

SPECIFICATIONS - DETAILED PROVISIONS
Section 15700 - Heating, Ventilation, and Air Conditioning Equipment

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**SECTION 15700
HEATING, VENTILATION, AND
AIR CONDITIONING EQUIPMENT**

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish, install, and test the heating, ventilation, and air conditioning (HVAC) equipment including ducts, registers, louvers, supply and exhaust ventilators, evaporative coolers, air conditioners, dampers, thermostats, controls and accessories as specified herein and shown on the Drawings.

1.02 SPECIFIC PROJECT VENTILATION AND AIR CONDITIONING REQUIREMENTS

Contractor shall furnish and install specific project HVAC equipment as shown on the Drawings and as specified in Section 15700.1, Detailed Heating, Ventilation and Air Conditioning Equipment.

1.03 GENERAL REQUIREMENTS

A. Ambient Conditions and Elevations

Equipment shall be designed to operate at the elevation and ambient conditions shown on the Drawings and specified in the Special Conditions.

B. Dimensional Restrictions

Layout dimensions will vary between manufacturers. The layout area indicated on the Drawings is based on typical equipment. Contractor shall review the Contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by the District.

C. Coordination

Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, and recommendations of the equipment manufacturer. Contractor shall verify that each component of the system is compatible with all other parts of the system; that all piping, ductwork, materials, equipment, and motor sizes are appropriate; and that all devices necessary for a properly functioning system have been provided.

D. Manufacturers and Local Service

Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer. However, all the component parts of the system need not be the products of one manufacturer.

Each equipment manufacturer shall have a local service center and shall be able to provide service within 24 hours. The service center shall be equipped and staffed to service the system and shall maintain a local parts supply. Information on equipment manufacturers' representatives shall be included with the submittals.

1.04 SUBMITTALS

A. Shop Drawings

In accordance with the requirements of the General Conditions, Contractor shall submit complete information, drawings, and technical data for all equipment and components, including, but not limited to, the following:

1. Complete specifications, dimensioned drawings of each equipment unit and support curb (if applicable), catalog cuts, data sheets, bill of materials, and descriptive literature which shall include make, model, dimensions, weight of equipment, and electrical schematic wiring diagrams (if applicable).
2. Details of unit support and anchorage requirements.
3. Complete performance data, performance curves, and ratings that will indicate full compliance with the specifications.
4. Control components, including description of control component operations. Equipment wiring diagrams and interconnection diagrams.
5. Detailed information on structural, mechanical, electrical, or other changes or modifications necessary to adapt equipment and materials to be supplied to the arrangement or details shown on the Drawings.
6. Shipping, unloading, storage, and installation instructions, lifting points, and any special precautions to be observed during unit storage and installation.

B. Operation and Maintenance Manuals

Operation and maintenance manuals shall be provided in accordance with the requirements of the General Conditions, and Detailed Provisions, Specification 01430.

PART 2 - PRODUCTS

2.01 GENERAL

A. Specific Project Requirements

Not all products specified herein are necessarily required for this project. Contractor shall refer to the Drawings and Item 1.02 "Specific Project Ventilation and Air Conditioning Requirements" herein for products required for this project. Said products shall be provided as specified herein and shown on the Drawings.

B. Equipment Manufacture and Fabrication

Manufacture and fabrication of equipment shall comply with the requirements of Section 11005, General Mechanical and Equipment Specifications.

C. Drive Units

Electric motors, V-belt drives, and safety guards shall be in accordance with the requirements of Section 11005, General Mechanical and Equipment and Section 16150 Induction Motors Specifications.

D. Electrical

Electric motor controls shall be as shown on the Drawings and as specified in Section 16480, Motor Control Centers, Switchboards, and Panelboards, Section 17005, General Instrumentation and Control Components, and Section 17010, Programmable Logic Controller. Motor starters and controls shall be furnished and installed as shown on the Drawings, except for equipment specified to be furnished with factory manufactured control panels.

E. Shop Testing

The equipment furnished under this section shall be tested at the factory according to the standard practice of the manufacturer. Ratings shall be based on tests made in accordance with applicable AMCA, ASHRAE, ARI, NBS, NFPA, and UL Standards.

F. Balance

All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that the resonance at normal operating speeds is avoided. In any case, the maximum measured root-mean-square (rms) value as measured at any point on the equipment shall not exceed those listed in the latest ASHRAE Applications Handbook.

At any operating speed, the ratio of rotative speed to the critical speed of a unit or components thereof shall be less than 0.8 or more than 1.3.

2.02 WALL LOUVERS

A. General

1. Louvers shall be intake or exhaust as shown on the drawings of the fixed (unless otherwise specified), flat blade, 45° type, having a width of 4" and sized to fit the opening specified.
2. Louvers shall be suitable for mounting in stud wall, with gypsum board and stucco, concrete walls, or masonry walls as shown on the Drawings. Size, number, and location shall be as shown on the Drawings.
3. Louvers shall be anchored into walls (from inside of building) at corners, top and side, and bottom and side with wood lag screws or expansion anchors as applicable. Additional anchors shall be provided such that maximum anchorage space shall be 24" O.C.
4. Louvers shall be weatherproofed. All louver edges, including flashing, in contact with wall surfaces shall be caulked with exterior grade caulking compound.

B. Wall Mounted Stationary (Fixed) Louvers

1. Fixed blade (stationary) intake or exhaust louvers shall be flat blade type of formed steel with blades at 45° angle. Frame and blades shall be minimum 16 gauge galvanized steel.
2. Each louver shall be provided with a removable 1/4" mesh, 23 gauge wire, galvanized insect screen with galvanized steel frame. Screen shall be attached with screws. Screen shall be located on interior side of wall.

3. Stationary wall louvers shall be Model 609B as manufactured by The Airo-lite, Co., or equal.

C. Wall Mounted Adjustable Louver

1. Adjustable blade intake or exhaust louvers shall be of formed steel construction with frame and blade minimum 18 gauge galvanized steel.
2. Blades shall be positioned at 45° when fully opened. Crank handle shall be provided for adjusting and shall be provided with an extension where wall thickness necessitates.
3. Each louver shall be provided with a removable 1/4" mesh, 23 gauge wire, galvanized insect screen with galvanized steel frame. Screen shall be attached with screws. Screen shall be located on interior side of wall.
4. Adjustable wall louvers shall be Model AEL-162 as manufactured by Louvers & Dampers, Inc., or equal.
5. Where shown on the Drawings or specified herein, adjustable louvers shall be provided with electric motor actuators. Actuators shall be operated by 120 VAC power and shall be provided with spring return to fully open or fully closed as specified.
6. Where shown on the Drawings or specified herein, adjustable louvers shall be recessed in the wall and be provided with a vandal protection type louver on exterior.

D. Wall Mounted Automatic Gravity Type Louvers

1. Intake and exhaust automatic gravity type louvers shall be suitable for high velocity and high static pressure and shall automatically open upon operation of the ventilation system or radiator cooling exhaust fan. Louver shall be intake or exhaust as shown on the Drawings and dictated by the ventilation system. Louvers shall consist of 16 gauge galvanized formed steel frame and 14 gauge aluminum tied blades with felt tip edges. Automatic gravity type louvers shall be as manufactured by Louvers & Dampers, Inc., or equal.
2. Intake and exhaust openings shall be provided with weather protection fixed louvers on exterior face and the gravity louvers on the interior face unless otherwise specified.

E. Wall Mounted Acoustical Louver

1. Formed steel acoustical wall louvers shall be provided where specified or shown on the Drawings. Construction shall be similar to fixed wall louvers. Noise side of louver shall include Type 703 fiberglass at 3.0 lb/cu ft density covered with 20 gauge perforated galvanized steel, or equal. Minimum noise reduction of 14 dB at octave band No. 3 shall be provided.
2. Each louver shall be provided with a removable 1/4" mesh, 23 gauge wire, galvanized insect screen with galvanized steel frame. Screen shall be attached with screws. Screen shall be located on interior side of wall.
3. Acoustic louver shall be 8" thick Model ALC-8-101 as manufactured by Louvers & Dampers, Inc., or equal.

2.03 SHEET METAL DUCTWORK AND MISCELLANEOUS ACCESSORIES

A. Construction

1. Ductwork (ducts and fittings) shall be constructed as shown on the Drawings with airtight joints and seams in accordance with ASHRAE standards and SMACNA Duct Construction Manual. Unless specified otherwise, ductwork shall be fabricated per SMACNA low pressure class, with static pressure rating of 2" w.g. (positive or negative) and suitable for air velocities of up to 2,500 fpm. Ductwork materials shall be galvanized steel per ASTM A527 with coating designation G-90, unless otherwise specified. Minimum duct gauges required are as follows:

<u>Maximum Size of Ducts</u>	<u>Galvanized Steel U.S. Standard Gauge</u>
12" and less	24
13" through 30"	22
31" through 54"	20

2. All transverse joints shall be sealed per SMACNA Class C requirements with vinyl acrylic duct sealant, nonflammable wet or dry, UL listed, with flame spread O, fuel contributed O, and smoke developed O. Gaskets for flanged duct joints shall be 1/4" thick, full faced, closed cell, expanded neoprene sponge.

B. Supports

Supports for horizontal ducts shall be galvanized steel angles or double struts with threaded hanger rods unless specified otherwise. Supports for vertical ducts shall be band iron strap or angle bracket type. Inlet ducts shall be amply braced to withstand maximum negative pressure.

C. Flexible Connectors

1. Flexible duct connections shall be made at each point where the air conditioning or air handling unit is connected to a duct. Flexible connectors shall be UL listed, waterproof, fire resistant, mildew resistant, air-tight woven fibrous glass cloth, double coated with chloroprene or chlorosulphonated polyethylene, and provided with sheet metal collars. Flexible connectors shall be as manufactured by Ventfabrics, Inc., United McGill, Duro-Dyne Ductmate.
2. Fabric for flexible connections protected from sunlight and the weather shall be suitable for a temperature range of -20 to 180°F and shall weigh at least 27 ounces per square yard.
3. Fabric for flexible connections exposed to sunlight or the weather shall be suitable for a temperature range of -10 to 250°F and shall weigh at least 24 ounces per square yard.

D. Volume Control Dampers

Where shown on the Drawings, provide factory fabricated volume control dampers with locking quadrant and 8" maximum blade width. Volume control dampers shall be Ruskin MD-25 or MD-35 (rectangular), MDRS-25 (round), or equal. Dampers shall be manually adjusted for air balancing.

E. Insulation and Weatherproofing

1. All exterior ductwork shall be provided with an insulation and weatherproofing system suitable for outdoor conditions, including direct sunlight and rain. The insulation system shall be installed in strict accordance with the manufacturer's printed recommendations.

2. Insulation material shall be a flexible, closed-cell, 1" thick (minimum) elastomeric insulation in sheet form. The insulation material shall be AP Armaflex SA, as manufactured by Armacell. Insulation material shall have a maximum thermal conductivity of 0.28 BTU-in/hr-sq ft-deg-F at 90°F. Insulation material shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50.
3. Adhesive shall be a contact adhesive, Armaflex 520 as manufactured by Armacell.
4. Sheet insulation shall be adhered directly to clean, oil-free duct surfaces with a full coverage of contact adhesive. The duct insulation shall be constructed from the bottom up, with the top insulation sized to extend over the side insulation to form a watershed. Butt-edge seams shall be adhered using contact adhesive by the compression fit method to allow for expansion/contraction. Standing metal duct seams shall be insulated with the same insulation thickness as installed on the duct surface. Seams shall be covered using strips of sheet insulation. Standing seams shall be adhered using contact adhesive. Insulation seams shall be staggered when applying multiple layers of insulation.
5. All insulated ductwork shall be weatherproofed with 0.020" thick stucco-embossed aluminum jacketing. Jacketing shall be manufactured from ASTM B-209, Temper H-14 aluminum alloy with factory bonded moisture barrier. Aluminum jacketing shall be installed with a 2" overlap at longitudinal seams and end joints. Secure jacket with stainless steel sheet metal screws at 6" on center along seams and at end joints. Overlapped longitudinal seams shall be arranged to shed water. All joints shall be sealed with a silicone mastic to provide a continuous weather-tight joint. Strapping shall be 3/4" wide aluminum or stainless steel. Aluminum jacketing shall be as manufactured by Pabco Childers Metals, RPR Products, Inc., or equal.

2.04 SUPPLY AND RETURN REGISTERS

A. General

Supply and return registers shall be constructed of Type 304 stainless steel. Unless specified otherwise, supply registers shall be double deflection with front deflection blades parallel to the short dimension of the register and return registers shall be single deflection with deflection blades parallel to the short dimension of the register. Registers shall be as manufactured by Titus, A-J Manufacturing Co., or equal.

B. Construction

1. Registers shall be provided with a 1-1/4" wide border on all sides for flush surface mounting. Borders shall be provided with continuous foam gaskets. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds. Where registers are shown to be mounted in exposed ductwork, register frames shall not extend beyond the sides of the ductwork. Register manufacturer shall coordinate register size and mounting with ductwork manufacturer.
2. Deflection blades shall be contoured and spaced on 3/4" centers. Blades shall have friction pivots on both ends to allow individual blade adjustment without loosening or rattling. Plastic blade pivots are not acceptable.
3. Each register shall be provided with an opposed blade volume damper constructed of heavy gauge Type 304 stainless steel. Damper shall be operable from face of register.
4. Registers shall be unpainted and furnished with a uniform satin (mill) finish.

2.05 ROOF MOUNTED EXHAUST VENTILATORS, LOW PROFILE TYPE WITH HOOD

- A. Roof exhaust ventilators shall be of low profile design with extruded aluminum hood of the centrifugal, belt-driven type. Construction of the fan housing shall be of heavy gauge aluminum.
- B. The fan wheel shall be all-aluminum of the centrifugal blower type featuring backward inclined blades and a tapered inlet shroud. Wheels shall be statically and dynamically balanced.

- C. Motors shall be of the heavy duty, permanently lubricated, sealed ball bearing type. Drives shall be sized for 165% of motor horsepower capabilities and of the cast iron type, keyed to the fan and motor shafts. Variable pitch drives shall be standard. Fan shaft shall be of steel construction, turned, ground, and polished to precise tolerances in relationship to the hub and bearings. Drive belts shall be of the oil-resistant, non-static, non-sparking type with life expectancy of over 24,000 hours. Bearings shall be flanged and of the permanently lubricated, permanently sealed, ball bearing type capable of over 200,000 hours bearing life. The entire drive assembly and wheel shall be removable, as a complete unit, from the support structure without disassembling the external fan housing. The complete drive assembly shall be mounted on rubber vibration isolation. Direct drive units shall be of identical construction as belt drive units, except for drives, belts, and fan shaft bearings. Fans shall be licensed to bear the AMCA ratings seal for air and sound performance. Motor voltage and phase shall be as shown on the Drawings and as specified in Part 1.02 herein.
- D. Fans shall be Model HLC-B as manufactured by Loren Cook, Model LD/LB as manufactured by Greenheck, or equal. Each fan shall have the performance as specified in Part 1.02 herein.
- E. Unless shown otherwise on the Drawings, roof exhaust ventilators shall be mounted on prefabricated metal roof curbs. Prefabricated roof curbs shall be a minimum 8" high, constructed of minimum 18-gauge galvanized steel, with 2" x 2" treated wood nailer, 1" (minimum) semi-rigid thermal insulation, and 3" x 3" integral cant. Exhaust ventilators shall be installed level on pitched roofs, and roof curbs shall be sized to accommodate the roof pitch shown on the Drawings. Prefabricated roof curbs shall be model SC as manufactured by Louver & Dampers, Inc., or equal. Ventilators shall be provided with automatic gravity backdraft dampers.

2.06 ROOF MOUNTED EXHAUST VENTILATORS, DOWNBLAST TYPE

- A. Downblast type exhaust ventilators shall be roof-mounted with a belt-driven centrifugal fan wheel. Fan enclosure shall be spun aluminum, mushroom style.
- B. Centrifugal fan wheel shall be backward inclined, aluminum construction. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- C. Aluminum enclosure structural components shall be constructed of minimum 16 gauge marine alloy aluminum and shall be bolted to a rigid aluminum support structure. Aluminum base shall have continuously welded curb cap corners. The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.

- D. Motors shall be of the heavy duty, permanently lubricated, sealed ball bearing type. Drives shall be sized for 150% of motor horsepower capabilities and of cast iron construction. Bearings shall be heavy duty regreasable ball type in a cast-iron pillowblock housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed. The motor, bearings, and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. Fan shaft shall be of steel construction, turned, ground, and polished to precise tolerances in relationship to the hub and bearings. Motor voltage and phase shall be as shown on the Drawings and as specified in Part 1.02 herein.
- E. Fans shall be Type ACE as manufactured by Loren Cook Company, Type GB as manufactured by Greenheck, or equal. Each fan shall have the performance as specified in Part 1.02 herein.
- F. Unless shown otherwise on the Drawings, roof exhaust ventilators shall be mounted on prefabricated metal roof curbs. Prefabricated roof curbs shall be a minimum 8" high, constructed of minimum 18-gauge galvanized steel, with 2" x 2" treated wood nailer, 1" (minimum) semi-rigid thermal insulation, and 3" x 3" integral cant. Exhaust ventilators shall be installed level on pitched roofs, and roof curbs shall be sized to accommodate the roof pitch shown on the Drawings. Prefabricated roof curbs shall be model SC as manufactured by Louver & Dampers, Inc., or equal. Ventilators shall be provided with automatic gravity backdraft dampers.

2.07 RESTROOM CEILING EXHAUSTER

- A. Contractor shall furnish and install restroom exhausters as specified herein and as shown on the Drawings. Exhausters shall be ceiling mount type, direct driven, UL listed, centrifugal exhaust fans.
- B. Fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel and shall be easily removable from the housing. Motor shall be mounted on rubber vibration isolators. Unit shall be supplied with integral wiring box and receptacle. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. Inlet shall be provided with an aluminum grill.
- C. Blower wheel shall be centrifugal forward curve type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204-96.
- D. Motor shall be open drip-proof type with permanently lubricated sealed bearings and built-in thermal overload protection.

- E. Fans shall be Gemini GC type as manufactured by Loren Cook, or equal.
- F. Unless shown otherwise on the Drawings, ceiling exhausters shall be provided with hanging isolator hardware, including all-thread rods, isolator bushings, and appurtenances.

2.08 PAD MOUNTED AIR CONDITIONING UNIT

- A. A commercial pad mounted packaged air conditioning unit shall be provided for room cooling as shown on the Drawings. Air conditioning unit shall be factory assembled, piped, internally wired, and fully charged. Unit shall be UL listed and carry UL label. Unit shall be factory run tested to check cooling operation, fan and blower rotation, and control sequence. Unit shall be designed for pad mounted installations.
- B. The packaged unit shall be a 1-phase, 230V (or 3-phase, 460V) 60 Hz horizontal airflow model as required per Part 1.02 herein, and shall be rated for a minimum total cooling capacity as specified in Part 1.02, with a minimum Seasonal Energy Efficiency Ratio (SEER) of 13. Packaged unit shall be equipped with the following components: compressor, refrigerant circuit, indoor/outdoor coil and fan, return air filter and frame, and system controls.
- C. All components shall be mounted in a galvanized steel cabinet with a baked-on enamel finish. Access panels, removable top cover, knockouts for utility and control connections, and coil guards shall be a part of the cabinet.
- D. Coils shall be constructed with aluminum fins mechanically bonded to internally grooved copper tubes. Coils shall be provided with a balanced port thermal expansion valve to provide optimal performance over the application range. Coils shall be pressure and leak tested to 450 psig. An epoxy modified, phenolic dip coating shall be provided for enhanced corrosion protection.
- E. The compressor shall be a hermetically sealed, high efficiency compressor with internal pressure relief and internal over-current and over-temperature protection. Motors for indoor air and outdoor fans shall be permanently lubricated and have built-in thermal overload protection. Indoor air fan (blower) shall provide a minimum air flow (cfm) as specified in Part 1.02 herein.

- F. The air conditioning unit shall be as manufactured by Trane, or equal. The air conditioning unit shall be provided with the following accessories: internal filter frame and pleated air filter (air filter clean resistance per manufacturer's recommendations), standard indoor thermostat as recommended by manufacturer, and a NEMA 3R, 240V, 1-phase or 480V, 3-phase (per Part 1.02 herein) air conditioning fused disconnect switch with 120V, 1-phase, GFI receptacle. A minimum of three (3) spare air filters shall be furnished for each air conditioner.
- G. The air conditioning unit shall be installed in accordance with the manufacturer's printed installation instructions. Electrical connections to the unit shall be made with flexible liquid-tight conduit and weather-tight fittings. Condensate drain piping shall be copper and be fabricated with a trap and cleanout plug. Disconnect switch shall be mounted on the air conditioning unit. The unit shall be anchored to the concrete support slab with vibration isolation pads and Type 316 stainless steel anchors (size and embedment per air conditioning unit manufacturer).
- H. Contractor shall coordinate selection of packaged unit and accessories with associated supply/return ductwork to provide a complete and operable air conditioning system.

2.09 PAD MOUNTED HEAT PUMP UNIT

- A. A commercial pad-mounted packaged heat pump unit shall be provided for room cooling/heating as shown on the Drawings, and as specified herein. Heat pump unit shall be factory assembled, piped, internally wired, and fully charged. Unit shall be UL listed and carry UL label. Unit shall be factory run tested to check cooling/heating operation, fan and blower rotation, and control sequence. Unit shall be designed for ground level installation.
- B. The packaged heat pump shall be a 1-phase, 230V (or 3-phase, 460V), 60 Hz horizontal airflow model as required per Part 1.02 herein and shall be rated for a minimum cooling/heating capacity as specified in Part 1.02, with a minimum Seasonal Energy Efficiency Ratio (SEER) of 13. Packaged unit shall be equipped with the following components: compressor, refrigerant circuit, indoor/outdoor coil and fan, return air filter and frame, and system controls.
- C. All components shall be mounted in a galvanized steel cabinet with a baked-on enamel finish. Access panels, removable top cover, knockouts for utility and control connections, and coil guards shall be a part of the cabinet.

- D. Coils shall be constructed with aluminum fins mechanically bonded to internally grooved copper tubes. Coils shall be provided with a balanced port thermal expansion valve to provide optimal performance over the application range. Coils shall be pressure and leak tested to 450 psig. An epoxy modified, phenolic dip coating shall be provided for enhanced corrosion protection.
- E. The compressor shall be a hermetically sealed, high efficiency compressor with internal pressure relief and internal over-current and over-temperature protection. Motors for indoor air and outdoor fans shall be permanently lubricated and have built-in thermal overload protection. Indoor air fan (blower) shall provide a minimum airflow (cfm) as specified in Part 1.02 herein.
- F. The packaged heat pump unit shall be as manufactured by Trane, or equal. The packaged heat pump shall be provided with the following accessories: internal filter frame and pleated air filter (air filter clean resistance per manufacturer's recommendations), rubber vibration isolation pads, standard indoor thermostat, and a NEMA 3R, 240V, 1-phase or 480V, 3-phase, fused disconnect switch with 120V, 1-phase, GFI receptacle. A minimum of three (3) spare air filters shall be furnished.
- G. The packaged heat pump shall be installed in accordance with the manufacturer's printed installation instructions. Electrical connections to the unit shall be made with flexible liquid-tight conduit and weather-tight fittings. Condensate drain piping shall be copper and be fabricated with a trap and cleanout plug. Disconnect switch shall be mounted on the packaged heat pump unit. The heat pump shall be anchored to the concrete support slab with vibration isolation pads and Type 316 stainless steel anchors (size and embedment per heat pump manufacturer).
- H. Contractor shall coordinate selection of packaged unit and accessories with associated supply/return ductwork and structural roof framing and provide a complete and operable heat pump system.
- I. Contractor shall provide volume control dampeners as necessary and also where shown on the Drawings to achieve air flow splits as specified.

2.10 WALL MOUNTED AIR CONDITIONING UNIT

- A. A commercial wall mounted packaged air conditioning unit shall be provided for room cooling as shown on the Drawings. Air conditioning unit shall be factory assembled, piped, internally wired, and fully charged. Unit shall be Intertek ETL listed. Unit shall be factory run tested to check cooling operation, condenser fan and blower rotation, and control sequence. Unit shall be designed for wall mounting installation.

- B. The packaged unit shall be a 1-phase, 230V, or 3-phase, 460V, 60 Hz horizontal airflow, through-wall, model and shall be rated for a minimum total cooling capacity as specified in Part 1.02 herein, with a minimum Energy Efficiency Ratio (EER) of 10.0. Packaged unit shall be equipped with the following components: compressor, blower assembly, condenser fan, phenolic epoxy coated condenser coil, phenolic epoxy coated evaporator coil, refrigerant circuit, return air filter and frame, and system controls.
- C. All components shall be mounted in a weather-resistant galvanized steel cabinet (20-gauge minimum thickness) with a baked-on polyester enamel finish. Lower base shall be 16-gauge (minimum) galvanized steel. The cabinet shall be provided with a sloped top and rain flashing. The cabinet shall be provided with full length side mounting brackets that are integral to the cabinet frame. Cooling section shall be fully insulated with minimum 1" thick fiberglass. Access panels, removable top cover, knockouts for utility and control connections, and coil guards shall be a part of the cabinet.
- D. The refrigeration system shall include a high efficiency scroll compressor, mounted on rubber pads. 3-phase compressors shall be provided with protection against phase reversal and phase failure that will prevent the compressor from operating when one of these conditions occurs. The refrigeration circuit shall be provided with factory installed high and low pressure controls and liquid line filter dryer. The refrigeration control shall be a factory installed capillary tube.
- E. The condenser fan, motor, and shroud shall be configured for easy slide-out removal.
- F. The indoor blower motor shall be high efficiency, permanent split capacitor (PSC) type. The blower motor shall be provided with protection against overload. Blower assembly shall include twin wheels with forward curve blades.
- G. The control system shall include a current limiting low-voltage transformer, on and off time delay circuits to prevent rapid compressor short cycling, low pressure bypass to prevent nuisance tripping during low temperature startup, and one (1) alarm output relay.
- H. The electrical control panel shall be configured for right-side or left-side access as specified in Part 1.02, herein.
- I. When specified in Part 1.02 herein, or shown on the Drawings, packaged units shall be provided with factory installed electric resistance heaters (rating as specified). Heater shall include automatic safety limit and thermal cut-off controls. Packaged units with heaters shall be provided with a factory installed circuit breaker (230 VAC models) or rotary disconnect (460 VAC models). Circuit breakers and rotary disconnects shall be provided with a lockable, hinged access covers.

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- J. When specified in Part 1.02 herein, or shown on the Drawings, packaged units shall be provided with options and accessories, including barometric fresh air dampener, motorized fresh air dampener, commercial room ventilator, economizer, or energy recovery ventilator.
- K. The air conditioning unit shall be provided with a NEMA 3R, 240V, 1-phase or 480V, 3-phase, fused disconnect switch with 120V, 1-phase, GFI receptacle.
- L. The air conditioning unit shall be installed in accordance with the manufacturer's printed installation instructions. The packaged unit shall be wall mounted with Type 316 stainless steel anchors bolts (size and embedment per packaged unit manufacturer).
- M. Electrical connections to the unit shall be made with flexible liquid-tight conduit and weather-tight fittings. Disconnect switch shall be mounted on air conditioning unit or alternately mounted on adjacent building wall.
- N. Contractor shall coordinate selection of packaged unit and accessories with associated supply/return ductwork to provide a complete and operable air conditioning system.
- O. The packaged unit shall be provided with a 5 year parts warranty.
- P. The wall mounted packaged air conditioning unit shall be Series WAA (right-side control panel) or WLA (left-side control panel) as manufactured by Bard, or equal.

2.11 EVAPORATIVE COOLER

- A. A commercial self-contained horizontal discharge, single housing, direct evaporative cooler, including fan section, media, water delivery system, and necessary appurtenances shall be provided for room cooling as shown on the Drawings, and as specified herein.
- B. The direct evaporative cooler shall be the wet pad, recirculating type suitable for connection to duct system or for through wall installation.
- C. Evaporative coolers and accessories shall be designed to operate continuously. Each complete unit shall be AMCA certified in conformance with AMCA Standard 210. Certified performance data for all evaporative coolers shall be obtained from tests made in AMCA-approved laboratories.
- D. Outside air shall be drawn through the wet evaporative cooler with the air handling unit supply fan. The cooler shall be located within the air handling unit downstream of an intake filter and a heating coil and upstream of the supply fan. A pump shall circulate water through the cooler.

- E. The packaged unit shall be 1 phase, 230V (or 3 phase, 460V) 60 Hz, horizontal air flow model as required per Part 1.02 herein, and shall be rated for minimum air flow, static pressure, media face velocity and media evaporation efficiency.
- F. Housing for the entire unit shall be constructed of Type 316 stainless steel in one piece with steel support frame and lifting lugs. Hinged access panels shall allow for access and removal of all internal components from a single side. Casing shall be insulated with 1 inch of 1-1/2-pound per cubic foot density neoprene coated NFPA-90 approved acoustical fiberglass insulation.
- G. The fan section shall have a horizontal discharge with a flange or other provision to connect sheet metal ductwork as shown on the Drawings. The fan shall be centrifugal type with lubricable bearings on each end. Fan motor shall be totally enclosed fan cooled type and shall be sized to be non-overloading on all parts of the fan curve. Fan shall be belt-driven with adjustable sheave on the motor. Manufacturer's standard vibration isolators shall be provided under the fan and motor, and neoprene flex connectors shall be provided between the fan discharge and the cabinet.
- H. The wet section of the evaporative cooler shall be welded or mechanically attached to the fan section and shall be supported across its entire width by same support frame. Internal components of the wet section shall include the cooling media, water delivery system, internal plumbing, make-up water valve, overflow, and drain fittings.
- I. The sump shall be stainless steel, leak-proof with welded corners and joints. A media support channel shall extend across the full width of the media and provide for water to flow from the media into the sump. Sump shall be provided with stainless steel couplers for connecting make-up water, overflow, and drain.
- J. An air bypass inhibitor plate shall be provided between the media and the sump to prevent any untreated air flow under the media.
- K. The water distribution system shall include a recirculating pump with mechanical float valve assembly to maintain water level in the sump. An adjustable bleed-off system with metering valve and all required piping and valves shall be provided. The internal plumbing shall include a PVC Schedule 80 header pipe with drilled orifice holes to spray water upward to a stainless steel splash plate that evenly distributes the water over the cooling media. A PVC union shall be provided in the riser pipe below the header to facilitate removal of the header pipe.

- L. Cooling media shall be rigid, 12-inch deep modules of cellulose evaporation material. Modules shall have at least 120 square feet of evaporative surface area per cubic foot of media. Media shall develop a saturation efficiency of not less than 90 percent and a maximum air pressure drop of 0.315 inches water column at 500 feet per minute face velocity.
- M. Power to the packaged unit shall be through a single feed and a fused disconnect located on the housing, and a starter and separate relay to control water distribution. Hand-Off-Auto switch and pilot lights shall also be mounted on the housing in a NEMA 3R enclosure.
- N. The evaporative cooler shall be controlled by the room air handling unit thermostat. On a high temperature signal from the thermostat, the unit's automatic fill and drain kit shall fill the sump tank and begin the spraying and evaporation. When room temperature drops to the low set point on the thermostat, the unit's automatic fill and drain kit shall drain the sump tank allowing the evaporative media to dry. The automatic fill and drain kit shall consist of two solenoid valves, fill and drain switch, time clock, and freeze stat.
- O. Evaporated cooler shall be manufactured by Premier Industries, Bessamaire, or equal.

2.12 SPLIT-DUCTLESS AIR CONDITIONING SYSTEM

- A. A split-ductless air conditioning system shall be provided for room cooling as shown on the Drawings. Air conditioning system components shall be factory assembled, piped, internally wired, and fully charged. The air conditioning system shall be Intertek ETL listed. The air conditioning system shall be factory run tested to check cooling operation, operation of internal components, and control sequence.
- B. The air conditioning system shall be a 1 phase, 230 volt, 60 Hz system and shall be rated for a minimum total cooling capacity as specified in Part 1.02, herein. The air conditioning system shall be provided with a single indoor unit or multiple indoor units as specified in Part 1.02, herein, or as shown on the Drawings. When specified herein or shown on the Drawings, the air conditioning system shall be provided with a heat pump system (each indoor unit) rated for a minimum total heating capacity as specified in Part 1.02, herein.
- C. The air conditioning system shall have a minimum Seasonal Energy Efficiency Ratio (SEER) of 14.0.

D. The air conditioning system shall be equipped with the following components: floor mounted outdoor unit, wall mounted or ceiling suspended indoor unit(s), refrigerant piping between the indoor and outdoor unit(s), control wiring between the indoor and outdoor unit(s), condensate drain piping for indoor unit(s) to outside of building, and wired wall mounted controller(s).

E. Outdoor Unit

1. The outdoor unit shall include a direct drive propeller fan(s), fan motor (one (1) motor per fan), factory pressure tested heat exchanger (condenser) coil, compressor, refrigerant accumulator on the suction side of the compressor, control circuit board, wiring, and piping. Air shall discharge horizontally from the outdoor unit.
2. The coil shall be constructed with lanced or corrugated aluminum plate fins attached to copper tubing.
3. The fan shall be provided with permanently lubricated shaft bearings.
4. Refrigerant flow between the outdoor unit and indoor unit shall be regulated by an electronically controlled expansion valve. One (1) valve shall be provided for each indoor unit. Branch box(es) shall be provided as required by the manufacturer for housing the expansion valve(s) external to the outdoor unit.
5. The compressor shall be hermetically sealed, inverter driven, variable speed, and dual rotary type. The compressor shall be provided with internal thermal overload protection and mounted on vibration isolation pads.
6. The outdoor unit shall be capable of monitoring ambient temperature, condenser coil temperature, and refrigerant discharge temperature.
7. The outdoor unit enclosure shall be a weather-resistant bonderized galvanized steel cabinet with an electrostatically applied, thermally fused polyester coating. All assembly hardware shall be weather-resistant and enclosure shall be provided with integral mounting feet.

F. Indoor Unit(s)

1. Each indoor unit shall include a line-flow or double inlet forward curve radial fan(s) direct driven by a single fan motor, factory pressure tested heat exchanger (evaporator) coil, easily removable return air filter, corrosion resistant condensate drain pan, control circuit board, wiring, and piping housed in a high strength molded plastic or corrosion resistant coated metallic enclosure. Air shall discharge horizontally from the indoor unit(s).
 2. The coil shall be constructed with smooth aluminum plate fins attached to copper tubing.
 3. The fan(s) shall be statically and dynamically balanced and provided with a permanently lubricated shaft bearing. The fan(s) shall be capable of operating at a minimum of three (3) selectable fixed speeds or operating in automatic (automatically vary speed).
 4. Each indoor unit shall include motorized, multi-position horizontal louvers to adjust air flow up and down, and manually or motorized adjustable vertical vanes to adjust air flow left and right.
 5. Each indoor unit shall have a self-diagnostic function, time delay start function, and auto restart function after power interruption. Each indoor unit shall be capable of monitoring indoor room temperature and evaporator coil temperature.
 6. Each indoor unit shall be purged with dry air in the factory prior to shipment.
 7. Each indoor unit shall be powered directly from the outdoor unit.
- G. Contractor shall coordinate selection of indoor unit(s) and outdoor unit to provide a complete and operable air conditioning system.
- H. Contractor shall install all interconnection control and power wiring between the indoor and outdoor units (and branch boxes if applicable) as required to provide a complete functioning air conditioning system. The control wiring shall be provided by the manufacturer of the air conditioning system to ensure unit compatibility.
- I. Contractor shall install all interconnection refrigerant piping between the indoor and outdoor units as required to provide a complete functioning air conditioning system. The refrigerant piping shall be annealed, refrigeration grade, seamless, copper tubing, AC/R type, meeting the requirements of ASTM B280. The refrigeration piping shall be provided with insulation meeting the requirements of Part 2.03E, herein.

- J. Contractor shall install 3/4 inch diameter condensate drain lines from indoor unit(s) to the exterior of building. Unless specified otherwise, condensate drain lines shall be constructed of Schedule 40 PVC. Condensate drain lines shall be installed with 2% minimum slope towards drain point and said points shall be located 6 inches above the outdoor finished grade. Condensate drain lines shall be supported by strut channel type pipe supports.
- K. The indoor and outdoor units shall be installed in accordance with the manufacturer's printed installation instructions. All mounting hardware shall be Type 316 stainless steel. Size and embedment of anchor bolts for outdoor units and wall mounted indoor units shall be determined by the manufacturer.
- L. Where interconnection control and power wiring, interconnection refrigerant piping, and condensate drain piping penetrate building walls, Contractor shall provide rubber sleeves through wall penetrations and seal said penetrations with silicone sealant after installation of wiring and piping. Contractor shall provide Diversitech PVC split channel type ducts, or approved equal.
- M. The air conditioning system shall be provided with a NEMA 3R, 240V, 1-phase fused disconnect switch with 120V, 1-phase GFI receptacle mounted adjacent to the outdoor unit.
- N. The air conditioning system shall be provided with a 5 year parts and defects warranty and the compressor shall have a 7 year warranty.
- O. Split-ductless air conditioning system shall be M-Series or P-Series as manufactured by Mitsubishi Electric, or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Contractor shall examine all equipment and material upon arrival at jobsite and determine that it is as specified and approved, and that it is new and in undamaged condition. Contractor shall verify openings (existing and/or new) in structures and ducts are of suitable size for equipment delivered. Contractor shall install all equipment, ductwork, fittings, and appurtenances in strict accordance with manufacturer's printed instructions and approved shop drawings.

- B. Contractor shall connect all necessary electrical power including furnishing of all necessary materials in addition to that included in the specified equipment. Wiring materials and installation shall be in accordance with Section 16050, Basic Electrical Materials and Methods, and controls and instrumentation in accordance with Section 17005, General Instrumentation and Control Components, and as shown on the Drawings.
- C. Prior to equipment operation, Contractor shall provide initial lubrication of all mechanical systems, check all belts, pulleys, and other moving parts for alignment and tolerances in accordance with the manufacturer's operating instructions.

3.02 START-UP AND INSTRUCTION

- A. Contractor shall arrange for qualified representatives of the manufacturer to inspect the installation and perform start-up of the equipment and to demonstrate required performance to the satisfaction of the District. As a minimum, manufacturer shall field measure air flow rates and specific pressures for each ventilator and air conditioning unit at each operating speed. Manufacturer shall also measure ventilator and air conditioning unit motor amperage, voltage, and power factor for each operating condition. Manufacturer shall furnish all labor and equipment required for field testing and furnish testing results to District in a written report.
- B. Contractor shall balance the ventilation and air conditioning systems by adjusting louvers or grills (unless fixed louvers or grills are specified) to obtain even air flow across a room. Contractor shall furnish calibrated (certification required) air velocity meters for such balancing.
- C. After the equipment has been installed, tested, and adjusted, and placed in satisfactory operating condition, the equipment manufacturer shall provide classroom instruction to District's operating personnel in the use and maintenance of the equipment. Two (2) hours of instruction shall be provided, unless otherwise specified. Contractor shall give the District formal written notice of the proposed instruction period at least two weeks prior to commencement of the instruction period. Scheduled training shall be at a time acceptable to the District and the manufacturer. During this instruction period, the manufacturer shall answer any questions from the operating personnel. The manufacturer's obligation shall be considered ended when he and the District agree that no further instruction is needed.

END OF SECTION