

SECTION 23 81 00
UNITARY AIR-CONDITIONING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. Air Moving and Conditioning Association (AMCA): Bulletin 300, Setup No. 1.
3. American Gas Association (AGA).
4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - b. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
5. American Society of Mechanical Engineers (ASME): BPVC Section IX, Welding and Brazing Qualifications.
6. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2370, Standard Test Method for Tensile Properties of Organic Coatings.
 - c. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - e. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
7. Canadian Standards Association (CSA).
8. ETL Testing Laboratories (ETL).
9. International Organization for Standardization (ISO):
 - a. 9001, Quality Management Systems - Requirements.
 - b. 13256-1, Water-Source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-Air and Brine-to-Air Heat Pumps.
10. National Electrical Manufacturers Association (NEMA).
11. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
12. UL: 94, Safety Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.02 ABBREVIATIONS

A. The following is a list of abbreviations which may be used in this section:

1. AC: Air Conditioning.
2. COP: Coefficient of Performance.
3. DX: Direct Expansion.
4. EER: Energy Efficiency Ratio.
5. HP: Heat Pump.
6. IR: Infra Red.
7. LED: Light Emitting Diode.
8. PSC: Permanent Split Capacitor.
9. PTAC: Packaged Terminal Air Conditioner.
10. SPST: Single Pole, Single Throw.
11. TXV: Thermostatic Expansion Valve.
12. UV: Ultraviolet.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature which shall include make, model, dimensions, weight of equipment, and electrical schematics for all products specified.
 - b. Manufacturer's standard finish color selection for enclosure finishes.
 - c. Complete performance data that will indicate full compliance with Specification:
 - 1) Include fan sound power level data (ref. 10 to 12 watts) at design operating point, based on AMCA Bulletin 300, Setup No. 1.
 - 2) Include heating and cooling performance data at design operating conditions.
 - d. Air Pressurization Unit: Documentation that media filter modules are UL rated Class 1.
 - e. Factory dip-applied protective coating product data.

B. Informational Submittals:

1. Manufacturer's documentation that media filter modules rated UL Class 1.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 67 00, Product Requirements, for heat pumps, air-conditioning units, and motors.

3. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement or details shown to equipment furnished.
4. Sample copy of guarantee.
5. Test reports.
6. Operation and Maintenance Data in conformance with Section 01 78 23, Operation and Maintenance Data.
 - a. Include wiring and control diagrams for equipment.
 - b. Include as-built version of equipment schedules.

1.04 QUALITY ASSURANCE

- A. Heating and Cooling Equipment: Minimum operating efficiencies, defined as COP and EER, as specified in ASHRAE 90.1.
- B. Unit shall be rated (when matched with appropriate outdoor unit) per AHRI 210/240.
- C. Units shall be certified by UL and CSA, and shall be UL or ETL listed and labeled.
- D. Cooling performance rated in accordance with AHRI testing procedures.
- E. Air Pressurization Unit Manufacturer Qualifications:
 1. Manufacturer shall have a minimum of 10 years' experience in design, fabrication and testing of systems that are 99.95 percent efficient in removal of these gases.
 2. Manufacturer shall be a single source provider of equipment, media, and testing services, and certified to ISO 9001 standards or adhere to quality standards equal to ISO 9001.
 3. Welding procedure qualifications and welder performance qualifications shall conform to the requirements of ASME BPVC Section IX. Welder's performance qualification records shall be made available to Contracting Officer upon request.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.
- B. Protection of Equipment:
 1. Box, crate, or otherwise protect from damage and moisture during shipment, handling, and storage.
 2. Protect from exposure to corrosive fumes and keep thoroughly dry at all times.

3. Store motors, drives, electrical equipment, and other equipment with antifriction or sleeve bearings in weathertight and heated storage facilities prior to installation.
4. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

1.06 SPECIAL GUARANTEE

- A. Refrigerant Compressors: Furnish manufacturer's extended guarantee or warranty, with Contracting Officer named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Contracting Officer, removal and replacement of compressors specified in this Specification found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

1.07 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following materials:

Item	Quantity
Filters.	One complete set per unit.
Special tools required to maintain or dismantle.	One complete set for each unit size.

- B. Delivery: In accordance with Section 01 67 00, Product Requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Physical Characteristics: None.
- B. Functional Characteristics:
 1. Multiple Compressor Units:
 - a. Provide completely independent refrigeration circuits and controls.
 - b. Indoor unit air coils shall have intermingled circuits, unless specified otherwise.
- C. Performance Characteristics: Specified components of this section, including insulation, facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

2.02 EQUIPMENT SCHEDULES

A. Refer to Article Supplements.

2.03 SPLIT SYSTEM HIGH WALL AC UNIT, DUCTLESS

A. Manufacturers and Products:

1. Mitsubishi.
2. Or equal.

B. General:

1. Physical Characteristics:
 - a. Split system, indoor, DX, ductless, fan coil AC unit, complete with DX coil, fan, fan motor, piping connectors, electrical controls, and microprocessor control system.
 - b. Suitable for use with air conditioner or heat pump outdoor unit.
 - c. Indoor unit shall be of the same manufacturer as the associated outdoor unit.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

C. Unit Cabinet:

1. Physical Characteristics:
 - a. High-impact plastic or painted galvanized steel.
 - b. Fully insulated.
 - c. Discharge and inlet grilles, high-impact polystyrene.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

D. Evaporator Fan:

1. Physical Characteristics:
 - a. Tangential direct-drive blower type with air intake at upper front face of unit and discharge at bottom front.
 - b. Air Sweep:
 - 1) Provide automatic, motor-driven horizontal air sweep as standard.
 - 2) Air sweep operation shall be user selectable.
 - 3) Vertical direction may be manually adjusted and horizontal air sweep may be manually set.
 - 4) Motor: Open drip-proof, permanently lubricated ball bearing with inherent overload protection.

2. Functional Characteristics:
 - a. Motor: Minimum three speed.
 3. Performance Characteristics: None.
- E. DX Evaporator Coil:
1. Physical Characteristics:
 - a. Copper tube with aluminum fins and galvanized steel tube sheets.
 - b. Fins bonded to tubes by mechanical expansion.
 - c. Condensate Drip Pan:
 - 1) Locate under coil with drain connection for hose attachment to remove condensate.
 - 2) Provide internal trap and auxiliary drip pan under coil header.
 2. Functional Characteristics: None.
 3. Performance Characteristics: None.
- F. Electric Heater: Units shall be equipped with factory-mounted electric heaters. Minimum protection shall include overcurrent and high temperature protection.
- G. Controls:
1. Physical Characteristics:
 - a. Refrigerant Metering:
 - 1) Factory installed refrigerant metering device.
 - 2) Heat Pump Applications: Reverse flow bypass refrigerant metering device with internal check valves.
 - b. Indoor coil freeze protection.
 - c. Wireless infrared remote control to enter set points and operating conditions.
 - d. Test mode button to run self-diagnostics and aid in troubleshooting.
 - e. Fan Speed Control: User-selectable for high, medium, low or microprocessor automatic operation during all operating modes.
 - f. Provide outdoor unit high temperature protection to detect excessive outdoor unit discharge temperatures.
 - g. Manual defrost button to initiate defrost cycle from handset.
 - h. Provide indoor coil high temperature protection to detect excessive indoor discharge temperature when unit is in heat pump mode.
 2. Functional Characteristics:
 - a. Automatic restart after power failure at same operating conditions as at failure.
 - b. Timer function to provide a minimum 15-hour timer cycle for system AUTO/START/STOP.

- c. Temperature-sensing controls shall sense return air temperature. Provide indoor air high discharge temperature shutdown.
 - d. Filter status indication after 250 hours of indoor fan operation.
 - e. AUTO/STOP features shall have integral setback control.
 - f. Automatic air sweep control provides ON or OFF activation of air sweep louvers.
 - g. Dehumidification mode provides increased latent removal capability by modulating fan speed and set point temperature.
 - h. Fan only operation provides room air circulation when no cooling is required.
 - i. Diagnostics to provide continuous checks of unit operation and warn of possible malfunctions. Error message shall be displayed at unit and at remote controller.
 - j. Time delay shall prevent compressor restart in less than 3 minutes.
 - k. Automatic heating-to-cooling changeover to provide automatic heating and cooling operation. Control shall include deadband to prevent rapid mode cycling.
 - l. Demand defrost shall be provided and shall minimize defrost cycles by internally adjusting defrost timing based on frost accumulation.
3. Performance Characteristics: None.
- H. Air Filters: Filter track with factory-supplied charcoal filters.
- I. Accessories: Provide as follows:
- 1. Internal Condensate Pump:
 - a. Physical Characteristics: To remove condensate from drain pan when gravity drainage cannot be used.
 - b. Functional Characteristics:
 - 1) Lift Capability: 25-foot WC.
 - 2) Float control in condensate drain pan to shut unit down in case of pump malfunction.
 - c. Performance Characteristics: None.

2.04 VARIABLE REFRIGERANT FLOW (VRF) SYSTEM HEAT PUMP UNIT

A. General:

- 1. Physical Characteristics:
 - a. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section. The outdoor unit modules shall be equipped with a single compressor which is inverter-driven. Each outdoor unit module shall be completely factory assembled, piped, and wired and run tested at the factory.

- b. Outdoor unit systems may be comprised of multiple modules with differing capacity. All units requiring a factory supplied twinning kits shall be piped together, without the need for equalizing line(s).
 - c. Refrigerant lines from the outdoor unit to the indoor units shall be insulated.
 - d. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
 - e. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
 - f. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads.
2. Functional Characteristics:
- a. Outdoor unit shall have a sound rating no higher than 66.5 dBA individually or 69.5 dBA twinned. Units shall have a sound rating no higher than 52 dBA individually or 55 dBA twinned.
 - b. The outdoor unit shall be capable of operating in heating mode down to minus 1.5 degrees F ambient temperatures or cooling mode down to 23 degrees F ambient temperatures.
 - c. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (minus 1.5 degrees F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23 degrees F.
 - d. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature.
3. Performance Characteristics: VRF system shall meet performance requirements per schedule and be within piping limitations and acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs.

B. Unit Cabinet:

1. Physical Characteristics:
- a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
 - b. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

2. Functional Characteristics: None.
3. Performance Characteristics: None.

C. Fan:

1. Physical Characteristics:
 - a. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s). Fans shall be factory set for operation at 0-inch WG. external static pressure, but capable of normal operation with a maximum of 0.32-inch WG. external static pressure via dipswitch.
 - b. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 - c. All fans shall be provided with a raised guard to prevent contact with moving parts.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

D. Refrigerant and Refrigerant Piping:

1. Physical Characteristics:
 - a. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
 - b. All refrigerant piping must be insulated with 1/2-inch closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E84 and CAN / ULC S-102. R value of insulation must be at least 3.
 - c. Refrigerant line sizing shall be in accordance with manufacturer specifications. Future changes to indoor unit styles or sizes must be possible without resizing/replacing refrigerant piping to any other branch devices or indoor units.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

E. Coil:

1. Physical Characteristics:
 - a. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a four-sided coil.
 - b. Outdoor Coil shall be elevated at least 12 inches from the base on the unit to protect coil from freezing and snow build up in cold climates.

- c. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
- d. The coil fins shall have a factory applied corrosion resistant blue-fin finish. Uncoated aluminum coils/fins are not allowed.
- e. The coil shall be protected with an integral metal guard.
- f. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
- g. Unit shall have panel heaters in order to prevent any residual ice buildup from defrost.
- h. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture.
 - 1) Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors.
 - 2) Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load.
 - 3) Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings or belly-band crankcase heaters.
 - 4) Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15 percent.
 - 5) The compressor shall be equipped with an internal thermal overload.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

F. Controls:

- 1. Physical Characteristics: The unit shall be an integral part of the system and control network and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
- 2. Functional Characteristics: Each outdoor unit module shall have the capability of four levels of demand control based on external input.
- 3. Performance Characteristics: None.

G. Electrical:

1. Physical Characteristics:
 - a. The outdoor unit shall be controlled by integral microprocessors.
 - b. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24V dc completed using a two-conductor, twisted pair shielded cable to provide total integration of the system.
2. Functional Characteristics: The outdoor unit electrical power shall be 208/230 volts, three-phase, 60-Hz or 460 volts, three-phase, 60-Hz per equipment schedule.
3. Performance Characteristics: None.

2.05 BRANCH CIRCUIT (BC) CONTROLLERS AS REQUIRED FOR
SIMULTANEOUS HEAT/COOL SYSTEMS

A. General:

1. Physical Characteristics:
 - a. BC (Branch Circuit) Controllers (or comparable branch devices) shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices which do not include controlled refrigerant subcooling risk bubbles in liquid supplied to indoor unit LEVs and are not allowed.
 - b. BC Controllers (or comparable branch devices) shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish and be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. BC Controllers (or comparable branch devices) shall be suitable for use in plenums in accordance with UL 1995 ed 4.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

B. BC Unit Cabinet:

1. Physical Characteristics:
 - a. The casing shall be fabricated of galvanized steel.
 - b. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.

- c. The unit shall house two tube-in-tube heat exchangers.
- d. Refrigerant Piping (specifications in addition to those for outdoor unit):
- e. All refrigerant pipe connections shall be brazed.
- f. Future changes to indoor unit quantities or sizes served by BC Controller or comparable branch device must be possible with no piping changes except between the branch device and indoor unit(s) changing.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

C. Refrigerant Valves:

- 1. Physical Characteristics:
 - a. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
 - b. Service shut-off valves shall be pre-installed by the equipment vendor and leak tested to the applicable factory specifications for each branch to allow service to any indoor unit without field interruption to overall system operation.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

D. Condensate Management:

- 1. Physical Characteristics: BC Controller (or comparable branch device) must have integral resin drain pan or insulate refrigeration components with removable insulation that allows easy access for future service needs.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

E. Electrical:

- 1. Physical Characteristics:
 - a. The unit electrical power shall be 208/230 volts, single-phase, 60 Hz. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60 Hz) or 207-253 (230/60 Hz).
 - b. The BC Controller shall be controlled by integral microprocessors.
 - c. The control circuit between the indoor units and outdoor units shall be 24V dc completed using a two-conductor, twisted pair shielded cable to provide total integration of the system.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

2.06 WALL MOUNTED INDOOR UNIT

A. General:

1. Physical Characteristics:
 - a. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor.
 - b. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
2. Functional Characteristics: The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch.
3. Performance Characteristics: None.

B. Unit Cabinet:

1. Physical Characteristics:
 - a. All casings shall have white finish.
 - b. Multi directional drain and refrigerant piping offering four directions for refrigerant piping and two directions for draining.
 - c. Provide back plate to secures the unit to the wall.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

C. Fan:

1. Physical Characteristics:
 - a. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.
 - b. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 - c. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

D. Filter:

1. Physical Characteristics: Return air removable, washable filter.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

E. Coil: Design criteria for indoor units include LEV/EEV.

1. Physical Characteristics:
 - a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
 - b. The coils shall be pressure tested at the factory.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

F. Electrical:

1. Physical Characteristics: None.
2. Functional Characteristics:
 - a. The unit electrical power shall be 208/230 volts, single-phase, 60 Hz, powered from the outdoor heat pump unit.
 - b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60 Hz) or 207-253 volts (230V/60 Hz).
3. Performance Characteristics: None.

G. Controls:

1. Physical Characteristics:
 - a. The unit shall include an IR receiver for wireless remote control flexibility.
 - b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degrees F to 9 degrees F adjustable deadband from set point.
 - c. Indoor unit shall include no less than four digital inputs capable of being used for customizable control strategies.
 - d. Indoor unit shall include no less than three digital outputs capable of being used for customizable control strategies.
2. Functional Characteristics: Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Performance Characteristics: None.

2.07 OVERVIEW

- A. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. Furnish energy conservation

features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence. System shall be capable of email generation for remote alarm annunciation.

2.08 ELECTRICAL CHARACTERISTICS

A. General:

1. Physical Characteristics:
 - a. Controller power and communications shall be via a common nonpolar communications bus and shall operate at 30V dc.
 - b. Wiring:
 - 1) Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
 - 2) Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

2.09 CONTROLS NETWORK

A. Manufacturers:

1. Carrier.
2. Or equal.

- B. Physical Characteristics: The Controls Network consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either BACnet® interfaces.

C. Functional Characteristics: None.

D. Performance Characteristics: None.

2.10 SPLIT SYSTEM AC OUTDOOR UNITS

A. Manufacturers:

1. Mitsubishi.
2. Or equal.

B. General:

1. Physical Characteristics:
 - a. Factory assembled, single piece, air-cooled air conditioner outdoor unit.
 - b. Contained within the unit enclosure shall be factory wiring, piping, controls, compressor, and holding charge of R-410 A refrigerant.
 - c. Outdoor unit shall be same manufacturer as associated indoor unit.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

C. Unit Cabinet:

1. Physical Characteristics:
 - a. Constructed of galvanized steel, phosphatized and coated with a baked enamel finish. Finish shall pass the 500-hour salt spray test.
 - b. Removable access panels for access to internal components.
 - c. Outdoor Compartment: Isolated, with acoustic lining to ensure quiet operation.
 - d. Knockouts for unit electrical power.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

D. Condenser Fans:

1. Physical Characteristics:
 - a. Direct-drive propeller type shall discharge air vertically and shall blow air through outdoor coil.
 - b. Motors:
 - 1) Totally enclosed, with Class B insulation and permanently lubricated bearings.
 - 2) Thermal overload protection.
 - c. Shaft of galvanized or stainless steel construction.
 - d. Fan blades shall be corrosion-resistant and be statically and dynamically balanced.
 - e. Equip openings with PVC-coated protection grille over fan and coil.

2. Functional Characteristics: None.
3. Performance Characteristics: None.

E. Compressor:

1. Physical Characteristics:
 - a. Fully hermetic reciprocating or scroll type.
 - b. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil.
 - c. Installed on rubber vibration isolators and shall have internal spring isolation.
2. Functional Characteristics:
 - a. Equipped with oil system, operating oil charge, and motor.
 - b. Internal overloads shall protect compressor from overtemperature and overcurrent.
 - c. Motor: NEMA rated, Class F, suitable for operation in a refrigerant atmosphere.
 - d. Scroll compressors shall have high discharge gas temperature protection.
3. Performance Characteristics: None.

F. Condenser Coil:

1. Physical Characteristics:
 - a. Constructed of aluminum fins mechanically bonded to internally enhanced seamless copper tubes that are cleaned, dehydrated, and sealed.
 - b. Coat entire coil with anticorrosion protective coating, in accordance with Article Factory Dip-Applied Protective Coating.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

G. Refrigeration Components:

1. Physical Characteristics:
 - a. Brass external liquid line service valve with service gauge port connections.
 - b. Suction line service valve with service gauge connection port.
 - c. Service gauge port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps.
 - d. Suction Line: Accumulator.
 - e. Pressure relief.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

H. Controls:

1. Physical Characteristics:
 - a. Factory selected, assembled, and tested.
 - b. Refrigerant Metering:
 - 1) Reversing valve for heat pump units.
 - 2) Heating mode metering device for heat pump units.
 - c. High pressure and liquid line low pressure switches.
 - d. Defrost board to provide defrost control.
 - e. Three-pole contactors.
2. Functional Characteristics:
 - a. Automatic restart on power failure.
 - b. Time delay control sequence shall be provided standard through control board on indoor units.
 - c. Automatic outdoor fan motor protection.
 - d. Start capacitor and relay (single-phase units without scroll compressors).
 - e. Safeties:
 - 1) Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
 - 2) Safety lockout if an outdoor unit safety is open.
 - 3) High condensing temperature protection.
 - 4) System diagnostics.
 - 5) Compressor motor current and temperature overload protection.
 - 6) High pressure relief.
 - 7) Outdoor fan failure protection.
3. Performance Characteristics: None.

I. Accessories: Provide as scheduled in Equipment Schedule.

2.11 HARSH ENVIRONMENT CORROSION PROTECTION SYSTEM

A. Manufacturers and Products:

1. Aero-Marine Engineering Inc.; Technicoat 10-1.
2. Or equal.

B. Physical Characteristics:

1. General:
 - a. Corrosion protection system below shall be provided for equipment where scheduled.
 - b. Exterior and interior surfaces of unit cabinet/casing shall be coated with anticorrosion protection coating as described below.
 - c. Protective coating to be applied to unit after factory assembly of equipment.

2. Coating Material:
 - a. Use one of the following materials:
 - 1) Epoxy modified phenolic. Straight phenolic materials are not acceptable.
 - 2) Epoxy or epoxy urethane.
 - 3) Complex chain linked polyelastomer material.
3. Cabinet Coating Process:
 - a. Unit Disassembly:
 - 1) Disassemble unit.
 - 2) Remove condenser fan motor.
 - 3) Mask or pull back exterior wires.
 - b. Cabinet Cleaning:
 - 1) Clean surfaces by residue-free solvent wipe down or steam cleaner/pressure washer with soap to remove lubricants, machining oils, and residual factory contamination. Do not soak or damage unit insulation.
 - 2) Rinse with clean potable water to remove cleaning solution.
 - c. Coating Application:
 - 1) Etch bare interior and exterior surfaces including: Compressor/condenser section, base rails, and underside of unit. Rinse etched surfaces to remove etching solution and residue.
 - 2) Previously painted surfaces to be scuff sanded with 220-grit to 320-grit abrasive to remove gloss on original coating. Sanded surfaces to be cleaned with residue-free solvent wipe down.
 - 3) Clean surfaces and allowed to dry.
 - 4) Base Coat: When cabinet is dry, apply primer to interior and exterior surfaces. Allow to dry minimum of 12 hours.
 - 5) Top Coat: When primer is dry, apply final protective coating to interior and exterior surfaces. Apply two coats for optimum protection.
 - 6) Allow coating to dry completely before reassembling unit.
 - d. Quality Control: Free from voids, checks, cracks, and blisters.
4. Refrigerant Coils: Condenser and evaporator coil(s) shall be coated with a corrosion protection coating in accordance with Article Factory Dip-Applied Protective Coating.
5. Fasteners: Replace factory fasteners with stainless steel components.
6. Electronic Multistage AC Unit Controller:
 - a. Heating and Cooling Stages:
 - 1) Four-stage cooling and four-stage heating electronic control.
 - 2) Staging delay between each cycle.
 - 3) Visual indication of activation of each stage.
 - b. Integrated thermostat.
 - c. Temperature Scale: Manually adjustable, 55 degrees F to 90 degrees F scale.

- d. Duty Cycle:
 - 1) Automatic duty cycling of equipment.
 - 2) Manual adjustment for 1-day to 24-day cycle time.
 - 3) Manual cycle advance.
 - 4) Visual indication of lead unit.
- e. Enclosure:
 - 1) Single wall-mounted enclosure with operator interface on outside of panel door.
 - 2) NEMA Type 1 enclosure.
- f. Operator interface to consist of temperature adjustment, LCD room temperature display, and visual indication of lead unit and each cooling and heating stage activation.
- g. Adjustments external to controller.
- h. Adjustable “dead band” between heating and cooling to be between 4 degrees F and 20 degrees F.
- i. Power loss memory for restoration of sequence of operation in event of power loss.

C. Functional Characteristics: None.

D. Performance Characteristics:

- 1. Cabinet finish shall meet or exceed the following criteria:
 - a. Salt Spray Test: In accordance with ASTM B117, minimum 3,000-hour duration, with no corrosion or degradation.
 - b. Exposure to UV Light: UV inhibited life of minimum 10 years when exposed to sun.

2.12 FACTORY DIP-APPLIED PROTECTIVE COATING

A. Manufacturers and Products:

- 1. Aero-Marine Engineering Inc.; Technicoat 10-1.
- 2. Or equal.

B. Physical Characteristics:

- 1. General:
 - a. Factory dip-applied protective coating for application to plate fin and tube coils.
 - b. Coil factory assembled and tested before coating application.
 - c. Coating suitable for coils with maximum 30 fins per inch fin density. Bridging of product across coil fins is unacceptable.
 - d. After application and proper curing, product shall endure bending of coil assembly in standard manufacturing process without cracking.

- e. Apply coating to coil before final factory assembly of equipment. Coating process that requires disassembly of equipment for removal of coil to be coated is not acceptable. If protective coating is applied to coil after factory assembly of equipment, cost for shipping unit to coating factory, disassembly, coating process, reassembly, and delivery to Site shall be borne by Contractor.
- 2. Coating Material:
 - a. Use one of the following materials:
 - 1) Epoxy Modified Phenolic. Straight phenolic materials are not acceptable.
 - 2) Epoxy or epoxy urethane.
 - 3) Polyelastomer: Complex chain linked polyelastomer material.
- 3. Coating Process:
 - a. Coil Inspection and Sealing:
 - 1) Inspect coil for open tubes, headers, capillary tubes; repair as necessary.
 - 2) Fill with dry nitrogen, cap and seal, to prevent contamination of internal coil surfaces with cleaning or coating solutions.
 - b. Coil Cleaning:
 - 1) Immerse coil in heated alkaline cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - 2) Followed with immersion in potable water bath to neutralize and remove cleaning solution.
 - c. Coating Application:
 - 1) Immerse coil assembly in coating bath, including headers, casing, and heat exchange surfaces.
 - 2) Completed remove coil from equipment during coating application.
 - 3) Spray-on coatings are not acceptable.
 - d. Curing: Oven baked at metal temperature not to exceed 400 degrees F.
 - e. Quality Control: Free from voids, checks, cracks and blisters.
- C. Functional Characteristics: None.
- D. Performance Characteristics:
 - 1. Coil finish shall meet or exceed the following criteria:
 - a. Salt Spray Test: In accordance with ASTM B117, minimum 3,000-hour duration, with no fin corrosion or degradation.

- b. Thermal Efficiency: Loss no greater than 1 percent after coating application.
- c. Exposure to UV Light: UV inhibited life of minimum 10 years when exposed to sun.

2.13 ELECTRICAL

A. General:

- 1. Physical Characteristics:
 - a. Units shall include high and low voltage terminal block connections.
 - b. Motor Starters/Contactors: Factory installed with unitary equipment, unless otherwise noted.
 - c. Disconnects: Factory installed nonfused disconnects or circuit breakers on each unit, unless otherwise noted.
- 2. Functional Characteristics: Control voltage to indoor unit fan shall be 24 volts.
- 3. Performance Characteristics: None.

B. Motors:

- 1. Physical Characteristics: None.
- 2. Functional Characteristics:
 - a. Refer to Section 26 20 00, Low-Voltage AC Induction Motors, for general requirements.
 - b. Unless otherwise stated, electric motors shall comply with the following:
 - 1) Voltage, Phase, Horsepower, Synchronous Speed: Refer to Equipment Schedule for motor driven equipment.
 - 2) Enclosure: ODP, unless specified otherwise.
 - 3) Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 4) Winding Thermal Protection: Manufacturer's standard.
 - 5) Space Heater: Manufacturer's standard.
 - 6) Multispeed Motors, Synchronous Speed, Number of Windings: Manufacturer's standard.
 - 7) Efficiency: Minimum efficiency per Section 26 20 00, Low-Voltage AC Induction Motors.
- 3. Performance Characteristics: None.

2.14 ACCESSORIES

A. Physical Characteristics:

- 1. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

2. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch-high engraved block type black enamel filled equipment identification number as specified.
3. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications. Quantity as recommended by manufacturer.

B. Functional Characteristics: None.

C. Performance Characteristics: None.

2.15 SOURCE QUALITY CONTROL

A. Factory Tests:

1. Direct expansion coils leak tested underwater with 200-psig air. Pressure tested to 450 psig.
2. Electric heating coils tested with 2,000-volt dielectric test.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install equipment in accordance with manufacturer's recommendations, and these Specifications.
2. Set and install equipment so equipment is level and adequately supported.
3. Ensure piping connections to equipment do not cause strain on equipment.
4. Ensure vibration isolation has been installed per manufacturer's instructions and isolation devices are performing as required.
5. Install safety devices as recommended by manufacturer and required by code.

B. Seal outside air intake watertight to roof curb.

C. Isolate sheet metal duct connections from portions of unit not internally spring-isolated from fans, or other vibrating or rotating equipment.

D. Inspect internal casing insulation, seal exposed edges, and butt joints with mastic to ensure insulation will not be loosened during operation.

E. Filters:

1. Install set of filters in each unit before operating and leave in place during startup and testing to keep equipment and ductwork clean.
2. Do not operate units until filters are installed. If operated without filters, completely clean ductwork, coils, and interior of units.

F. Lubricate unsealed bearings prior to startup.

3.02 FIELD QUALITY CONTROL

A. Initial equipment testing and startup shall be made by authorized representative of unit manufacturer.

B. Air-cooled outdoor unit shall not be started without complete prestart checkout of entire refrigerant piping system and charging of system with refrigerant as recommended by equipment manufacturer.

C. Field Testing:

1. Manufacturer shall provide factory-trained representative employed by equipment manufacturer to perform the following services. Supervision only, of Contractor personnel, will not be acceptable:
 - a. Leak test.
 - b. Refrigerant pressure test.
 - c. Evacuate (if required).
 - d. Dehydrate (if required).
 - e. Charge condensing unit with refrigerant and oil (if required).

D. Application of protective coating shall be done by companies certified by the product manufacturer:

1. Aero-Marine Engineering Inc.
2. Or equal.

3.03 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for the following:

1. Inspect installation including external interlock, power connections; supervise initial operation, calibration of operating and safety controls and supervise electrical testing including insulation resistance of motors and voltage balance between phases during starting and running.

2. Test Report:
 - a. Submit test reports unit is in safe and proper operating condition.
 - b. Contain pressure and control settings, meg readings, voltage readings per phase during START and RUN, suction temperature and pressure, liquid temperature and pressure.
 - c. List minor discrepancies to be corrected which do not affect safe and reliable operation.
 - d. One copy of report shall be left in unit control panel.
3. One copy of bound installation operation and maintenance service, and parts brochures, including applicable serial numbers, full unit description, parts ordering sources, shall be placed in unit control panel at time of starting.
4. Training of Contracting Officer's personnel for specified equipment.

3.04 ADJUSTING AND CLEANING

- A. Air System Balancing: As specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- B. Install set of filters at time of final cleaning as defined in Section 01 77 00, Closeout Procedures.

3.05 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 1. Split System DX Indoor Units Data Sheet.
 2. Split System DX Outdoor Units Data Sheet.
 3. VRF Indoor Unit Schedule Data Sheet.
 4. VRF Outdoor Unit Schedule Data Sheet.
 5. VRF Heat Recovery Branch Circuit Controller.
 6. Packaged DX Air Conditioning Units Data Sheet.

END OF SECTION

