**SECTION 23 62 13**

**PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSING UNITS**

**BASED ON DFD MASTER SPECIFICATION DATED 10/1/2012**

***This section has been written to cover most (but not all) situations that you will encounter. This is not intended to be used for refrigeration applications. 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 air cooled condensing units for use with split system type air conditioning. 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

Warranty

PART 2 – PRODUCTS

 Units up to 5 Tons

 Units 6 to 15 Tons

 Units 15 Tons and Larger

 Refrigerant Piping Specialties

PART 3 - EXECUTION

Installation

Startup

Construction Verification Items

Functional Performance Testing

Agency Training

**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 11 00 - Facility Fuel PipingSection 23 21 13 - Hydronic PipingSection 23 22 13 - Steam and Condensate Heating PipingSection 23 24 00 - Internal-Combustion Engine PipingSection 23 83 16 - Radiant-Heating Hydronic Piping

## Section 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), Coefficient of Performance (COP) and Integrated Part Load Value (IPLV) shall meet the minimum applicable requirements of ASHRAE 90.1(2004 edition). Units that are labeled Energy StaR® will be acceptable.

***Select units with performance that meets or exceeds the ASHRAE 90.1(2004 edition) energy efficiency requirements.***

Rate unit 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 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 shop drawings including the following information: specific manufacturer and model numbers, dimensional and weight data, required clearances, materials of construction, capacities and ratings, stages of unloading capacity achievable without hot gas bypass (and with hot gas bypass if applicable), 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.

**PART 2 – PRODUCTS**

##### UNITS UP TO 5 TONS

Manufacturers:Carrier, Trane, York, McQuay or approved equal.

***The following paragraphs give guidance to the designer for the performance requirement guidelines the State of Wisconsin must follow. The designer is encouraged to review the reference standards and comply with the latest version. The standards are the Federal Energy Management Program (FEMP) recommended efficiencies and ASHRAE Standard 90.1-2004. A/E should refer to ASHRAE Standard 90.1-2004 Paragraph 6.4.1 defining minimum efficiencies and performance criteria. Chillers must meet both the full load and part load requirements.***

***Select units with performance that meets or exceeds the ASHRAE 90.1(2004 edition) energy efficiency requirements.*** ***Units that are labeled Energy StaR® will be acceptable. Minimum performance shall be 13 SEER.***

Provide factory assembled, outdoor mounted, air-cooled condensing unit suitable for on grade or rooftop installation. Include compressor, air cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls, motor starting components and additional features as specified herein or required for safe, automatic operation. Capacity and steps of unloading as indicated in the equipment schedule. [The contractor may provide multiple separate units in lieu of a single unit in order to provide the required number of steps of unloading. This contractor is responsible for all additional costs, including electrical and controls costs, associated with multiple units.] Refrigerant is to be [R-22][R-410A][Other as selected by A/E]. [The sound pressure radiated from the unit must not exceed the maximum radiated sound pressure indicated on the drawings.]

***If noise is a critical issue, then schedule the maximum radiated sound pressure and include the above sentence.*** ***Schedule should be by octave band if available.***

***Refrigerant selection is to be based on A/E selection of equipment to perform as scheduled. The refrigerant used by be acknowledge by the EPA SNAP program and unit construction and safeties must comply with ASHRAE 15, IMC and COMM 45 as minimums.***

### CABINET

Construct cabinet of heavy gauge, galvanized steel coated with weather resistant paint. Provide removable access panels to facilitate full access to the compressor, fan and control components.

COMPRESSOR

Provide hermetic reciprocating or scroll type compressor with built in motor winding temperature and current protection, liquid and suction service valves, gage ports, sight glass and liquid line filter dryer. Provide crankcase heater with reciprocating type compressors. Mount compressors on vibration isolators.

 CONDENSER

Provide condenser coils with aluminum alloy plate fins mechanically fastened to seamless copper tubing with integral subcooler. Construct coils with design working pressure suitable for the refrigerant. [Louvered condenser guard shall be provided.]

***A/E should specify the louvered guard if needed to protect the coil and fins from hazards and /or weather damage.***

Provide direct-drive statically and dynamically balanced propeller type fans with vertical or horizontal discharge as indicated on the drawings and guards constructed of heavy gage PVC coated wire or galvanized steel.

 POWER WIRING

Provide factory installed 24-volt control circuit with fusing; control power transformer and all associated internal wiring. Provide a single point power connection to the unit(s). Provide factory installed magnetic contactors for compressor and condenser motors.

Electrical characteristics shall be as indicated in the equipment schedule.

CONTROLS

 ***Coordinate the thermostat or control requirements with the air unit or furnace.***

Provide high/low refrigerant pressure cutouts with manual reset and anti-short cycle compressor timer.

[Unit must be capable of operating down to ambient temperature of 40 deg F. Provide low ambient lockout to prevent compressor from operating below 40 degrees.]

[Provide “low ambient” controls and accessories needed so that unit is capable of operating down to ambient temperature of \_\_ F.]

 ***Select a unit that has a low ambient option if it is needed.***

**UNITS 6 TO 15 TONS**

Manufacturers:Carrier, Trane, York, McQuay or approved equal.

***The following paragraphs give guidance to the designer for the performance requirement guidelines the State of Wisconsin must follow. The designer is encouraged to review the reference standards and comply with the latest version. The standards are the Federal Energy Management Program (FEMP) recommended efficiencies and ASHRAE Standard 90.1-2004.*** ***A/E should refer to ASHRAE Standard 90.1-2004 Paragraph 6.4.1 defining minimum efficiencies and performance criteria. Chillers must meet both the full load and part load requirements.***

***Select units with performance that meets or exceeds the ASHRAE 90.1(2004 edition) energy efficiency requirements.*** ***Units that are labeled Energy StaR® will be acceptable. Minimum performance shall be 13 SEER for any unit under 65 MBtu/h.***

***For units between 65-135 MBtu/h(between 5 and 11 tons), the performance shall be a minimum of 11.0 EER and an 11.4 IPLV at standard ARI conditions.***

***For units between 135-240 MBtu/h(between 11 and 20 tons), the performance shall be a minimum of 10.8 EER and an 11.2 IPLV at standard ARI conditions.***

Provide factory assembled, outdoor mounted, air-cooled condensing unit suitable for on grade or rooftop installation. Include compressor(s), air cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls, motor starting components and additional features as specified herein or required for safe, automatic operation. Capacities, number of refrigeration circuits, steps of unloading and minimum capacity without hot gas bypass shall be as indicated in the equipment schedule. [The contractor may provide multiple separate units in lieu of a single unit in order to provide the required number of steps of unloading. This contractor is responsible for all additional costs, including electrical and controls costs, associated with multiple units.] Refrigerant is to be [R-22][R-134A][R-410A] [Other as selected by A/E]. [Provide hot gas bypass feature with associated accessories for low load operation.]. [The sound pressure radiated from the unit must not exceed the maximum radiated sound pressure indicated on the drawings.]

***If noise is a critical issue, then schedule the maximum radiated sound pressure and include the above sentence. Schedule should be by octave band if available. Include the performance information on the equipment schedule. The number of circuits and unloading steps varies with manufacturer and model. Modify spec and equipment schedule to include hot gas bypass if it is desired.***

***Refrigerant selection is to be based on A/E selection of equipment to perform as scheduled. The refrigerant used by be acknowledge by the EPA SNAP program and unit construction and safeties must comply with ASHRAE 15, IMC and COMM 45 as minimums.***

### CABINET

Construct cabinet of heavy gauge, galvanized steel coated with paint. Cabinet must meet the 500-hour salt spray exposure test in accordance with ASTM B117. Provide lifting holes to facilitate rigging and access panels to facilitate access to all-internal areas of unit that require service or repair.

COMPRESSORS

Provide scroll hermetic type or reciprocating type compressors.

Scroll compressors: Direct drive suction cooled motor with built in motor temperature and current protection. Provide oil pump with dirt separator, sight glass, liquid line filter dryer, crankcase heater, liquid line and gas line service valves with gage ports.

Reciprocating Compressors: Hermetic or semi hermetic compressors with built in temperature and current protection, liquid line, suction line and discharge line service valves with gage ports, liquid line filter drier, sight glass and crankcase heater. Provide oil level site glass on semi hermetic units. Mount compressors on vibration isolators.

 CONDENSER

Provide condenser coils with aluminum alloy plate fins mechanically fastened to seamless copper tubing with integral subcooler. Construct coils with design working pressure suitable for the refrigerant.

***The typical test pressure are 450 psig for R-22 or 660 psig for R-410A. The A/E can add this information if needed.***

Provide direct-drive statically and dynamically balanced propeller type fans with vertical discharge and guards constructed of heavy gage PVC coated wire or galvanized steel.

 POWER WIRING

Provide factory installed 24-volt control circuit with fusing, control power transformer and all associated internal wiring. Provide a single point power connection to the unit(s). Provide factory installed magnetic contactors for compressor and condenser motors. Electrical characteristics shall be as indicated in the equipment schedule.

CONTROLS

[Provide a terminal strip for external control of compressor stages for field provided controls.]

***This would be appropriate for projects where the controls will be provided by a temperature controls contractor. If you want to have a controller or thermostat furnished with the unit, then delete the above sentence and add specifications for a controller or thermostat here or in the air unit spec.***

Provide high/low refrigerant pressure cutouts with manual reset and anti-shortcycle compressor timer.

[Unit must be capable of operating down to ambient temperature of 40 deg F. Provide low ambient lockout to prevent compressor from operating below 40 degrees.]

[Provide “low ambient” controls and accessories needed so that unit is capable of operating down to ambient temperature of \_\_ F.]

 ***Select a unit that has a low ambient option if it is needed.***

[Convenience Outlet

Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle. Outlet shall include 15 amp GFI (ground fault interrupter) receptacle with independent fuse protection. Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer. Outlet shall be accessible from outside the unit.]

***A/E should consult with the facility and determine if a convenience outlet is required. In some applications this will be beneficial for the maintenance and servicing of the unit.***

# UNITS 15 TONS AND LARGER

Manufacturers:Carrier, Trane, York, McQuay or approved equal.

***The following paragraphs give guidance to the designer for the performance requirement guidelines the State of Wisconsin must follow. The designer is encouraged to review the reference standards and comply with the latest version. The standards are the Federal Energy Management Program (FEMP) recommended efficiencies and ASHRAE Standard 90.1-2004. A/E should refer to ASHRAE Standard 90.1-2004 Paragraph 6.4.1 defining minimum efficiencies and performance criteria. Chillers must meet both the full load and part load requirements.***

***For units between 135-240 MBtu/h(between 11 and 20 tons), the performance shall be a minimum of 10.8 EER and an 11.2 IPLV at standard ARI conditions.***

***For units greater than 240 MBtu/h(20 tons), the performance shall be a minimum of 10.1 EER and an 11.2 IPLV at standard ARI conditions.***

Provide factory assembled, outdoor mounted, air-cooled condensing unit suitable for on grade or rooftop installation. Include compressors, air cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls, motor starting components and additional features as specified herein or required for safe, automatic operation. Capacities, number of refrigeration circuits, steps of unloading and minimum capacity without hot gas bypass shall be as indicated in the equipment schedule. [The contractor may provide multiple separate units in lieu of a single unit in order to provide the required number of steps of unloading. This contractor is responsible for all additional costs, including electrical and controls costs, associated with multiple units.] Refrigerant is to be [R-22][R-134A][R-410A] [Other as selected by A/E]. [Provide hot gas bypass feature with associated accessories for low load operation]. [The sound pressure radiated from the unit must not exceed the maximum radiated sound pressure indicated on the drawings.]

***If noise is a critical issue, then schedule the maximum radiated sound pressure and include the above sentence. Schedule should be by octave band if available. Include the performance on the equipment schedule. The number of circuits and unloading steps varies with manufacturer and model. Modify spec and equipment schedule to include hot gas bypass if it is desired.***

***Refrigerant selection is to be based on A/E selection of equipment to perform as scheduled. The refrigerant used by be acknowledge by the EPA SNAP program and unit construction and safeties must comply with ASHRAE 15, IMC and COMM 45 as minimums.***

### CABINET

### Construct cabinet of heavy gauge, galvanized steel coated with paint. Cabinet must meet the 500-hour salt spray exposure test in accordance with ASTM B117. Provide lifting holes to facilitate rigging and access panels to facilitate access to all-internal areas of unit that require service or repair.

COMPRESSORS

Provide scroll hermetic type or reciprocating semi-hermetic type compressors.

Scroll compressors: Direct drive suction cooled motor. Provide oil level sight glass, suction service valve, liquid line shut off valve with charging port for each compressor circuit.

Reciprocating Compressors: Provide serviceable compressors equipped with force-fed lubrication system, suction and discharge shutoff valves, high side pressure relief device, liquid line shutoff valves, liquid line sight glass, oil level site glass, suction line filter dryer, hot gas bypass stub tubes and crankcase heater. Mount compressors on vibration isolators. Compressors shall unload using electric solenoid unloading.

CONDENSER

Provide condenser coils with aluminum alloy plate fins mechanically fastened to seamless copper tubing with integral subcooler. Construct coils with design working pressure suitable for refrigerant selected.

***The typical test pressure are 450 psig for R-22 or 660 psig for R-410A. The A/E can add this information if needed.***

Provide direct-drive statically and dynamically balance propeller type fans with vertical discharge and guards constructed of heavy gage PVC coated or galvanized steel. Provide motors with built in current protection and permanently lubricated sealed ball bearings.

 POWER

Provide factory installed 24-volt control circuit with fusing, control power transformer and all associated internal wiring. Provide a single point power connection to the unit(s). Provide factory installed magnetic contactors for compressor and condenser motors, three-leg compressor overload protection and single phasing condition protection with manual reset. Electrical characteristics shall be as indicated in the equipment schedule.

CONTROLS

[Provide a terminal strip for external control of compressor stages for field provided controls.]

***This would be appropriate for projects where the controls will be provided by a temperature controls contractor. If you want to have a controller or thermostat furnished with the unit, then delete the above sentence and add specifications for a controller or thermostat here or in the air unit spec.***

Provide high/low refrigerant pressure cutouts with manual reset and anti-shortcycle compressor timer.

[Unit must be capable of operating down to ambient temperature of 40 deg F. Provide low ambient lockout to prevent compressor from operating below 40 degrees.]

[Provide “low ambient” controls and accessories needed so that unit is capable of operating down to ambient temperature of \_\_ F.]

 ***Select a unit that has a low ambient option if it is needed.***

[Convenience Outlet

Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle. Outlet shall include 15 amp GFI (ground fault interrupter) receptacle with independent fuse protection. Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer. Outlet shall be accessible from outside the unit.]

***A/E should consult with the facility and determine if a convenience outlet is required. In some applications this will be beneficial for the maintenance and servicing of the unit.***

###### REFRIGERANT PIPING SIZING

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

###### REFRIGERANT PIPING ACCESSORIES

Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 450 psig and a maximum working temperature of 225 deg F. For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 850 psig and a maximum working temperature of 225 deg F.

Flexible pipe connectors: Double braided bronze hose flexible pipe connectors with solder end connections.

Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.

Sight glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.

Solenoid Valves: Two way normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.

Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.

Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

Charging Valves: Provide ¼” SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.

Check valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

#### PART 3 - EXECUTION

 **INSTALLATION**

Install units, piping and accessories in accordance with the manufacturer’s written instructions and recommendations. Mount unit(s) on a [precast][poured] concrete pad on grade or on [roof mounted rails][roof curbs] as indicated on the drawings.

For small roof mounted units use a curb instead of rails. 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 0914 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 power wiring requirements with the electrical trade.

### 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 start up. 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 [XX] hours.

END OF SECTION