

SECTION 15600 - HVAC EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Furnish and install all required equipment, appurtenances, combination starter-disconnects, motor starters, and accessories for a complete heating and/or cooling system. All equipment furnished for this project shall comply with applicable requirements of ASHRAE Standard 90.1 and ASHRAE Standard 62 latest issues. Disconnects and starter enclosures shall carry NEMA Class and Group as required by the application.
- B. See other sections of these specifications that may specify accessories or features.
- C. Refer to the schedules on the drawings where equipment capacities are not included in this section.
- D. Review other sections of the specifications and the plans for services required to each piece of mechanical equipment. Any required accessories, appurtenances, or service omitted from the plans or specifications that is not called to the attention of the Architect-Engineer at least 72 hours before bidding and corrected by addendum shall be provided as though shown.
- E. Motors required in connection with equipment shall be of sufficient size and speed for duty to be performed, not exceeding their full-rated load when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. Motors shall also be compatible with variable frequency drives where specified and shall conform to NEMA standards for the application. See ENERGY POLICY ACT below.
- F. Belt drives shall be adjustable "V" Belt Type. Selection shall be based on 150% of the motor horsepower. Selection shall be factory-set so that specified capacity is a midpoint setting, allowing 20% overall speed adjustment. Motors shall be selected on 110% of the brake horsepower required with a service factor of 1. Motors and/or drives shall be changed if required to deliver specified CFM should static pressure differ from that specified due to excessive duct offsets and configuration in the opinion of the engineer.
- G. All exposed rotating machinery shall be equipped with guards.
- H. Submit all equipment for approval.
- I. All refrigeration compressors shall carry manufacturer's standard 5-year warranty.
- J. Make wall and roof penetrations weather tight at mechanical penetrations.
- K. Furnish all starters, combination starter-disconnects, motor controllers or contactors for proper operation of all motors, including specified requirements for interlocks and control sequences. Starters shall be Square D Class 8536 or as approved, equipped with solid-state overloads.
- L. Equipment with water coils or drain pans mounted in attic or above ceilings shall be set in or immediately above drain pans constructed of minimum 24 gauge galvanized steel with joints made water tight, piped to outside or other conspicuous point with open and visible discharge to serve as an alarm that a leak is occurring. An alternate to the sight drain is to provide a float switch in the pan to stop the equipment when standing water occurs in the pan. Pans shall be minimum 1-1/2" deep and minimum 6" larger than equipment including coverage for chilled water valves or as required by code.

- M. Mechanical equipment installed higher than ten (10) feet above the floor including equipment installed above ceilings shall be provided with work platforms on service side(s) of the equipment for maintenance access. Platform shall be accessible by ladder or other means as needed.
- N. Ground mounted equipment shall be bolted down to its concrete pads at a minimum of two points to reduce theft hazard.
- O. Test all equipment to manufacturers standard when tests are required.
- P. Air Filters: Air filters shall be rated in accordance with ASHRAE Standard 52.2-99. Install one clean set of filters at substantial completion to replace the initial set (all filters). Deliver one spare set to Owner. Do not operate equipment without all filters in place. Provide filters in accordance with the following except where indicated otherwise on the drawings. Filters shall be UL Listed Class 2. The Minimum Efficiency Reporting Values (MERV) shall be as indicated.
 - 1. PTAC and residential type gas and electric furnaces – MERV 4 filters
 - 2. Roof top units, 3 thru 25 tons capacity – 2" filters, Farr Aeropleat III, 0.09" SPWG resistance at 250 FPM, MERV 7.
 - 3. Roof top units thru 50 tons capacity – 4" filters, 0.07" SPWG resistance at 250 FPM, MERV 7 and other features same as 2 above.
 - 4. Air handling units same as 3 above except same as 2 above where 4" racks are not available.
 - 5. Not used.
 - 6. Where higher efficiency filters are specified, filters shall be Farr E-Series RIGA-FLO (or as shown) as follows:
 - a. MERV 11 filters – 0.32" initial SPWG resistance at 500 FPM.
 - b. MERV 13 Filters – 0.5" initial SPWG resistance @ 500 FPM.
 - c. MERV 14 Filters – 0.56" initial SPWG resistance at 500 FPM.
 - d. MERV 15 (HEPA) filters shall be Farr Micretain, 1.0" SPWG initial resistance at 500 FPM. Furnish MAGNA series housings as indicated.
 - e. Furnish pre-filters same as 3. above.
 - f. Provide appropriate media for side access housings when specified
 - g. Furnish other filters as shown on the drawings.
- P. Access Doors: See SECTION 15100 for requirements.
- Q. Unless otherwise specified below, all air conditioning equipment shall comply with the following standards as a minimum:
 - 1. ANSI/ASHRAE 15 (Safety Code for Mechanical Refrigeration)
 - 2. ASHRAE Handbook (HVAC Systems and Equipment)
 - 3. NFPA 90A (Installation of Air Conditioning and Ventilating Systems)
 - 4. NFPA 90B (Installation of Warm Air Heating and Air Conditioning Systems)
 - 5. NFPA 214 (Water Cooling Towers)

1.02 INDOOR AIR QUALITY PROVISIONS

- A. Equipment provided shall comply with requirements set forth in ASHRAE Standard 62-2004.
- B. Evaporator coil drain pans shall be self-draining to prevent standing water.
- C. All HVAC equipment that handles moving air shall have provisions for easy accessibility for in-situ cleaning and inspection of all moving parts and interior areas. "Easy

Accessibility" includes hinged access panels when available as options and other approved reasonable and convenient means of access.

- D. Maintain minimum ten (10) foot separation between exhaust terminations and OA intakes, windows and doors.

1.03 ENERGY POLICY ACT (EPACT)

- A. All motors subject to the Energy Policy Act shall be "Energy Efficient" as defined by this act.

PART 2 – PRODUCTS

2.01 FANS

- A. Ceiling Centrifugal Fans
 - 1. Ceiling ventilators shall be direct drive, forward curved, centrifugal blower type. Fan wheel and scroll shall be constructed of galvanized steel. Fan wheel shall be dynamically balanced. The housing shall be constructed of galvanized steel and acoustically insulated for quiet operation. An integral aluminum backdraft damper shall be standard. A terminal box with cord, plug, and receptacle shall be provided to facilitate removal of complete fan wheel and motor assembly without disturbing the ductwork. The motor shall be permanently lubricated with built-in thermal overload protection and shall be factory tested prior to shipment. The ceiling ventilators shall be furnished standard with a powder-painted white steel grille.
 - 2. Ceiling ventilators shall be certified and licensed to bear the AMCA Seal for Air and Sound Performance. Ceiling ventilator performance shall be based on tests and procedures performed in accordance with AMCA publication 211 and comply with the requirements of the AMCA Certified Ratings Program. Fan sound power level ratings shall be based on tests and procedures performed in accordance with AMCA publication 311 and comply with the requirements of the AMCA Certified Ratings Program. Ceiling ventilators shall be UL listed and CSA certified.

2.02 PIPE HEAT TRACING

- A. Furnish a complete UL Listed System of pipe heating cable for freeze prevention complete with components, installation accessories, thermostats, and controls installed in strict accordance with Article 427 of the National Electric Code.
- B. The heating cable shall consist of two (2) 16 AGW Nickel-coated-copper bus wires embedded in a radiation-crosslinked polymer capable of regulating its power output in response to temperature changes all along its length with a self-regulating index of no less than 90% between 50° and 140°F. The heating cable shall be covered with a radiation-crosslinked modified polyolefin dielectric jacket (2,000 PSI Minimum) which in turn shall be covered with a tinned copper braid (3.0 Ohms/1,000' Maximum electrical resistance) and an outer modified polyolefin jacket. Voltage ratings shall be 120, 208, 220, 240, or 277.
- C. Installation:
 - 1. The heating cable shall be installed under the pipe's thermal insulation without spiraling and with sufficient heat output to maintain the pipe temperature of no

less than 40°F when outside ambient is -20°F and the average wind speed is 15 MPH.

2. When used on non-conductive pipe, the heater shall be attached to the pipe with a solid aluminum tape.
 3. All power, splice, and tee connections must be made up using reusable, NEMA 4X, 6P, quick-connect components, requiring no stripping of the core insulator. No heat shrink components will be allowed in making these connections.
 4. After cable installation and before and after installation of THERMAL pipe insulation, the heating cable shall be tested using a 2,500-volt megger. Minimum ELECTRICAL insulation resistance shall be 20 megohms regardless of circuit length. Both bus wires and braid shall be tested to verify the connection of all splices and tees. A copy of the meggering report shall be supplied to the engineer. All material shall be installed in accordance with the manufacturer's recommendations.
- D. Quality Control: Subject to requirements, furnish heat tracing as manufactured by one of the following:
1. The product shall be XL-Trace as distributed by INDUSTRIAL HEATER, 2941 Kate Bond Blvd., Suite 101, Bartlett, Tennessee, 38133.

2.03 AIR HANDLING UNIT (SINGLE WALL CONSTRUCTION)

- A. Each unit shall be furnished with components as specified. All units and accessories shall be constructed of heavy gauge galvanized steel. Air handling units shall be certified in accordance with (ARI) standard 430.
- B. Fan Section:
1. Fan section shall have an access door on each side secured by quick-release latches. Hinges shall be of the slip joint type allowing easy removal of doors. All doors shall be gasketed.
 2. Fan sections used in cooling application shall be internally insulated with standard 1 inch thick, 1-1/2 lb. bonded mat fiberglass insulation, affixed with a waterproof adhesive. All insulation shall comply with NFPA 90. Fan shall be internally isolated with 2" spring isolators.
- C. Coil Section
1. Heating and cooling coil sections shall be internally insulated with standard 1 inch thick, 1-1/2 lb. bonded mat fiberglass insulation, affixed with a waterproof adhesive. Insulation shall comply with NFPA 90.
 2. Horizontal unit arrangements shall be available with standard and long coil sections.
 3. Coil sections with coils higher than 42 inch finned height shall have an intermediate drain pan (between top and bottom coils) with plastic drain tubes extending into main drain pan.
 4. Standard and long coil sections shall have a removable panel on each side for easy coil access and removal with hinged and latched access door on return-bend side of coil section. Standard and long coil sections shall have a double drain pan with insulation between the inner and outer pan. The drain pan shall have welded corners and a 1-1/4 inch MPT drain connection on each side for positive draining.
- D. Blowers:
1. Each unit shall contain one forward curved or Airfoil, double width, double inlet blower. Standard forward curved blowers through Size 14 are class I.
 2. Blower wheels shall be statically and dynamically balanced before they are assembled and dynamically balanced after being installed in the fan section.

- E. Fan Shaft:
 - 1. Shafts shall be solid steel, continuous diameter, turned, ground and polished. Each shaft shall be coated with a non-hardening rust inhibitor.
 - 2. Shaft critical speed shall be at least 1.25 times the maximum operating speed.
- F. Bearings:
 - 1. Pillow block bearings shall be self-aligning, noise tested and have air conditioning fit, Average bearing life shall be in excess of 200,000 hours.
 - 2. Extended lube lines and grease fittings shall be furnished to each bearing to allow lubrication from outside the cabinet.
- G. Heating/Cooling Coils:
 - 1. All coils shall be staggered tube design, have heavy wall copper headers, and die-formed plate type aluminum fins. Coil casings shall be constructed of 16 gauge galvanized steel.
- H. Drive: Drive components shall be high quality statically balanced. Drives shall be designed to be a minimum of 1.20 times the rated motor horsepower.
- I. Motors: Motors shall be mounted inside the blower section, on a heavy gauge steel channel.
- J. Furnish other sections and accessories as indicated.

SSSSS plastic drain tubes extending into main drain pan.

- 4. Standard and long coil sections shall have a removable panel on each side for easy coil access and removal with hinged and latched access door on return-bend side of coil section. Standard and long coil sections shall have a double drain pan with insulation between the inner and outer pan. The drain pan shall have welded corners and a 1-1/4 inch MPT drain connection on each side for positive draining.
- D. Blowers:
 - 1. Each unit shall contain one forward curved or Airfoil, double width, double inlet blower. Standard forward curved blowers through Size 14 are Class I.
 - 2. Blower wheels shall be statically and dynamically balanced before they are assembled and dynamically balanced after being installed in the fan section.
 - 3. Blowers shall be mounted on steel springs designed and selected for 2" deflection.
 - E. Fan Shaft:
 - 1. Shafts shall be solid steel, continuous diameter, turned, ground and polished. Each shaft shall be coated with a non-hardening rust inhibitor.
 - 2. Shaft critical speed shall be at least 1.25 times the maximum operating speed.
 - F. Bearings:
 - 1. Pillow block bearings shall be self-aligning, noise tested and have air conditioning fit, Average bearing life shall be in excess of 200,000 hours.
 - 2. Extended lube lines and grease fittings shall be furnished to each bearing to allow lubrication from outside the cabinet.
 - G. Heating/Cooling Coils:
 - 1. All coils shall be staggered tube design, have heavy wall copper headers, and die-formed plate type aluminum fins. Coil casings shall be constructed of 16 gauge galvanized steel.

2. Water coils shall have steel MPT connections.
 3. All coils shall be submerged in water and leak tested with 400 PSIG dry nitrogen.
 4. All 5/8" tube chilled and hot water coils to be certified in accordance with ARI Standard 410.
 5. All coils shall have double wall, double pitch, IAQ type drain pans.
- H. Mixing Box:
1. Filter mixing box shall be furnished with angular filter section and have either top, back or bottom openings, or any combination of the three. Openings shall be furnished with airfoil parallel blade low leak dampers and jamb rails equal to Ruskin CD60. Blade bearings shall be brass inserts and shall provide smooth operation and corrosion resistance. Mixing boxes shall have similar design, less filters.
 2. Section to have full access doors on each side with slip-joint hinges, quick-release latches and gasketing.
 3. Section shall be for filters indicated in Part 1 – General and as indicated. Filter velocities not to exceed recommended maximum face velocities.
- I. Drive:
1. Drive components shall be high quality statically balanced. Drives shall be designed to be a minimum of 1.20 times the rated motor horsepower.
 2. Fan shafts shall be mounted on self-aligning grease lubricated ball bearings designed for 200,000 hours average life.
- J. Motors:
1. Motors shall be mounted inside the blower section, on a heavy gauge steel channel.
 2. Motors shall be high-efficiency design.
- K. Furnish other sections and accessories as indicated on the drawings.

2.04 SMALL SPLIT SYSTEM CONDENSING UNITS (THREE PHASE)

- A. Condensing Units:
1. General: Unit shall be fully charged from the factory for up to 25 feet of piping. Unit shall be designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities matched with air handlers and furnace coils shall be A.R.I. certified the UL listed. The unit shall be designed for outdoor application.
 2. Casing: Unit casing shall be constructed of galvanized steel and painted with a weather-resistant powder paint.
 3. Refrigerant Controls: Refrigeration system controls shall include condenser fan and compressor contactor, high and low pressure protection for the compressor, liquid line drier, and low pressure switch. Field braze connections shall be externally accessible, multi-use liquid and gas line valves with service pressure gauge ports.
 4. Compressor: Compressor shall have epoxy dipped hermetic motor windings and thermostatically controlled sump heater. Other features shall include: roto-lock suction and discharge refrigerant connections, centrifugal oil pump, special steel alloy valves in valve plate assembly, and internal spring mounts. The compressor shall have a 5-year warranty.
 5. Condenser Coil: The coil shall be all aluminum with minimum brazed joints, 3/8 inch OD seamless aluminum glued to a continuous aluminum fin. The coil shall be protected on all four sides by hail guard panels and shall have a 5-year warranty.

6. Low Ambient Cooling: Furnish for low ambient operation to temperature(s) as scheduled. Furnish refrigerant expansion devices, head pressure controls, and evaporator defrost controls as appropriate for the required ambient.
7. Accessories: Furnish standard and necessary accessories as required for the application.

B. Furnaces and Evaporators: Furnaces and evaporators shall be as scheduled.

2.05 SEE DRAWINGS FOR ADDITIONAL EQUIPMENT.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor, prior to installing any equipment, shall examine the conditions under which the equipment is to be installed, and shall notify the Architect/Engineer of conditions detrimental to the proper installation of the equipment.
- B. Install all equipment in accordance with the manufacturer's latest written instructions, including clearances, and in accordance with governing codes and recognized industry standards and practices to insure that the equipment serves the intended function.
- C. Coordinate all work with other trades as necessary for proper interfacing.
- D. All equipment shall be protected from any form of damage. Any damaged equipment shall be replaced without additional cost to the Owner.

3.02 START-UP

- A. All major equipment and systems shall be started by a factory trained service mechanic, or a UA-MCA Certified Technician that is experienced in the service and operation of that piece of equipment. Major equipment includes chillers, cooling towers, boilers, boiler feed sets, condensing units, energy recovery units, unit ventilators, packaged ventilating units, make-up air units, air-water heat pumps, pumps, chemical treatment systems, controls, etc. The Mechanical Contractor shall start-up and place into operation all auxiliary equipment such as exhaust fans, small in-line pumps, etc.
- B. The factory trained service mechanic shall be accompanied by the Test and Balance Agency. The Agency shall verify the unit performance and shall prepare his report accordingly.

3.03 CONDENSATE DRAIN TRAPS

- A. Provide trapped condensate drains at all evaporators with depth as detailed and as recommended by equipment manufacturer. 1 inch and larger traps shall be constructed of tees with plugs for cleanouts.

END OF SECTION 15600