



05-04-2023

## DIVISION SEVENTEEN

### SECTION 17000 - HEATING, VENTILATION AND AIR CONDITIONING

#### 17001 GENERAL

Work under this section includes, but is not necessarily limited to, furnishing and installing the following:

- A. Heating, ventilating and air conditioning equipment.
- B. Duct installation and ductwork.
- C. Register, grilles and diffusers.
- D. Controls and control wiring.
- E. Piping and insulation.

#### 17002 CODES, STANDARDS AND REGULATIONS

- A. All work shall be in accordance with all applicable federal, state, and local codes, standards and regulations (Code). See drawings.
- B. When these drawings and specifications call for materials or construction of a better quality or larger sizes than required by the above-mentioned rules and regulations, the provisions of the drawings and specifications shall take precedence.
- C. Codes are minimum standards and if the codes require a more stringent method or material than the drawings or specifications require, then the codes shall govern.
- D. The Contractor shall furnish, without extra charge, any additional materials and labor which may be required for compliance with the above laws, rules and regulations, even though the work is not mentioned in these specifications or shown on the drawings.
- E. The Contractor shall secure all permits, inspections and licenses and tests required for this work and pay all fees in connection therewith.

#### 17003 DRAWINGS AND SPECIFICATIONS

- A. The drawings accompanying these specifications are generally diagrammatic and do not show all details of bolts, nuts, fittings, connections, etc., required for the complete system, and do not indicate the exact locations of piping, fixtures, ducts, equipment, etc., unless definitely dimensioned. While these drawings shall be followed as closely as possible, all dimensions shall be checked and verified at the building, and any necessary changes shall be made to accord with structural conditions, equipment to be installed, other systems, etc., without additional cost.
- B. The drawings and specifications are complementary each to the other, and what is called for by one shall be as binding as if called for by both. Any details which are omitted, and which are necessary for the proper installation or operation of the system included under this contract, must be supplied and installed by the Contractor without extra charge.
- C. It shall be understood that where the words "The Contractor", "This Contractor" or "Mechanical Contractor" appear in either the drawings or specifications, it shall mean the Heating, Ventilating and Air Conditioning Contractor.
- D. Any omissions from either the drawings or these specifications are unintentioned, and it shall be the responsibility of the Contractor to call to the attention of the Architect any pertinent omissions before submitting a bid. Complete working systems are required, whether every small item of materials is shown and specified or not.
- E. It shall be understood that where the words "provide, furnish and/or install" are used, it is intended that the Heating, Ventilating and Air Conditioning Contractor shall purchase and install completely any and/or all materials necessary and required for this particular item, system, equipment, etc.
- F. Some items of equipment are specified in the singular; however, the Contractor shall provide and install quantity of items indicated on the drawings, and as required for complete systems.
- G. The term "as approved" in this division of the specifications shall mean as approved by the Project Architect in writing.

#### 17004 COORDINATION OF WORK

- A. It is understood and agreed that the Contractor has by careful examination satisfied himself as to nature and location of work, conformation of the ground and building structure, the character, quality and quantity of materials to be encountered, general and local conditions and all other matters which can and may affect the work under this contract. The Contractor shall be held responsible for visiting the site and thoroughly familiarizing himself with existing conditions. No extras will be allowed because of additional work necessitated by evident job

conditions that are not indicated on the drawings.

- B. The Contractor shall compare the drawings and specifications for this contract with the drawings and specifications for other trades, and shall report any discrepancies between them to the Project Architect and obtain from him written instructions for changes necessary in the work. The work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provisions to avoid interference in a manner approved by the Project Architect. All changes required in the work of the Contract caused by his neglect to do so shall be made by him at his own expense. Coordinate work in this division with work of other divisions.
1. Location of pipes, ducts, electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe, duct and electrical raceway prior to fabrication.
  2. Installation and Arrangement: The Contractor shall install all work to permit removal (without damage to other parts) of all parts and equipment requiring periodic replacement and maintenance. The Contractor shall arrange pipes, ducts, raceways, and equipment to permit ready access to valves, starters, motors, control components, and to clear the opening of swinging and overhead doors and of access panels.

#### 17005 ACCESSIBILITY

- A. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include, but not be limited to, valves, traps, cleanouts, motors, controllers and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility.
- B. The Contractor shall apprise the General Contractor of exact locations and size of access panels for each concealed device requiring service. Access panels shall be provided by this Contractor and installed by the General Contractor. Access panels shall be all steel construction with 16 gauge frames and 18 gauge panels. Units shall be Milcor, Miami Carey, or American Hatch Corporation. Panels and frames shall be factory primed with rust inhibiting paint; finish coat by General Contractor. Provide suitable UL listed doors where installed in rated construction.
- C. Locations of access panels shall be submitted in sufficient time to be installed in the normal course of work.
- D. Access panels will not be required for access to work located above a lift-out "T" bar type ceiling.

## 17006 MATERIALS AND WORKMANSHIP – GENERAL

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment furnished under this specification shall be essentially the standard products of a manufacturer regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.
1. **Delivery and Storage:** Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Project Architect until installed. All items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.
  2. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
  3. **Protection:** Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Project Architect. Damaged or defects developing before acceptance of the work shall be made good at the Contractor's expense.
  4. **Dimensions:** It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications.
  5. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation of all equipment and materials. The Contractor shall promptly notify the Project Architect in writing of any conflicts between any requirements of the contract documents and manufacturer's directions and shall obtain the Project Architect's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Project Architect, he shall bear all cost arising in correcting the deficiencies.
- B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of installation of the work together with all skilled workmen, fitters, metalworkers, welders, helpers and labor required to unload,

transfer, erect, connect-up, adjust, start, operate and test each system.

- C. Unless otherwise specifically indicated on the drawings or specifications, all equipment and materials shall be installed with the approval of the Architect in accordance with recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

#### 17007 APPROVAL OF MATERIALS AND EQUIPMENT

- A. Certain models and manufacturers of materials and equipment are specified. The Contractor shall submit his proposal on the specified materials and equipment or their equivalent. Equivalent shall be interpreted to mean an item of material or equipment similar in quality to that named and which is suitable for the same use and capable of performing the same function as that named, the Project Architect being the judge of equality.
- B. Equipment model numbers noted in this specification or on the drawings are intended to denote a minimum standard of quality and do not necessarily relate to specific options or arrangement as shown. Contractor shall provide equipment with all standard features plus all optional features as stated and in the arrangement shown or as directed by the Architect if not shown.

#### 17008 SHOP DRAWINGS, SUBMITTAL DATA AND PROCEDURES

- A. The Contractor shall submit to the Architect copies of certified prints, catalog data and specification sheets for all items of equipment and material specified or required for this job. Composite wiring diagrams shall be submitted for approval. The Contractor shall furnish the number of copies specified in general sections of the contract. All shop drawings for the project shall be submitted at the same time, reasonably promptly after the material list has been approved.
- B. The Contractor shall analyze all shop drawings before submittal to the Architect and certify that they meet requirements of the contract drawings and specifications.
  - 1. Certification to be in form of suitable approval stamp placed on each shop drawing.
  - 2. Data submitted for approval without Contractor's stamp of approval will not be considered.
- C. The Project Architect will review submittal data, and if found acceptable, will return all except two (2) sets marked "Approved" or "Approved as Noted".
- D. If the Project Architect deems submittal data is either incomplete or incorrect, one copy will be returned for correction and a new submittal set will be required.
- E. At least one set of all "Approved" shop drawings, certified prints, etc., shall be maintained at the job site and available to representatives of the Project

Architect.

F. Items that require submittals shall be:

1. All items of equipment
2. Insulation
3. Piping specialties
4. Air distribution
5. Controls

G. Approval by the Project Architect of shop drawings for any materials, apparatus, devices and layouts shall not relieve this Contractor from the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve the Contractor from responsibility for errors of any sort on the shop drawings.

H. If the submitted items or arrangement deviate from the Contract Documents, the Contractor shall advise the Project Architect of the deviations in writing accompanying the shop drawings, including the reason for the deviation.

I. Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.

#### 17009 OPERATION AND MAINTENANCE MANUAL AND PERFORMANCE RECORDS

A. The Contractor shall provide, in a suitable loose leaf binder, a compilation of catalog data of each manufactured item of equipment used in the work. Two copies are required.

B. The following items shall be included in the binders:

1. Catalog data, descriptive brochures, etc.
2. Installation instructions and diagrams.
3. Control and wiring diagrams for appropriate equipment and systems.
4. Complete operating instructions for all systems.
5. Maintenance schedules and instructions with recommended spare parts that should be stocked by Owner.
6. Design capacities and performance data test results.

#### 17010 RECORD DRAWINGS

A. The Architect shall furnish the Mechanical Contractor one (1) set of drawings covering the mechanical contract upon which the Mechanical Contractor shall mark all changes, modifications, or revisions effected during construction such

that the Architect may prepare record drawings from the information contained thereon upon completion of the work.

#### 17011 VIBRATION ISOLATION

- A. All systems shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Architect. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable. Sound or vibration conditions considered objectionable by the Architect shall be corrected in an approved manner by the Contractor at his expense.
- B. Where connections are made to pieces of equipment containing rotating or reciprocating machinery, suitable approved means shall be provided as required to prevent transmission of noise and vibration.
- C. Suspended equipment shall have steel spring vibration mounting with adjustable snubbers.
- D. Floor mounted equipment shall be mounted on vibration eliminators.

#### 17012 EQUIPMENT STANDS, FOUNDATIONS, HANGERS, SUPPORTS AND MISCELLANEOUS STEEL

- A. Provide all stands and supports for equipment, piping, ductwork, etc., as shown or required. All stands and supports shall be fabricated from suitable steel structural members.
- B. Provide suitable lintels as indicated or as directed by the Architect for wall openings larger than 12" x 12".
- C. All concrete foundations and all concrete pads shown under pumps and equipment shall be provided by this Contractor, unless otherwise noted. Pads shall be placed under each piece of equipment so that no equipment base rests directly on the concrete floor or ground.
- D. Construction of foundations, supports, pads, bases and piers where mounted on the floor shall be of the same material and same quality of finish as the adjacent and surrounding flooring material. All pads shall be extended beyond machine base 3 inches minimum in all directions with top edge chamfered. Inset 6-inch steel dowel rods into floors to anchor pads. Concrete shall develop strength of 3,000 psi at 28 days.
- E. All miscellaneous steel for stands, hangers, supports, lintels, etc., shall be galvanized or shall receive one shop coat plus two finish coats of rust resistant paint.

- F. All equipment, stands, supports and hangers shall be securely fastened to the building structure. Attachments shall be of a strong, durable nature.
- G. No equipment shall be supported from ductwork or piping.
- H. Any stands, supports, hangers or attachments which are, in the opinion of the Architect, inadequate shall be replaced as directed.

#### 17013 CONCEALMENT OF PIPE, CHASES AND HOLE

- A. Unless otherwise indicated, all piping and/or ductwork shall be run in concealed spaces above ceilings or in chases. Piping and/or ductwork in equipment rooms, crawl space and unfinished storage areas shall be installed exposed and as high as practical. This Contractor shall be responsible for the location and size of holes required for pipe and other equipment and shall advise the General Contractor of chase spaces and holes required as building progresses.

#### 17014 CUTTING AND PATCHING

- A. This Contractor shall have an experienced mechanic upon the job before concrete floors, concrete or masonry walls are set in place; whose duty it shall be to locate the exact position of any and all sleeves and holes for the future installation of his pipe or duct work. This Contractor shall locate and size all openings required for his equipment and give this information to the General Contractor in time to not delay the building construction.
- B. If it becomes necessary to cut holes in concrete floors or concrete or other masonry walls, this Contractor shall call the General Contractor or his Superintendent of Construction and inform him of position and size of the hole or other opening to be provided and he shall determine the method to be used. Under no condition shall this Contractor make any cuts without permission from the General Contractor, nor shall he cut any green floors or walls.
- C. This Contractor shall arrange proper openings in the building to admit his equipment. If it becomes necessary to cut any portion of the building to admit any equipment, the portion cut must be restored to their former condition by this Contractor through agreeable arrangement with the General Contractor.

#### 17015 SLEEVES AND INSERTS

- A. This Contractor shall provide and locate all sleeves and inserts required before the floors and walls are built or shall be responsible for the cost of cutting and patching required for pipes where sleeves and inserts were not installed, or where incorrectly located. This Contractor shall do all drilling required for the installation of his hangers.
- B. Sleeves shall be provided for all piping passing through concrete floor slabs and



concrete, masonry, tile and gypsum wall construction. Sleeves shall not be provided for piping installed under concrete slabs on grade or paving unless specifically noted.

- C. Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeves shall be packed with oakum and lead and made completely watertight.
- D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations; make actual lengths to suit the following:
  - 1. Terminate sleeves flush with walls, partitions and ceiling.
  - 2. In areas where pipes are concealed, as in chases, terminate sleeves one inch above finished floor.
  - 3. In all areas where pipes are exposed, extend sleeves 1/4-inch above finished floor, except in rooms having floor drains where sleeves shall be extended 4 inches above floor.
- E. Duct sleeves shall be constructed of 22 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. Pipe sleeves shall be Schedule 40 galvanized steel pipe unless otherwise indicated on the drawings.
- F. Fasten sleeves securely in floors, walls, etc., so they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeves during construction.
- G. All piping and/or ductwork passing thru sleeves in fire walls, fire partitions or floor acting as fire separation shall have opening around pipe or duct caulked smoke tight with approved fireproof material to form a fire and smoke stop. Each sleeve shall contain a minimum of one-inch of packing. At the Contractor's option, "Pyro-Pac" seals as manufactured by Thunderline Corporation may be used to seal around piping through fire and smoke walls. Any sleeves provided and not used shall be sealed with concrete or other approved fireproof material.
- H. Escutcheon plates shall be provided for all exposed pipes, insulated pipes and all exposed conduit passing thru walls, floors and ceilings in finished areas. Plates shall be nickelplated, of the solid ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above floor surface in finished areas, provide deep recessed plates to conceal the pipe sleeves.

- I. Escutcheon plates will not be required in equipment rooms unless specifically noted on drawings.

#### 17016 EXCAVATION, TRENCHING AND BACKFILL

- A. Perform all excavating, trenching and backfilling necessary to install work. Trenches are to be excavated so that pipe will have a solid bearing. Trenches are to be at least 12 inches wider than the diameter of the pipe. Furnish pumps as required to keep trenches dry during laying and jointing of mains. Provide shoring where required to maintain trench against settlement until final acceptance. After work is installed, inspected, tested and approved, trenches shall be refilled in 6-inch layers with clean damp earth, and thoroughly tamped and brought to proper grade.
- B. Excavation:
  - 1. Excavation work under this contract shall be bid unclassified.
  - 2. Where it is necessary to cut existing paving, sidewalks, etc., for the installation, the Contractor shall patch such paving to smooth finish with equal type paving construction as that cut.
  - 3. Wherever shrubs, flowers, hedges and/or sod are removed, they shall be preserved and reset according to good nursery practice. In areas where sod is not suitable to preserve and replace, this Contractor shall provide top soil as required. Areas shall be backfilled and well tamped and brought up to finish grade. Re-seed all disturbed areas as required to equal surrounding grass types already established.

#### 17017 ELECTRICAL WORK:

- A. All electrical work and equipment (including motors) provided by this Contractor shall comply with the detailed Electrical Specifications of this project.
- B. In general, the Electrical Contractor shall provide disconnect switches and all load side power wiring to termination points in mechanical equipment. Mechanical Contractor shall be responsible for notifying the Electrical Contractor of wiring and disconnect requirements for mechanical equipment. Disconnect switches shall be sized to handle the maximum allowable fuse size for the equipment served. Mechanical Contractor shall be responsible for additional costs of electrical work required to serve mechanical equipment with electrical characteristics differing from those indicated on the mechanical schedules.
- C. This Contractor shall provide properly sized fuses to protect his equipment.
- D. This Contractor shall provide all control wiring interlocks and specialties as

shown or as required if not shown to properly operate mechanical equipment. All control wiring shall be suitable for healthcare application and shall be installed in conduits conforming to the detailed electrical specification.

- E. Mechanical Contractor shall review the electrical drawings. All electrical work not specifically shown on the electrical drawings, but required for the proper operation of each item of mechanical equipment shall be furnished by the Mechanical Contractor. Mechanical Contractor shall be responsible for all changes and coordination of electrical work required for substituted mechanical equipment.
- F. Motors shall be of sufficient size for the duty to be performed and shall not exceed their full rated load when driven equipment is being operated at specified capacity under the most severe conditions likely to be encountered. Motors shall have continuous duty classification based on a 40 degree C. ambient temperature. Except as specified otherwise, all motors 1/2 hp and above shall be wired for three phase service and shall have ball, roller or taper bearings. Provide standard grease fittings that are accessible for service without disconnecting other equipment.

#### 17018 KITCHEN AND LAUNDRY EQUIPMENT

- A. Mechanical services for kitchen and laundry equipment shall be provided and installed by the Mechanical Contractor.
- B. Kitchen and laundry equipment shown on the drawings are based on assumed manufacturers. Mechanical Contractor shall coordinate with the actual suppliers and provide appropriate mechanical connections for equipment installed. Complete, properly operating systems installed in accordance with manufacturer requirements are required.

#### 17019 MAJOR ITEMS OF EQUIPMENT

- A. Mechanical equipment shall be as scheduled on drawings complete with all options and accessories indicated. Design basis manufacturers and models are scheduled on drawings. Alternate manufacturers of equivalent performance and quality may be considered if acceptable to the Architect/Engineer. Contractor is responsible for coordination and revisions necessitated by the use of alternate equipment. No extras will be allowed.
- B. Fan Coils and Air Handlers:
  - 1. Hydronic 4-pipe units with heavy gauge steel cabinet, copper coils with aluminum fins, DWDI fan, insulated drain pan, matching circulation pumps and controls, NSF listed for use with potable domestic water, Williams Comfort ISP design basis.

2. See drawing schedules and details for equipment arrangement, performance, options and accessories.
3. Installation shall be in strict accordance with manufacturer recommendations. General Contractor shall schedule preconstruction meeting with local Williams equipment representative (Heat Transfer Sales) to cover installation requirements. Plumbing and Mechanical Subcontractors shall be expected to attend.

C. Chillers:

1. Air cooled chiller package with scroll compressors, microchannel condenser coils, propeller fans, integral duplex pumps, buffer tank and controls, Trane design basis.
2. See drawing schedules and details for equipment arrangement, performance, options and accessories.

D. Heat exchanger:

1. Plate and frame, double wall NSF construction, 316 stainless steel plates, factory polyisocyanurate insulation with aluminum jacket, Taco design basis.
2. See drawing schedules and details for equipment arrangement, performance, options and accessories.

E. Thru-wall Heat Pumps:

1. Thru-wall heat pump shall be a complete single package unit with electric auxiliary heat to include compressor(s), DX coils, electric heat coil, direct drive centrifugal indoor fan, propeller outdoor fan, motors, controls, internal piping and wiring. Unit shall have condensate removal system and shall be furnished with all accessories required for a complete operational installation. Provide matching galvanized steel wall sleeve, architectural louvered outdoor grille, standard front cabinet, unit mounted thermostat and fan controls for continuous fan operation. Units shall be Amana or equal by other approved manufacturer.

- F. Exhaust Fans: Exhaust fans shall be size, type, and capacities as shown on the drawings. All units shall be provided with birdscreen (where applicable), backdraft damper and disconnect switch mounted in fan junction box. Wiring from motor to junction box shall be installed with green grounding conductor. All single-phase motors shall be provided with internal overload protection device. Manufacturers and accessories shall be as scheduled on drawings.

G. Energy Recovery Units:

1. Single package fixed enthalpy core energy recovery unit with integral supply and exhaust fans, Energywall design basis.
2. Energy recovery core shall be enthalpy type with minimum efficiency of 65% at design conditions.
3. Provide disposable air filters on inlet air connection to unit (supply and exhaust).
4. See drawing schedules and details for equipment arrangement, performance, options and accessories.

H. Kitchen Exhaust Hoods:

1. Type I wall canopy commercial kitchen hood, NFPA 96 rated for all types of cooking equipment, CaptiveAire design basis. Provide for 0 inch clearance to combustible materials on top and sides as required.
2. Provide matched dedicated outdoor air makeup system with integral temperature and humidity controls.
3. Construction shall be type 430 stainless steel with a #3 or #4 polish where exposed. Individual component construction shall be determined by manufacturer and ETL. Construction shall be dependent on the structural application to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96.
4. Hood shall be furnished with U.L. classified aluminum baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6".
5. U.L. LED light fixtures shall be installed and pre-wired to a junction box.
6. The hood shall include:
  - a) A double wall insulated front to eliminate condensation and increase rigidity. The insulation shall have a flexural modulus of 475 EI, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.
  - b) An integral front baffle to direct grease laden vapors toward the exhaust filter bank.
  - c) The grease drain system shall be an integral part of the hood back

and have a minimum 1/8" per foot slope with an exposed, removable ½ pint grease cup to facilitate cleaning.

- d) Factory furnished listed fire suppression system with pre-wired control panel.
- e) Complete fan switching package and controls per Code.
- f) Matching exhaust fan(s) with curb(s).
- g) Matching dedicated outdoor air conditioning and makeup unit.
- h) Factory startup and commissioning.

7. See drawing schedules and details for equipment arrangement, performance, options and accessories.

I. Dishwasher Exhaust Hood:

- 1. Type II wall canopy condensate hood, CaptiveAire design basis.
- 2. Construction shall be type 430 stainless steel with a #3 or #4 polish where exposed. Individual component construction shall be determined by manufacturer and ETL. Construction shall be dependent on the structural application to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures water vapor shall have a liquid-tight continuous external weld.
- 3. Hood shall include:
  - a) Matching exhaust fan with curb.
  - b) Fan Switch with interlock to dishwasher.
- 4. See drawing schedules and details for equipment arrangement, performance, options and accessories.

17020 ROOF MOUNTING CURBS:

- A. Mechanical Contractor shall provide General Contractor curbs of the correct size and quantity and exact locations of same.
- B. Curbs shall be at least 12 inches high and shall match the equipment for which they are intended to support.
- C. Curbs for fans shall be prefabricated of minimum 18 gauge galvanized steel, with recess to adjust for insulation thickness.
- D. Curbs shall be lined with rigid fiberglass insulation.
- E. Provide wind and/or seismic engineered design as required.

## 17021 AIR DISTRIBUTION EQUIPMENT

- A. Registers, diffusers and grilles shall be of sizes and styles as scheduled on the drawings, Price design basis. Construction shall be aluminum or steel as indicated with suitable mounting frame. Finish shall be as directed by the Architect. Equipment shall be models scheduled or equal.

## 17022 DUCTWORK

- A. Provide all ductwork as indicated on the drawings. All duct dimensions shown on the drawings are clear and free inside dimensions. The heating and air conditioning contractor may change the cross section dimensions of ductwork when required to meet job conditions; however, at least same ASHRAE equivalent cross sectional area shall be maintained.
- B. All ductwork shall be galvanized steel in accordance with SMACNA "HVAC Duct Construction Standards," one-inch pressure class, Seal Class C. All sheet metal work shall be performed by trained mechanics, experienced in this type of work and shall be installed in a neat, workmanlike and substantial manner.
- C. Provide manual dampers in branch duct runouts for balancing the air flow for supply, return and exhaust. Dampers shall be fitted with exposed locking quadrants. Each damper quadrant to be marked to indicate open and closed position and be securely anchored to ducts. Dampers in diffusers or registers are not acceptable in lieu of duct mounted dampers.
- D. Duct hangers and supports shall be in accordance with standards and details as described and set forth in SMACNA "HVAC Duct Construction Standards" for pressure class specified. All hangers and supports shall be securely attached to the building structure.
- E. All duct joint sealing compounds, glues, mastics, and adhesives used on duct construction shall be "Fire Safe" and be "U.L." approved and labeled.
- F. All square bends or elbows with a centerline radius of turn less than 1-1/2 times the width of the duct shall be fitted with double thickness air foil turning vanes of an approved type, unless otherwise shown.
- G. All ductwork shall be installed in accordance with the applicable requirements of NFPA 90A.
- H. Runouts to diffusers shall be round sheetmetal ducts same size as diffuser neck size unless otherwise shown. If transition is necessary, it shall be made at the diffuser neck with a tapered fitting.

- I. Flexible ducts may be used as connectors between runouts and diffusers to adjust for final diffuser location. Connectors shall not exceed 6 feet in length unless otherwise noted and shall be supported so as to prevent sagging. Centerline bend radius shall not be less than one duct diameter. Connectors shall be U.L. labeled and shall meet Class I requirement of NFPA 90A. Connectors shall be insulated with one pcf one-inch thick fiberglass insulation and be constructed with one zinc coated spring steel Helix bonded to a non-perforated liner. All connections shall be secured with 1/2-inch wide positive locking steel straps. Connectors shall be Genflex SL-181 or approved equal.
- J. Flexible connections shall be installed at all connections between ductwork and fans. Each unit shall be of double thickness, heavy glass fabric, forming a flexible, air tight bellow joint. Joints, in all cases where space permits, shall be a minimum of 6 inches in width. All flexible duct connections at fans to be Ventglass as made by Vent Fabric, Inc. of Chicago, Illinois; Duro Dyne "Durolon"; or other type as approved that has U.L. approval for operation at 265 degrees.
- K. In all cases where duct sleeves are roughed through walls, floors, or ceilings, they shall be blocked and braced to prevent sagging or crushing occurring during construction.
- L. Exhaust duct shall be minimum of 26 gauge and shall be run uninsulated, except where connected to energy recovery exhaust or where otherwise shown on the drawings.
- M. Kitchen hood exhaust duct shall be factory manufactured ETL listed grease duct for 0" clearance to combustibles. All work shall be in accordance with NFPA 96.
- N. Dryer vent ductwork shall be 26 gauge minimum galvanized steel with joints sealed with non-combustible sealant. No screws or fasteners may extend into duct. Minimum clearance to combustible materials shall be 6" unless approved equivalent protection is provided. Dryer vent terminations shall be as recommended by dryer manufacturer. Installation and arrangement shall be in strict accordance with dryer manufacturer's instructions. Verify requirements with equipment provided.
- O. All duct joints and connections shall be sealed with approved mastic or sealant to effectively seal joints to air-tight condition.
- P. Round runouts shall be connected to rectangular trunk duct with spin-in type fittings with volume dampers, and insulation guards. Fittings shall be sealed to trunk duct with high pressure duct joint sealing compound. Fittings shall be Genflex SM-IDELG or approved equal.
- Q. Round runouts shall be connected to round trunk duct with round tap fittings with volume dampers. Fittings shall be sealed to trunk duct with high pressure duct joint sealing compound.



- R. Ceiling radiation dampers shall be UL listed fusible link, approved for use with planned construction. Installation shall be in strict accordance with manufacturer's installation instructions to maintain listing.
- S. Fire dampers shall be UL listed multi-leaf type, constructed in accordance with NFPA 90A. Damper rating shall be appropriate for the assembly rating. Installation shall be in strict accordance with manufacturer's instructions to maintain listing.

#### 17023 PIPING

##### A. General:

- 1. Piping shall be installed in a neat and workmanlike manner.
- 2. Routing shall be, in general, parallel to or at right angles to building walls.
- 3. Piping systems shall be fitted in proper alignment. Extra fittings shall not be used to make up for poor alignment.
- 4. Pipes (including conduits) shall not be strapped together with cable ties, etc. Each pipe shall be attached to supports independently.

##### B. Chilled Water Piping:

- 1. Source Side of Heat Exchanger to Chiller Only:
  - a) Schedule 40 black steel (ASTM A53 or ASTM A120) with Class 150 forged steel welding fittings (ASTM A234) or malleable iron threaded fittings (ANSI B16.3) or grooved mechanical joint fittings (ASTM A536).
  - b) Polypropylene (PP-R), SDR 11 (ASTM F2389) with manufacturer recommended fusion weld fittings and joints.
- 2. Load Side of Heat Exchanger (including connections to fan coils and air handlers, etc.): Refer to Section 15021 for domestic water. All pipe and fittings shall be NSF rated for potable water use.

##### C. Hot Water Piping (including connections to fan coils and air handlers, etc.): Refer to Section 15021 for domestic water. All pipe and fittings shall be NSF rated for potable water use.

##### D. Coil and Auxiliary Drain Piping:

- 1. Drain piping shall be Schedule 40 PVC pipe and fittings (ASTM D-2665) with solvent weld joints (ASTM 2564) unless otherwise specified or indicated.

2. Drain piping routed along floors subject to traffic or as indicated shall be Schedule 40 galvanized steel (ASTM A53 or ASTM A120) with recessed threaded galvanized iron drainage pattern fittings and teflon tape.
3. Provide cleanout at equipment trap and at each change in direction.
4. Slope pipe as required to obtain proper drainage.

17024 PIPING SPECIALTIES:

- A. Refrigerant Piping: Each refrigerant circuit shall be equipped with isolation shutoff valve, thermal expansion valve, and sight glass as recommended by the refrigeration equipment manufacturer.

17025 HANGERS AND SUPPORTS:

- A. Support all piping from building structure by means of hangers or inserts to prevent vibration, secure piping in place and to provide for expansion and contraction.
- B. Horizontal piping shall be supported by all metal hangers or brackets with individual means of vertical adjustment for the leveling of lines after piping is in place. All hangers shall be locked in place with a separate locknut on hanger rod after line is properly leveled. Hangers shall be adjustable clevis type Grinnell Fig. 260 or equal.
- C. Hangers on insulated lines shall encompass pipe and insulation and shall have a 16 gauge steel saddle 12 inches long attached to hanger to protect insulation. A wood or foamglass spacer block equal to the length of the shield shall be provided to prevent crushing of the insulation. Jacket shall be contiguous around spacer.
- D. All hangers shall be supported by solid steel rods with machine threads in the following sizes:
 

1.	Size of Pipe	Size of Rod
2.	2" and smaller	3/8"
3.	2-1/2" and 3"	1/2"
4.	4"	5/8"
- E. Horizontal distance between hangers shall not exceed values indicated in the following table:

Maximum Hanger Spacing (Feet)

	Pipe Size (Inches)									
	<1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Plastic Pipe	4	4	4	4	4	4	4	4	4	4
Copper Pipe	6	6	6	10	10	10	10	10	10	10

- F. Channel type brackets and clamps as manufactured by Unistrut Hydra-Zorb or B-Line shall be used to support piping runs along walls. Clamps shall allow for insulation thickness.
- G. Route piping neatly and parallel or perpendicular to building structure.

### 17026 MECHANICAL THERMAL INSULATION

#### A. Duct Insulation:

1. All air conditioning supply, return, energy recovery supply and energy recovery exhaust ductwork (except pre-insulated flexible duct) shall be externally insulated with fiberglass duct wrap with factory-laminated reinforced foil kraft vapor barrier facing in thickness prescribed by Code or 2 inch, minimum. Insulation shall be applied over clean, dry, air tight ducts. Joints shall be butted tightly together and vapor barrier facing shall be overlapped 2 inches, minimum. Seams shall be stapled with outward clinching staples, 6 inches on center, maximum. All joints and seams shall be taped with two wraps of adhesive duct tape. On ducts larger than 24 inches in width, metal clip fasteners 18 inches on center, minimum, to prevent insulation from shifting or sagging. Any penetrations or rips in the facing shall be sealed to provide a vapor tight barrier.
2. Dishwasher hood exhaust ductwork shall be insulated with UL E226 listed fire-rated duct wrap for zero clearance to combustible construction. Install strictly according to manufacturer's instructions to maintain listing.

#### B. Chilled Water Piping Insulation:

1. Refer to Section 15026 "Plumbing Insulation".

#### C. Hot Water Piping Insulation:

1. Refer to Section 15026 "Plumbing Insulation".

#### D. Coil Condensate Piping Insulation: Condensate piping insulation shall be 1/2-inch thick "slip on" type Armstrong "Armaflex" or equal pre-formed tubing insulation. Insulation sections shall be tightly butted together and sealed with Armstrong 520 adhesive to obtain vaportight installation. Fittings shall be insulated with miter cut pieces.

#### E. Before closing out any ceiling areas or chases that contain insulation on cold

ducts or piping, the vapor barrier seal shall be checked by the Architect. It shall be the duty of the Contractor to notify the Architect ahead of time in order that the work will not be delayed by this inspection.

#### 17027 MECHANICAL PAINTING

- A. All equipment, equipment supports, hoods, etc., except galvanized, furnished by this Contractor shall be cleaned after fabrication, primed and painted with two coats of rust resistant paint, color selected by the Architect.
- B. All hangers, hanger rods inserts, and beam clamps in mechanical room shall be painted flat black.
- C. All sheet metal ductwork or duct liner visible through return and exhaust air grilles shall be painted with flat black enamel.

#### 17028 TEMPERATURE CONTROL SYSTEM

- A. General: Furnish and install temperature control system as shown on the drawings and/or specified herein. Systems shall be complete in every respect, tested, adjusted and calibrated for accurate and reliable temperature and system control. Control system installation, testing, calibration and adjustment shall be performed by competent mechanics experienced in work of this nature.
- B. Electric/Electronic Temperature Control Systems: Controls shall be electric/electronic type, complete with all items required for a properly operating control system. Equipment shall include but not be limited to: thermostats, thermostat guards, damper operators, sensors, electric switches, relays, interlocks, time controls, transformers, wiring and panels. All electrical work for controls shall be by this Contractor and shall be in strict accordance with the electrical specifications for the project.
- C. Sequence of Operation: Sequence of operation shall be as indicated on the drawings and as specified herein.
- D. Fire Alarm Interlock: Interlock all air handlers, exhaust fans and energy recovery units with building fire alarm system to shutdown in the event of fire. Coordinate requirements with Electrical Contractor.
- E. Emergency fan shutdown switch: Provide global manual shutdown switch for air handling systems to stop fans in an emergency. Locate switch at nurse station or other location as indicated or prescribed by Code.
- F. Energy recovery units shall be scheduled to start-stop through auxiliary contacts in the VRV control system and shall be interlocked to shut-down on fire alarm activation.

## 17029 PLACING IN SERVICE, TESTING, ADJUSTING AND BALANCING

- A. The Contractor shall provide start-up services, testing and trial operations as required and as directed by the Architect to prove that all work performed under these drawings and specifications is in complete operational condition and shall function as intended. All costs associated with tests shall be paid by the Contractor. Contractor shall advise the Architect at least three days prior to testing so that the Architect may witness the tests.
- B. The interior of all equipment, coils and piping shall be cleaned and flushed of all grease and foreign matter with approved type chemicals.
- C. After installation and start-up of equipment, the Contractor shall test, adjust and balance systems to quantities indicated on the drawings.
- D. Testing and balancing shall be performed according to procedures outlined in the latest edition of the Associated Air Balance Council (AABC) "National Standards." The Contractor shall furnish all labor, devices and test equipment required to accomplish testing and balancing.
- E. Three (3) copies of all test data, tabulated on AABC Test Report Forms shall be submitted to the Architect.
- F. Air System Tests: Provide testing and balancing results for each air handling system installed (air handlers, fans, ventilators, fan-coils, etc.). Information supplied shall include but not be limited to the following:
  - 1. Equipment manufacturer, model, serial number, nameplate data, designation from drawings and location.
  - 2. Motor nameplate and operating horsepower, volts, phase, amperes, and RPM.
  - 3. Fan driver and driven pulley sizes and RPM.
  - 4. Drive belt size and type.
  - 5. Fan discharge pressure, design and actual.
  - 6. Fan inlet pressure, design and actual.
  - 7. Space inlet/outlet air flow quantities (supply, return, exhaust, outside air), design and actual.
  - 8. Air temperature and humidity (supply, return, exhaust, outside air).
  - 9. Space temperature at room thermostat.

10. Date and time tests are performed.

G. Refrigerant Piping Test: Test refrigerant piping per Code, ASHRAE 15 and manufacturer's instructions.

17030 CLEAN-UP, TOUCH-UP PAINTING AND IDENTIFICATION AND INSTRUCTIONS:

A. It is the Contractor's responsibility to turn over to the Owner all equipment and work in a clean and first-class condition. All torn or gouged insulation shall be patched and all equipment panels shall be straight with no dents or construction debris on them. All equipment which is scratched up shall be properly primed and touched up with paint matching the adjacent surfaces. This Contractor shall protect his equipment from damage during construction with suitable covers.

B. All items of mechanical equipment shall be identified with engraved bakelite plates permanently attached to the equipment. All switches, disconnects, time clocks and other items controlling or associated with items of mechanical equipment shall be labeled likewise, whether or not they are furnished by this Contractor. Contractor shall submit a list of equipment identification for approval prior to labeling.

C. When all of the requirements of the drawings and specifications have been met and prior to final inspection, the Contractor shall arrange to instruct the Owner or his representative in the correct and proper procedures for the operation and maintenance of the systems.

17031 GUARANTEE

A. The Contractor shall guarantee all heating, ventilating and air conditioning systems subject to the General Conditions of these specifications. The Contractor shall further guarantee that each piece of apparatus furnished and installed under this contract shall have a capacity for performance of not less than that called for when the apparatus is operating under design conditions. Provide extended warranty for VRFZ systems as indicated.

END OF SECTION 17000