing shall be fully weatherproof for outdoor installations.
 - d. Microprocessor Controls shall be factory wired with field installed remote pendant station.
 - e. Refrigerant shall be R-410A.
 - f. Isolate moving parts from cabinets to reduce noise.
 - g. Use dry-charged tubing for connection of unit's refrigerant system.
 - 3. Approved Products -
 - a. Carrier Corp, Syracuse, NY (800) 227-7437 or (315) 432-6000 www.carrier-commercial.com
 - b. Friedrich Air Conditioning Co, Austin, TX (800) 541-6645 or (210) 225-2000 www.friedrich.com
 - c. Mitsubishi Electronics America Inc, HVAC Div, Norcross, GA (800) 421-1140 or (770) 448-1268
 - d. Sanyo Air Conditioning Products, Chatsworth, CA (818) 998-7322 www.sanyo.com
 - e. L.G. Electronics, USA, Englewood Cliffs, NJ (201) 585-0018, www.lghvac.com

PART 3 - EXECUTION**3.1 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service - Units shall be started up, checked out, and adjusted by Unit Manufacturer's authorized factory trained service mechanic. Use equipment check-out sheet provided by Manufacturer. Complete and sign all items on sheet.

END OF SECTION

SECTION 232300**REFRIGERANT PIPING SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install piping for refrigeration systems as described in Contract Documents.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Refrigerant piping shall be installed by a refrigeration contractor licensed by State.

PART 2 - PRODUCTS**2.1 REFRIGERANT PIPING**

- A. Meet requirements of ASTM B 280-88, "Specification for Seamless Copper Tube for Air Conditioning & Refrigeration Field Service", hard drawn straight lengths.
- B. Do not use pre-charged refrigerant lines.

2.2 REFRIGERANT FITTINGS

- A. Wrought copper with long radius elbows.
- B. Approved Manufacturers:
 - 1. Mueller Streamline
 - 2. Nibco Inc
 - 3. Grinnell
 - 4. Elkhart Products Corp

2.3 CONNECTION MATERIAL

- A. Brazing Rods:
 - 1. Copper to Copper Connections:
 - 2. AWS Classification BCuP-4 Copper Phosphorus (6% silver).
 - 3. AWS Classification BCuP-5 Copper Phosphorus (15% silver).
 - 4. Copper to Brass or Copper to Steel Connections:
 - 5. AWS Classification BAg-5 Silver (45% silver).
 - 6. Do not use rods containing Cadmium.

2.4 FLUX

- A. Approved Manufacturers:
 - 1. "Stay-Silv white brazing flux" by J W Harris Co
 - 2. High quality silver solder flux by Handy & Harmon

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Do not install refrigerant piping underground or in tunnels.
- B. Slope suction lines down toward compressor one inch/10 feet. Locate traps at vertical rises against flow in suction lines.
- C. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary.
 - 1. No soft solder (tin, lead, antimony) connections will be allowed in system.
- D. Braze valve, sight glass, and flexible connections.
- E. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

3.2 FIELD QUALITY CONTROL

- A. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
 - 1. Draw vacuum on each entire system with vacuum pump to 200 microns using vacuum gauge calibrated in microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum. Isolate compressor from system piping using shut-off valves prior to pulling vacuum.
 - 2. Break vacuum with freon to be used and re-establish vacuum test. Vacuum shall hold for 24 hours at 200 microns without compressor running.
 - 3. Conduct tests at 70 deg F ambient temperature minimum.
 - 4. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
 - 5. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.

END OF SECTION

SECTION 232310**REFRIGERANT SPECIALTIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install refrigeration specialties as described in Contract Documents except for expansion valves on 2 through 5 ton condensing units.

PART 2 - PRODUCTS**2.1 EXPANSION VALVES**

- A. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
- B. Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
- C. Approved Manufacturers:
 - 1. Alco
 - 2. Henry
 - 3. Mueller
 - 4. Parker
 - 5. Singer
 - 6. Sporlan

2.2 FILTER-DRIER

- A. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
- B. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type using flared copper fittings.
- C. Size shall be full line size.
- D. Approved Manufacturers:
 - 1. Alco
 - 2. Mueller
 - 3. Parker
 - 4. Sporlan
 - 5. Virginia

2.3 SIGHT GLASS

- A. Combination moisture and liquid indicator with protection cap.
- B. Sight glass shall be full line size.
- C. Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses

allowed.

- D. Approved Manufacturers:
 - 1. Alco
 - 2. Mueller
 - 3. Parker
 - 4. Superior
 - 5. Virginia

2.4 MANUAL REFRIGERANT SHUT-OFF VALVE

- A. Ball valves designed for refrigeration service and full line size.
- B. Valve shall have cap seals.
- C. Valves with hand wheels are not acceptable.
- D. Provide service valve on each liquid and suction line at compressor.
- E. If service valves come as integral part of condensing unit, additional service valves shall not be required.
- F. Approved Manufacturers:
 - 1. ConBraCo (Apollo)
 - 2. Henry
 - 3. Mueller
 - 4. Superior
 - 5. Virginia

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.

END OF SECTION

SECTION 232311**REFRIGERANT PIPE COVER****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, and Section 23 0501 apply to this Section.

PART 2 - PRODUCTS**2.1 BASIC COVER**

- A. Basic refrigerant line cover shall be 18 gauge steel, hot-dipped galvanized steel meeting the requirements of ASTM A361-85.
- B. Pop rivet attachments will not be allowed.
- C. All fastening devices shall be plated screws. Arrange covers so they may be taken apart for service.

2.2 MANUFACTURED OUTER COVER

- A. Refrigerant line covers at exterior walls shall be 24 ga steel, hot-dipped galvanized meeting requirements of ASTM A361-85, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process for Roofing and Siding", 1.25 oz/sq ft and complete with accessories recommended by Manufacturer for proper installation.
 - 1. Approved Manufacturers –
 - a. AEP / Span, Dallas, TX or San Diego, CA
 - b. Idose Aluminum Products, Allentown, PA
 - c. Berridge Manufacturing Co., Houston, TX
 - d. Copper Sales Inc., Minneapolis, MN
 - e. Engineered Components Inc., Stafford (Houston), TX
 - f. Fashion Inc., Lenexa, KS
 - g. Alumax Building Specialties, Mesquite, TX
 - h. MM Systems Corp., Tucker, GA
 - i. Merchant & Evans Industries Inc., Burlington, NJ
 - j. Reynolds Metals Company, Richmond VA
- B. Finish:
 - 1. Fluoropolymer Resin-base finish for coil coating components. Thermo cured two coat system consisting of primer and top coat factory applied over properly pretreated metal.
 - 2. Color as selected by Engineer from Manufacturer's standard colors.
 - 3. Approved Manufacturers –
 - a. Equal to Duranar 200 by PPG or Fluoropon by Desoto containing 70% minimum Kynar 500 by Pennwalt Corp.

PART 3 - INSTALLATION

- 3.1 Do not use pop rivets. All fastening devices shall be plated screws and arranged so covers may be taken off for service.
- 3.2 Provide access opening for viewing the sight glass on the refrigerant line.

END OF SECTION

SECTION 233114**LOW-PRESSURE STEEL DUCTWORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install above-grade ductwork and related items as described in Contract Documents.

PART 2 - PRODUCTS**2.1 DUCTS**

- A. Fabricate of zinc-coated lockforming quality steel sheets meeting requirements of ASTM 653A/653M, "Specification for Sheet Steel Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality", with G 60 coating.
- B. Use of aluminum, non-metallic, or round ducts is not permitted. [Specification writer: Use of aluminum ducts in areas with high chlorine content (eg.: ventilation for pools, spas, etc.) should be considered on a per job basis.]

2.2 DUCT JOINTS

- A. Ducts with sides up to and including 36 inches shall be as detailed in the SMACNA manual.
- B. Duct sizes over 36 inches shall be fabricated using SMACNA T-24 flange joints or pre-fabricated systems as follows:
 - 1. Ducts with sides over 36 inches to 48 inches:
 - a. transverse duct joint system by Ductmate/25, Nexus, Ward, or WDCI (Lite) (SMACNA "E" or "G" Type connection).
 - 2. Ducts 48 inches & larger:
 - a. Ductmate/35, Nexus, or WDCI (Heavy) (SMACNA "J" Type connection).
 - 3. Approved Manufacturers:
 - a. Ductmate Industries Inc, 10760 Bay Meadows Drive, Sandy, UT 84092 (801) 571-5308
 - b. Nexus, Exanno Corp, P O Box 729, Buffalo, NY 14206 (716) 849-0545
 - c. Ward Industries Inc, 1661 Lebanon Church Road, Pittsburg, PA 15236 (800) 466-9374
 - d. WDCI, P O Box 10868, Pittsburg, PA 15236 (800) 245-3188

2.3 ACCESS DOORS IN DUCTS

- A. At each manual outside air damper and at each motorized damper, install factory built insulated access door with hinges and sash locks. Locate doors within 6 inches of installed dampers. Construction shall be galvanized sheet metal, 24 ga minimum.
- B. Fire and smoke damper access doors shall have a minimum clear opening of 12" x 12" or as specified on Drawings to easily service fire or smoke damper. Doors shall be within 6 inches of fire and smoke dampers and in Mechanical Room if possible.
- C. Identify each door with 1/2" high letters reading "smoke damper" or "fire damper".

- D. Approved Manufacturers:
1. AirBalance - Fire/Seal #FSA 100
 2. Air Control Products - HAD-10
 3. Cesco-Advanced Air - HAD-10
 4. Elgen - Model 85 A
 5. Kees Inc - ADH-D.
 6. Louvers & Dampers - #SMD-G-F
 7. Nailor-Hart Industries Inc - Series 0831
 8. National Controlled Air Inc - Model AD-FL-1

2.4 FLEXIBLE EQUIPMENT CONNECTIONS

- A. 30 oz closely woven UL approved glass fabric, double coated with neoprene.
- B. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 250 deg F.
- C. Approved Manufacturers:
1. Cain - N-100
 2. Duro Dyne - MFN
 3. Elgen - ZLN
 4. Ventfabrics - Ventglas

2.5 CONCEALED CEILING DAMPER REGULATORS

- A. Approved Manufacturers:
1. Cain
 2. Duro Dyne
 3. Metco Inc
 4. Vent-Lock - #666
 5. Young - #303

2.6 VOLUME DAMPERS

- A. In Main Ducts:
1. 16 gauge galvanized steel, opposed blade type with 3/8 inch pins and end bearings. Blades shall have 1/8 inch clearance all around.
 2. Damper shall operate within acoustical duct liner.
 3. Provide channel spacer equal to thickness of duct liner.
 4. Approved Manufacturers:
 - a. Air Balance - Model AC-2
 - b. Air Control Products - CD-OB
 - c. American Warming - VC-2-AA
 - d. Greenheck - VCD-1100
 - e. NCA, Safe Air
 - f. Vent Products - 5100
- B. In Sheet Metal Branch Ducts:
1. Extruded aluminum, opposed blade type. When in open position, shall not extend beyond damper frame.
 2. Maximum blade length 12 inches.
 3. Damper Regulator shall be concealed type with operation from bottom or with 90 deg miter gear assembly from side.
 4. Approved Manufacturers:
 - a. Air Control Products - TCD-OB
 - b. Air Guide - OB
 - c. Arrow - OBDAF-207
 - d. CESCO - CDA
 - e. Reliable Metals - OBD-RO

- f. Tuttle & Bailey - A7RDDM
- g. Safe Air
- h. Young - 820-AC

- C. Dampers above removable ceiling and in Mechanical Rooms shall have locking quadrant on bottom or side of duct. Otherwise, provide concealed ceiling damper regulator and cover plate.

2.7 DUCT HANGERS

- A. 1" x 18 gauge galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 8 feet apart. Do not use wire hangers.
- B. Attaching screws at trusses shall be 1-1/2 inch No. 10 round head wood screws. Nails not allowed.

2.8 DUCT SEALER

- A. Cain - Duct Butter or Butter Tak
- B. Design Polymerics - DP 1010
- C. DSC - Stretch Coat
- D. Duro Dyne - S2
- E. Hardcast - #601 Iron-Grip or Peel-N-Seal Tape
 - 1. Kingco - 15-325
 - 2. Mon-Eco - 44-41
 - 3. Trans-Continental Equipment Co - Multipurpose Duct Sealant
 - 4. United - Sheet Metal duct-sealer

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ducts:
 - 1. Straight and smooth on inside with joints neatly finished unless otherwise directed.
 - 2. Duct panels through 48 inch dimension having acoustic duct liner need not be crossbroken or beaded.
 - 3. Crossbreak unlined ducts and duct panels larger than 48 inch or bead 12 inches on center.
 - 4. Securely anchor ducts to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger.
 - 5. Brace and install ducts so they shall be free of vibration under all conditions of operation.
 - 6. Ducts shall not bear on top of structural members.
 - 7. Make duct take-offs to branches, registers, grilles, and diffusers as detailed on Drawings.
 - 8. Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
 - 9. Properly flash where ducts protrude above roof.
 - 10. Install internal ends of slip joints in direction of flow. Make joints air tight using specified duct sealer.
 - 11. Cover horizontal and longitudinal joints on exterior ducts with two layers of Hardcast tape installed with Hardcast HC-20 adhesive according to Manufacturer's recommendations.
 - 12. Paint ductwork visible through registers, grilles, and diffusers flat black.
- B. Install flexible inlet and outlet duct connections to each furnace, fan, fan coil unit, and air handling unit.
- C. Install concealed ceiling damper regulators.

1. Paint cover plates to match ceiling tile.
 2. Damper regulators will not be required for dampers located directly above removable ceilings or in Mechanical Rooms.
- D. Provide each take-off with an adjustable volume damper to balance that branch.
1. Anchor dampers securely to duct.
 2. Install dampers in main ducts within insulation.
 3. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
 4. Where concealed ceiling damper regulators are installed, provide a cover plate.
- E. Install grilles, registers, and diffusers. Level floor registers and anchor securely into floor.
- F. Air Turns:
1. Permanently installed, consisting of single thickness curved metal blades with one inch straight trailing edge to permit air to make abrupt turn without appreciable turbulence, in 90 degree elbows of above ground supply and return ductwork.
 2. 4-1/2 inch wide minimum vane rail. Do not use junior vane rails.
 3. Double thickness vanes not acceptable.
 4. Quiet and free from vibration when system is in operation. See SMACNA Manual
- G. Install motorized dampers

END OF SECTION

SECTION 233346**FLEX DUCT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

PART 2 - PRODUCTS**2.1 DUCTS**

- A. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict air flow after bending.
- B. Nominal 1-1/2 inches thick, 3/4 lb/cu ft density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
- C. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
- D. Length of flexible ductwork shall not exceed 8'-0".

2.2 APPROVED MANUFACTURERS

- A. ANCO-FLEX - 4625
- B. Flex-Aire - PF/UPC #090
- C. Hart & Cooley - F114
- D. Thermaflex - G-KM

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install duct in fully extended condition free of sags and kinks.
- B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with 1/2 inch wide metal cinch bands and sheet metal screws.

END OF SECTION

SECTION 235540**ELECTRIC RADIANT WALL HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, and Section 23 0501 apply to this Section.

1.2 SUMMARY

- A. Furnish and install wall heaters as described in Contract Documents.

1.3 QUALITY ASSURANCE

- A. Units shall be UL listed and comply with NEC.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Fan type for recess mounting in wall.
- B. 20 gauge minimum sheet metal casing.
- C. Heating element shall be encased in steel finned casting and protected by thermal switch.
- D. Fan motor shall be heavy duty enclosed and permanently lubricated.
- E. Fan shall be precision balanced and fan-motor assembly mounted to be vibration free.
- F. Units shall be controlled automatically by integral thermostat when heater is in "ON" position.
- G. Heater shall have built-in fan delay.
- H. Finish - Baked-on enamel.
- I. Approved Manufacturers:
 - 1. Q' Mark
 - 2. Berko
 - 3. Thermador
 - 4. Markel

END OF SECTION**END OF DIVISION**