

Part 1 General

1.1 Scope

- .1 The following generally describes the scope of the work covered by this Section:
 - .1 Provision of packaged HVAC units with controls and accessories as required by the work shown in the Contract Documents and as specified.
 - .2 Co-ordinate the installation with Section 15900 and all other trades.

1.2 Related Sections

- .1 Ductwork and Accessories - Section 15800
- .2 Controls - Section 15900

1.3 References

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 430- 89, Central Station Air Handling Units.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181- 92, Ready-Mixed Organic Zinc-Rich Coating.

1.4 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 01330 – Submittal Procedures.
- .2 The shop drawings shall indicate the following: fan size and configuration, fan curves showing point of operation, motor drive bearings filters, mixing box, dampers, coil, plus all performance data.

1.5 Waste Management and Disposal

- .1 Separate and recycle waste materials.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 Extra Materials

- .1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Engineer, supply one (1) complete set of air filters for each filter bank.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 Packaged Air Handling Units (AH-4, AH-9)

- .1 Furnish outdoor, indirect gas fired heat/cool units with packaged cooling. Units shall be sectionalized, factory assembled and consist of a condensing unit, direct expansion cooling coil with drain pan, blower section, gas heating section, flat filter section and mix box with low-leakage dampers.
- .2 Units shall be pre-wired; factory tested and shall bear the CSA and CGA approval as a complete unit.
- .3 Unit shall be a single package, piped and wired at the factory. All cooling and heating controls shall be integral to the unit. Unit shall be equipped with low limit freeze protection with by-pass timer.
- .4 Unit casing shall be heavy gauge G90 rated steel. Unit roof shall be sloped for water drain off and feature standing seam construction. The entire unit casing shall be insulated with 25 mm (1") thick 0.7 kg (1 ½ lb) fiberglass insulation with hard neoprene backing.
- .5 The gas fired heating section shall be four pass design with a primary combustion chamber and multi-tube secondary heat exchanger. Internal turbulators or other flue restrictors to boost efficiency are unacceptable.
 - .1 Construct entire primary and secondary heat transfer surfaces from Type 409 Series stainless steel.
 - .2 Type 409 stainless steel burner shall feature an integral combustion air blower and motor; combustion air proving switch, removable pilot assembly and positive pilot combustion air supply.
 - .3 The combustion air damper shall be interlocked with the main gas valve to insure proper air/gas mixture.
 - .4 The unit shall be suitable for natural gas and designed and certified by ETL and CGA to provide full gas modulation. The minimum turndown ratio shall be 10:1.

- .6 Unit shall feature a cooling section that shall include direct expansion cooling coil, compressors, condenser coils and fans. The direct expansion cooling coil must be ARI Certified; submit proof of certification to the Engineer.
 - .1 Unit shall provide a minimum of two stages of cooling control.
- .7 AH-4 shall be supplied with a low-leakage outdoor air damper. The damper shall be aluminum air foil type with seals inset into 22 gauge steel mix box liners.
 - .1 The outdoor air damper shall be supplied with a two-position damper actuator.
- .8 AH-9 shall be supplied with a mix box featuring outdoor air and return air dampers. The dampers shall be aluminum airfoil low leak type with seals inset into 22 gauge steel mix box liners.
 - .1 The dampers shall be equipped with modulating actuators.
- .9 The unit shall be provided with a flat filter section. Filter access shall be through latched and gasketed access doors located on both sides of the unit.
 - .1 The pre-filters shall be 50 mm (2") thick pleated, panel type with a 30% Efficiency.
 - .1 Acceptable Material: Farr 30/30.
- .10 Units shall be supplied with a factory fabricated roof curb.
- .11 Units shall be served by a single point power connection, all motor starters and internal controls shall be factory wired.
- .12 Units shall be supplied with a non-fused disconnect for installation by Division 16.
- .13 Acceptable Material: ICE, Engineered Air.

2.2 Air Handling Units (AH-6, AH-7, AH-8)

- .1 Provide in the arrangements and types shown on the drawings, factory-built modular air handling units. The unit is to be provided in sections suitable for final assembly on site. The Unit is to be designed and arranged for one side access with one side of the unit installed against a building wall. The unit is to be constructed with features as follows.
- .2 Unit casing shall be of minimum 16 gauge (1.6 mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides, and be primed with a two-part acid-based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All walls, roofs and floors shall be formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and, on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant. All unprotected metal and welds shall be factory coated.

- .3 Air unit insulation to be 50 mm (2") interior neoprene coated insulation for cabinet and 50 mm (2") rigid insulation on casing floor with condensate pans and drains. Provide solid metal liner throughout unit.
- .4 Units shall be provided with access doors to allow access to all interior components including fans and motors; filters; dampers and operators; access plenums and humidifiers/wet cells; electrical control panels; burner compartments; compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable. Provide hinged access doors in welded steel frames. Doors shall be fully lined with closed cell bulb gasket and Leverlok handles, operable from both sides.
- .5 Fans: statically and dynamically balanced centrifugal DIDW with shafts operating less than 80% of first critical speed, bearings selected for average life of 150,000 hours and provided with lubrication fittings extended to the drive side for convenient servicing.
- .6 Filters: provide and angular filter section to accommodate 50 mm (2") thick filter panels.
 - .1 Filters shall be 50 mm (2") thick Farr 30/30.
- .7 Provide Magnehelic pressure differential gauge to read pressure differential across each filter bank. Scale of gauge to read at approximate midpoint when filters require service or replacement. Mount gauge on the exterior of the unit on the service side.
- .8 Coils: ARI rated. Provide hinged, camlatched and insulated access doors on air leaving side of coil section. Locate across door on service side of unit.
- .9 A full coil section width casing with access door shall be used to separate all coils.
- .10 Insulated casings and plenums shall be provided for all units, including those servicing heat and vent applications.
- .11 Units shall be installed to allow removal of all coils and filters. Clearance equal to full-finned width of coil shall be provided to facilitate removal.
- .12 Units shall be mounted on internal vibration isolators and concrete housekeeping pads.
- .13 Cooling coil drain pans shall be fabricated of stainless steel as an integral part of the floor paneling, and be a minimum of 50 mm (2") deep, with welded corners. Drain pans shall extend a minimum of 300 mm (12") downstream of coil face and be provided with a 40 mm (1 1/2") stainless steel drain connection. Drain pans must be sloped and pitched such that there is no standing water. Intermediate drain pans shall be provided between cooling coils where required for effective moisture removal.
- .14 Drives: Complete with motors, adjustable motor slide rail or pivot base, adjustable sheaves and belts.

- .1 Belt Guards: Expanded metal-type with 25 mm (1") diameter tachometer openings at both fan and motor shafts. Provide one opening through an adjustable plate to compensate for motor position adjustments.
- .2 Provide fixed sheaves for drives over 5.6 kW (7.5 HP). For either type of shave (fixed or variable pitch), provide a second set as required by the TAB firm if field testing proves this necessary.
- .15 Vibration Isolation: Spring isolators for floor mounted application.
- .16 Acceptable material: McQuay, Trane, York, Engineered Air.

2.3 Rooftop Units (AH-10, AH-11, AH-12)

- .1 Factory assembled and tested; designed for roof installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, glycol heating coil, filters and dampers.
- .2 Construction
 - .1 Unit shall be completely factory assembled, piped and wired and shipped in one section.
 - .2 Unit shall be specifically designed for outdoor roof top application with a fully weatherproof cabinet.
 - .3 Cabinet shall be constructed entirely of G90 galvanized steel with the exterior constructed of 18 gauge or heavier material.
 - .4 Paint finish shall be capable of withstanding at least 2000 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - .5 The unit roof shall be sloped to assure drainage.
 - .6 A compartment c/w hinged access doors with quarter turn latch shall contain the compressors and electrical control panel.
 - .7 Unit specific color-coded wiring diagrams shall match the unit color coded wiring and will be provided in both point-to-point and ladder form.
 - .8 Diagrams shall also be laminated in plastic and permanently affixed inside the control compartment.
 - .9 Access to filters, blower, heating section, and other items needing periodic checking or maintenance shall be through hinged access doors with latches which are operable from both sides.
 - .10 Access doors shall have stainless steel hinges and full perimeter gasketing and open against air pressure.
 - .11 Air side service access doors shall have rain gutters over the door.
 - .12 All access doors will have an internal metal liner to protect the door insulation.

- .13 The interior air side of the cabinet shall be entirely insulated on all exterior panels with 50 mm (2") thick, 1 1/2 lb. density fiberglass insulation covered with a metal liner.
- .14 Unit shall have decals and tags to indicate unit lifting and rigging, service areas and caution areas. Installation and maintenance manuals shall be supplied with each unit.
- .15 Cabinet options include:
 - .1 Unit exterior to be "Grey" in color.
 - .2 Unit shall be furnished with 304 stainless steel drain pans.
 - .3 Unit base shall be insulated with 50 mm (2") thick, 1 1/2 lb density fiberglass insulation.
- .3 Supply Fans:
 - .1 The fan shall be direct or belt drive single width single inlet un-housed airfoil centrifugal, plenum fans.
 - .2 Blower(s) shall be entirely self contained on a slide deck for service and removal from the cabinet. All belt drive blower(s) shall have backward inclined airfoil blades. Adjustable V-belt drive shall be provided with a minimum rating of 140% of the motor nameplate brake horsepower when the adjustable pulley is at the minimum RPM. Blowers, drives and motors shall be dynamically balanced.
 - .3 Supply fans shall have all aluminum construction and rated class II. Fans attached to 1760 rpm motors shall have be rated for a minimum of 1800 RPM maximum speed. Fans attached to 1170 rpm motors shall have be rated for a minimum of 1200 RPM maximum speed. Motor bearings shall be rated for 200,000 hours service and shall have external lubrication connections. Fan(s) and motor(s) shall be dynamically balanced, and the entire fan assembly mounted on spring isolators.
 - .4 Supply air shall be from the bottom.
- .4 Outside Air Options:
 - .1 Shall be 3-position dry bulb activated economizer with multi-stage integrated economizer and compressor operation controlled by the conditioned space controller for maximum benefit.
 - .2 The outside air damper and return air damper assembly shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals.
 - .3 Damper blades shall be gear driven and designed to have no more than 127 LPS of leakage per m² of area at 500 pa (25 CFM of leakage per ft.² of area at 2 in. w.g.) air pressure differential across the damper.
 - .4 Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure.

- .5 The outdoor air section shall include a relief air damper sized to accommodate 100% of the supply air volume.
- .5 Motors shall be high efficiency and motor bearings shall be ball bearing and shall have external lubrication connections.
- .6 Power Exhaust (AH-12)
 - .1 The control shall be modulating damper controller by building pressure and all controls shall be factory installed.
- .7 Air Cooled Condenser Section:
 - .1 The condensing section shall be equipped vertical discharge axial flow direct drive 1170 RPM fans with all aluminum construction and adjustable blade pitch. Direct drive fans shall be directly connected to and supported by the motor shaft. Motor bearings have external lubrication connections.
 - .2 Condenser coils shall be copper tubes with aluminum fins mechanically bonded to the tubes.
 - .3 Condenser coils to be sized for a minimum of 6°C (10°F) of refrigerant sub-cooling.
- .8 Evaporator coils shall feature the following:
 - .1 Copper tube with aluminum fins mechanically bonded to the tubes.
 - .2 Rated in accordance with ARI Standard 410.
 - .3 Galvanized steel end casings.
 - .4 Equalizing type vertical tube headers.
 - .5 A thermostatic expansion valve.
 - .6 A double sloped drain pan for the positive drainage of condensate. Drain pan(s) shall be fabricated of 304 stainless steel.
 - .7 A drain connection on each side of the unit. The manufacturer shall provide a P-trap condensate drain fitting for field installation to the drain connections.
- .9 Refrigeration System:
 - .1 Compressors shall be of the hermetic scroll type arrangement with internal thermal overload protection and mounted on the compressor manufacturer's recommended rubber vibration isolators.
 - .2 All units shall be multiple stages with a minimum of 2 stages of capacity control.
 - .3 Compressors shall be mounted in an isolated compartment to permit operation of the unit without affecting air flow when the door to the compartment is open.
 - .4 Compressors shall be isolated from the base pan and supply air to avoid any transmission of noise from the compressor into the building area.
 - .5 System shall be equipped with thermostatic expansion valve type refrigerant flow control.

- .6 System shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant controls.
- .7 Unit shall be equipped with Schrader type service fittings on both the high side and low pressure sides of the system.
- .8 Unit shall be equipped with replaceable core refrigerant liquid line driers.
- .9 Unit shall be fully factory charged with refrigerant. Options: (Multiple selections are permissible)
 - .1 Hot gas bypass shall be provided on the first refrigerant circuit.
 - .2 Each compressor shall be individually staged for capacity control.
 - .3 Unit shall be equipped with a 5 minute anti-short cycle delay timer for each stage.
 - .4 Unit shall be equipped with 20 second between stage delay timers for each stage.
- .10 The heating system shall include the following features:
 - .1 A modulating gas valve capable of a minimum 3:1 turndown ratio.
 - .2 A stainless steel heat exchanger capable of accommodating a minimum of 50% outdoor air at design heating conditions.
- .11 Filters shall be 50 mm (2") thick, fiberglass, pleated with an ASHRAE efficiency of 30%. Maximum face velocity shall be 500 fpm.
 - .1 Acceptable material Farr 30/30.
- .12 Controls:
 - .1 Unit shall be supplied with a full control system that includes motor starters, overloads, transformers, relays, etc.
- .13 Power Option:
 - .1 Unit shall be provided with a factory installed and wired internal disconnect.
 - .2 Unit shall be provided with a factory installed and field wired 115 volt, 15 amp ground fault service receptacle.
- .14 Unit shall be mounted on a factory furnished, knocked down and field assembled roof curb. Roof curbs shall be constructed of galvanized steel with a wood nailer strip. Curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.
- .15 Acceptable material: Aeon, Lennox, Trane, York.

2.4 Cooling and Heating Coils (HC-6, HC-7, HC-8/CC-6, CC-7, CC-8)

- .1 Provide separate drain pans for each stacked cooling coil. Each pan shall be fully draining.

- .2 Access doors shall be provided on the upstream and downstream side of all coils.
- .3 Water and glycol coils shall be fully drainable through line-sized drains. Separate vent connections are not acceptable as drain fittings.
- .4 Air vents shall be provided at all high points.
- .5 Hose and drain valves shall be provided with isolation valves.
- .6 Water and glycol coils shall be piped in counterflow configuration.
- .7 Water, glycol and DX Type: Provide cooling and heating coils as detailed on the coil schedule. A.R.I. rated and constructed of 0.035" copper tubes and aluminum fins unless otherwise noted, and pressure tested for operation up to 1400 kPa (200 psi) for water and glycol coils. Refer to drawings for piping connections and dimensional data. Coils for built-up systems to be fully drainable.
- .8 Acceptable material: McQuay, Lennox, Trane, York.

2.5 Condensing Units (CU-6, CU-7, CU-8)

- .1 Factory assembled, tested, air-cooled condensing units shall consist of a hermetic compressor(s), air-cooled condenser section, control system, suction and liquid connection valves, fans, motors, starters and all components necessary for safe and controlled unit operation when connected to the specified low side equipment. The unit shall be capable of stable operation to a minimum of 13°C (55°F) outdoor temperature.
- .2 Compressors: The compressors shall be a sealed hermetic scroll type with a forced feed lubrication system and oil charge. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all phases and shall be mounted on RIS vibration isolators. Models 8 tons and larger shall be furnished with a crankcase heater.
- .3 Condenser: The condenser coil(s) shall consist of seamless copper tubes mechanically bonded into plate type fins. The fins shall have full drawn collars to completely cover the tubes. A subcooling section shall be an integral part of the main condenser coil. Condenser fan(s) shall be propeller type arranged for horizontal air discharge on 2 through 5 ton models (vertical air discharge on 8 through 25 ton models) and individually driven by direct drive fan motor(s). The fan discharge area shall be protected, single-phase, direct drive, 1100 rpm, open drip-proof type. The condenser coil(s) shall be mechanically protected from physical damage by a wire guard covering the full face area of the coil.
- .4 Refrigerant Circuit: The condensing unit shall be furnished with a liquid line filter drier and service valves for liquid and suction connections. The finished field installed refrigerant circuit furnished by the contractor shall include the low side cooling

components, refrigerant, thermal expansion valve, liquid line (insulated hot gas bypass line) and insulated suction line.

- .5 Control System: A centrally located weatherproof control panel shall contain the field power connection points, control terminal block and control system. Power and starting components shall include fan motor contactors, time delay relay(s) for the compressor(s), inherent fan motor overload protection and unit power terminal blocks for connection to remote disconnect switch. Safety and operating controls shall include a manually reset high pressure switch and an automatic reset low pressure switch. Barrier panels shall be furnished to protect against accidental contact with line voltage when accessing the control system.
- .6 Service Accessibility: Entrance to the separate compressor(s) and control panel compartment shall be through an access panel.
- .7 Wiring Diagrams:
 - .1 Wiring diagrams shall be in color and marked to match the color and markings of the wires and shall be both "point-to-point" and "ladder" diagrams.
 - .2 Diagrams shall be laminated in plastic and permanently fixed to the control compartment door.
 - .3 Installation and maintenance manuals shall be supplied with each unit within the control compartment.
- .8 Provide the following options and accessories:
 - .1 Hot gas bypass, factory supplied and mounted.
 - .2 Control Circuit Transformer.
 - .3 Vibration Isolators.
 - .4 Isolation valves for liquid, suction, hot gas bypass lines.
- .9 Acceptable material: Aaon, Trane, York, Lennox.

2.6 Vibration Isolation

- .1 Provide flexible connections at the supply and return inlets as noted in Section 15800.
- .2 Factory installed vibration isolators shall be provided on the fan section.

Part 3 Execution

3.1 Packaged Air Handling Units (AH-4, AH-9)

- .1 Provide appropriate protection apparatus.

- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.
- .4 Units to be mounted on factory supplied roof curbs.

3.2 Air Handling Units (AH-6, AH-7, AH-8)

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.
- .4 Units to be mounted on factory supplied roof curbs.

3.3 Rooftop Units (AH-10, AH-11, AH-12)

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.
- .4 Units to be mounted on factory supplied roof curbs.

3.4 Condensing Units (CU-6, CU-7, CU-8)

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

END OF SECTION