SECTION 23 81 26

SPLIT-SYSTEM DUCTLESS AIR-CONDITIONERS

BASED ON DSF MASTER SPECIFICATION DATED 7/13/2017

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

# P A R T 1 - G E N E R A L

## SCOPE

This section includes specifications for split-system ductless heat pump and cooling only type systems. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference

Reference Standards

Quality Assurance

Submittals

Operation and Maintenance Data

Delivery, Storage and Handling

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PART 2 – PRODUCTS

[Units up to 3 Tons](#_UNITS_UP_TO)

[Cooling Coil Condensate Piping](#_COOLING_COIL_CONDENSATE)

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PART 3 - EXECUTION

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## RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 23 05 00 - Common Work Results for HVAC

Section 23 08 00 – Commissioning of HVAC

Section 23 23 00 – Refrigerant PipingSection 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

## REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

## REFERENCE STANDARDS

ARI 210/240 Unitary Air Conditioning and Heat Pump Equipment

ARI 365 Commercial and Industrial Unitary Air Conditioning Condensing Units

ASHRAE 15 Safety Standard for Refrigeration Systems

ASHRAE 90.1 (2004 edition) Energy Standard for Buildings Except Low Rise Residential Buildings

NEC National Electrical Code

ASTM B117 Standard Practice for Operating Salt Spray (fog) Apparatus

UL Underwriters Laboratory

## QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

Unit Energy Efficiency Ratio (EER), Seasonal Energy Efficiency Ratio (SEER), Integrated Energy Efficiency Ratio (IEER), and Heating Seasonal Performance Factor (HSPF) shall meet the minimum applicable requirements of ASHRAE 90.1 current edition.

Units that are labeled ENERGY STAR® will be acceptable.

Select units with performance that meets or exceeds the ASHRAE 90.1 (Current edition), FEMP energy efficiency requirements, and minimum rating listed in this specification section.

Unit rated performance in accordance with the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.

Construct units in accordance with ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.

Factory run and test units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.

## SUBMITTALS

Refer to division 1, General Conditions, Submittals

Submit air cooled condensing unit and evaporative unit shop drawings including the following information: specific manufacturer and model numbers, dimensional and weight data, required clearances, materials of construction, capacities and ratings, efficiencies, stages of unloading capacity achievable without hot gas bypass, refrigerant type and charge, component information, size and location of piping connections, electrical connections, wiring diagrams and information for all specialties and accessories.

Submit manufacturer's installation and start-up instructions, maintenance data, troubleshooting guide, parts lists, controls and accessories.

At substantial completion, submit warranty certificate and copy of start-up report.

## OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

Delete the following if there are no additional requirements.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. [A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]

## DELIVERY, STORAGE AND HANDLING

Comply with manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.

Ship units to jobsite fully assembled.

## WARRANTY

Provide a one year parts and labor warranty on the entire unit beginning upon substantial completion of project.

Provide a five year parts warranty on the compressor(s) beginning upon substantial completion of project.

# P A R T 2 – P R O D U C T S

## UNITS UP TO 3 TONS (10.5 kW)

Manufacturers: Carrier, Daikin, Friedrich, Mitsubishi, Toshiba, York, or approved equal.

Review unit application and the need for low ambient operation. Most units provide cooling down to 32 degrees F without the low ambient option. Currently Daikin SkyAir model is listed for operation down to -40 degrees F, Carrier 40MKCB and Mitsubishi series P are listed down to -20 degrees F while others operate down to 5 degrees F). Where the optional low ambient kit is required to meet the low ambient temperature, make sure that multiple manufacturers can meet this requirement in the size selected.

If control of auxiliary heat is required, only Daikin, Carrier, and Mitsubishi currently offer this option and the unit may not be one of the ones providing low ambient.

### GENERAL

Provide a heating and cooling Heat Pump unit or Cooling Only unit with an indoor ceiling or wall mounted fan coil with matched outdoor condensing unit as scheduled.

Indoor fan coil units shall be complete with coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, R-410A or R32 refrigerant and integral Temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.

Outdoor condensing unit shall be factory assembled suitable for ground, rooftop, or wall hung mounting. Units shall consist of a compressor, an air cooled coil, propeller type outdoor fan, metering device(s), and control box. Units shall discharge air horizontally or vertically as shown on the drawings.

### INDOOR FAN COIL UNIT (Ceiling Mounted Cassette)

Unit cabinet shall be constructed of zinc coated steel. Provide fully insulated cabinet with discharge and inlet grilles. Grilles shall have hinges and can be opened to obtain access to the filters, indoor fan motor and control box.

Fans shall be centrifugal direct drive blower type with center intake and perimeter discharge on the unit. Automatic, motor driven air vanes shall be provided.

Coils shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wettability. A drip pan under the coil shall have drain connections for hose attachment to remove condensate. Condensate pan shall be corrosion resistant.

Motors shall have permanently lubricated ball bearing with inherent overload protection. Fan motors shall a minimum of 3 speeds.

Unit shall have a filter track with factory supplied cleanable filters.

If unit requires outside air for ventilation add a fresh air intake and connect to unit. The maximum amount of fresh air cannot exceed 10% of the total supply air.

Provide fresh air intake duct connection.

Minimum performance shall be 16.0 SEER and 10.0 HSPF for units.

### INDOOR FAN COIL UNIT (Wall/Ceiling Mounted)

Cabinet shall be constructed of a durable material with a galvanized steel sub-chassis. Unit shall be fully insulated for improved thermal and acoustic performance.

Unit cabinet discharge and inlet grilles shall be constructed of high-impact plastic.

Fans shall be direct drive blower type with air intake and discharge on the unit. Automatic, motor driven air sweep shall be provided.

Horizontal and/or vertical discharge louvers shall be adjustable.

Coils shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wettability. A drip pan under the coil shall have drain connections for hose attachment, on either the left or right hand side, to remove condensate. Condensate pan shall be corrosion resistant.

Motors shall have permanently lubricated ball bearing with inherent overload protection. Fan motors shall a minimum of 3 speeds.

Unit shall have filter track with factory supplied mildew proof cleanable filters.

If unit requires outside air for ventilation add a fresh air intake and connect to unit. The maximum amount of fresh air cannot exceed 10% of the total supply air.

Provide fresh air intake duct connection.

Minimum performance shall be 16.0 SEER and 10.0 HSPF for units.

### AIR-COOLED CONDENSING UNIT

Unit cabinet shall be constructed of galvanized steel, bonderized, and coated with a baked enamel finish on the inside and outside. Unit cabinet shall be capable of withstanding 500 hour salt spray test per Federal Test Standard No. 141 (method 6061). Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fans, and control components. Outdoor compartment shall be isolated and have an acoustic lining.

Outdoor fans shall be direct drive propeller type and shall discharge air horizontally or vertically. Outdoor fan motors shall be totally enclosed, single phase motors with class B insulation and permanently lubricated bearings. Motor shall be protected by internal thermal overload protection and shafts shall have inherent corrosion resistance.

Fan blades shall be statically and dynamically balanced.

Outdoor fan openings shall be equipped with protective grille over fan.

Compressor shall be fully hermetic scroll or a rotary swing type variable speed compressor. Compressor shall be equipped with operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and over current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators. Compressors shall be provided with crankcase heater.

Outdoor coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed. Air cooled condenser coils shall be leak tested at 573 psig.

Refrigerant circuit components shall include service valves with service gage port connections on compressor suction and discharge lines, each with brass caps, accumulator, and a reversing valve (for heat pump units).

Provide the low ambient kit for units that will need to provide cooling year round.

Low Ambient Kit: Provide wind baffle and regulate fan motor cycles in response to saturated condensing temperature of the unit. The control shall be capable of starting and operation down to [0][-13][-20] degrees F ([-17][-25][-28] degrees C) ambient air temperature. Installation of kit shall not require changing the outdoor fan motor.

If unit installation requires stacking of units or mounting units off of walls use the factory provided installation kits.

[Provide optional stacking kit for installation. (Not for Heat Pumps)]

[Provide optional wall mounting kit for installation.]

Condensing unit controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

* A time delay control sequence.
* Outdoor fan failure detection.
* Compressor motor current and temperature overload protection.
* Compressor low and high pressure protection.

### CONTROLS

Controls shall consist of a microprocessor based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62 degrees F to 84 degrees F (16.7 degrees C to 28.9 degrees C). User interface with the unit shall be accomplished through a wired remote control (can be configured for degrees F or degrees C).

The unit shall have the following functions as a minimum:

* An automatic restart after power failure at the same operating conditions as at failure.
* A timer function to provide a minimum 24 hour timer cycle for system Auto Start/Stop.
* Temperature sensing controls shall sense return air temperature.
* Automatic air sweep control to provide on or off activation of air sweep louvers.
* Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
* Fan only operation to provide room air circulation when no cooling or heating is required.
* Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
* Evaporator fan speed control shall be user selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
* Automatic heating to cooling changeover. Control shall include dead band to prevent rapid mode cycling between heating and cooling.
* A liquid level sensor in the condensate reservoir shall stop cooling operation if the liquid level in the reservoir is too high.

Engineers note: If unit is to be integrated into an existing system the unit must also have the capability to control an exterior source of heat. Unit may also need to be disabled to prevent cooling when the space is in heating mode. Discuss this with DFD.

[Provide Wired Thermostat for wall mounting.]

Engineers note: A wired thermostat may not be available in all unit sizes. Verify that it is available in the size of unit you are specifying

[Provide Auxiliary Heat control capability.]

[Provide Remote Shut-off control capability.]

### ELECTRICAL

Unit’s electrical requirements shall be 208/230 volt, single phase, and 60 hertz.

Engineers note: Power wiring is typically connected to the outdoor unit. Power and control wiring is required between indoor and outdoor units. Coordinate with electrical so both connections are covered.

Division 26 contractor shall provide conduit for both the power and control wiring between indoor unit and outdoor unit.

All power and control wiring must be installed per NEC and all local electrical codes.

## COOLING COIL CONDENSATE PIPING

Provide ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

Galvanized steel pipe with cast iron drainage fittings may also be specified. Note that drainage pattern fittings are not the same as pressure fittings.

## INTEGRAL CONDENSATE PUMP

The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly and a remote sound shielded pump assembly.

## REFRIGERANT PIPING

Provide precharged refrigerant lines that can be oriented to connect to the side or back of unit. Both refrigerant lines shall be insulated.

It is not the intent of this specification to require a hard piped system on small air cooled condensing units that are typically provided by the manufacturer with precharged tubing. If precharged tubing is available in the proper length, it may be used. In that case, use the manufacturer's standard liquid line refrigerant specialties also. If, however, the application requires a special refrigerant piping system, use the following pipe specification.

Provide ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.

Precharged tubing line sets may be used on systems 3 tons and less in size.

# P A R T 3 - E X E C U T I O N

## INSTALLATION

Install units, piping and accessories in accordance with the manufacturer’s written instructions and recommendations. Mount condensing unit(s) on a [precast concrete pad on grade] [poured concrete pad on grade] [roof mounted curb per DFD detail] [wall mounting kit] as indicated on the drawings.

For roof mounted units use a curb instead of rails. Run both the refrigeration piping and the electrical through the curb per DFD detail. This eliminates the problem of repairing and re-roofing between rails under small units.

Maintain adequate service access and airflow clearances for all components as recommended by the manufacturer and as indicated on the drawings.

Charge unit(s) with full oil charge and refrigerant charge based on the entire refrigeration system pipe size and length.

Provide all control wiring in conduit in compliance with Section 23 09 14 or Section 23 09 15 and Division 26 00 00 - Electrical.

If the temperature controls are to be provided by the temperature control contractor then modify the above sentence accordingly.

Coordinate installation of a service outlet with electrical engineer.

Coordinate power wiring requirements with Division 26 00 00 contractor.

## REFRIGERANT PIPING SIZING

The unit manufacturer shall verify the final refrigeration pipe sizing process to insure conformance to specific unit requirements such as maximum lengths, refrigerant velocities, unloading considerations and proper oil return. This contractor shall provide refrigeration piping drawings from the field which details the way the piping will actually be installed.

**REFRIGERANT PIPING**

Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the International Mechanical Code, Chapter 11 and the Wisconsin Administrative Code Chapter SPS 345.

All brazing filler metals shall have a melting temperature above 1400 degrees F and contain a minimum of 6% silver.

Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.

No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.

Leak test the system by charging the system to a pressure of 10 psig with refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

**REFRIGERANT PIPING ACCESSORIES**

Install accessories in accordance with the manufacturer’s written instructions and recommendations.

## STARTUP

Adjust units for maximum operating efficiency, adjust all controls to required final settings and demonstrate that all components are functioning properly. Submit four copies of a written startup report following the initial startup. Include in the report: work done to the system, all readings taken, a statement certifying that the refrigeration system(s) are leak free and a statement certifying that the unit(s) have been placed in proper running condition as recommended by the manufacturer and as intended in the drawings and specifications.

## CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

## FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01 91 02.

## AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 2 hours.

END OF SECTION