SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged, refrigerant compressor and condenser units.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressor and condenser units shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

1.4 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Credit EA 4: Documentation indicating that compressor and condenser units and refrigerants comply.

C. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For compressor and condenser units indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Design Calculations: Calculate requirements for selecting vibration isolators[**and seismic restraints**] and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which compressor and condenser units will be attached.
2. Liquid and vapor pipe sizes.
3. Refrigerant specialties.
4. Piping including connections, oil traps, and double risers.
5. Compressors.
6. Evaporators.

B. Seismic Qualification Certification: For compressor and condenser units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label water-cooled compressor and condenser units to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

C. Coordinate location of piping and electrical rough-ins.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Compressor failure.
    b. Condenser coil leak.

2. Warranty Period: [**Five**] [**10**] <**Insert number**> years from date of Substantial Completion.
3. Warranty Period (Compressor Only): [**Five**] [**Seven**] [**10**] <**Insert number**> years from date of Substantial Completion.
4. Warranty Period (Components Other Than Compressor): [**Five**] [**10**] <**Insert number**> years from date of Substantial Completion.
5. Warranty Period (Condenser Coil Only): [**Five**] <**Insert number**> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 1 TO 5 TONS (3.5 TO 17.6 kW)

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Factory assembled and tested; consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: [**Single**] [**Two**] speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
3. Accumulator: Suction tube.

D. Refrigerant: [**R-22**] [**R-407C**] [**R-410A**] <**Insert type**>.

E. Refrigerant: R-407C or R-410A.

F. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

G. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection[**and ball bearings**].

H. Accessories:

1. Coastal Filter: Mesh screen to protect condenser coil from salt damage.
2. Crankcase heater.
3. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
4. [**Electronic programmable thermostat**] [**Low-voltage thermostat and subbase**] to control compressor and condenser unit and evaporator fan.
5. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
6. Filter-dryer.
7. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
8. Liquid-line solenoid.
9. Low-Ambient Controller: Cycles condenser fan to permit operation down to [**30 deg F (minus 1 deg C)**] [**0 deg F (minus 18 deg C)**] [**with time-delay relay to bypass low-pressure switch**].
10. Low-Ambient Controller: Controls condenser fan speed to permit operation down to minus 20 deg F (minus 29 deg C)[**with time-delay relay to bypass low-pressure switch**].
11. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
12. PE mounting base.

13. Precharged and insulated suction and liquid tubing.
14. Sound Hood: Wraps around sound attenuation cover for compressor.
15. Thermostatic expansion valve.
16. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
17. Reversing valve.
18. <**Insert accessories**>.

I. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

J. Capacities and Characteristics:

1. Compressor and Condenser Unit:

   a. Full-Load Cooling Capacity: <**Insert MBh (kW)**>.
   b. Energy-Efficiency Ratio (EER): <**Insert value**>.
   c. Seasonal Energy-Efficiency Ratio (SEER): <**Insert value**>.
   d. Coefficient of Performance (COP): <**Insert value**>.
   e. Compressor Suction Temperature: <**Insert deg F (deg C)**>.
   f. Capacity Steps: <**Insert number**>.

2. Refrigerant Connections:

   a. Liquid Pipe Size: <**Insert NPS (DN)**>.
   b. Suction Pipe Size: <**Insert NPS (DN)**>.

3. Compressor:

   a. Rated-Load Amperes: <**Insert value**>.
   b. Locked-Rotor Amperes: <**Insert value**>.
   c. Power Input: <**Insert kilowatts**>.

4. Air-Cooled Condenser:

   a. Ambient-Air Temperature: <**Insert deg F (deg C)**>.
   b. Airflow: <**Insert cfm (L/s)**>.
   c. Number of Condenser Fans: <**Insert number**>.
   d. Condenser Fan Motor Size: <**Insert horsepower**>.

5. Electrical Characteristics:

   a. Kilowatt Input: <**Insert value**>.
   b. Volts: <**Insert value**>.
   c. Phase: <**Insert value**>.
   d. Hertz: <**Insert value**>.
   e. Maximum Circuit Amperes: <**Insert value**>.
   f. Maximum Instantaneous Current Flow during Startup: <**Insert value**>.
   g. Maximum Overcurrent Protection: <**Insert amperage**>.

2.2 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS (21 TO 422 kW)

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

1. Capacity Control: [**On-off compressor cycling**] [**Hot-gas bypass**].

D. Compressor: Hermetic or semihermetic rotary screw compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

1. Capacity Control: [**On-off compressor cycling**] [**Modulating slide-valve assembly or port unloaders**] [**Variable-frequency controller**] [**Hot-gas bypass**].

E. Refrigerant: [**R-22**] [**R-407C**] [**R-410A**] [**R-134a**] <**Insert type**>.

F. Refrigerant: R-407C, R-410A, or R-134a.

G. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

H. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:

1. Permanently lubricated, ball-bearing[**totally enclosed**] motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

I. Operating and safety controls include the following:

1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.
3. Low-oil-pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Three-leg, compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.

J. Accessories:

1. [**Electronic programmable thermostat**] [**Low-voltage thermostat and subbase**] to control compressor and condenser unit and evaporator fan.

2. Low-Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F (minus 18 deg C)[**with time-delay relay to bypass low-pressure switch**].
3. Low-Ambient Controller: Controls condenser fan speed to permit operation down to minus 20 deg F (minus 29 deg C)[**with time-delay relay to bypass low-pressure switch**].
4. Gage Panel: Package with refrigerant circuit suction and discharge gages.
5. Hot-gas bypass kit.
6. Part-winding-start timing relay, circuit breakers, and contactors.
7. Reversing valve.
8. <**Insert accessories**>.

K. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.
4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
5. Condenser coil [**hail guard**] [**grille**].

L. Capacities and Characteristics:

1. Compressor and Condenser Unit:

   a. Full-Load Cooling Capacity: <**Insert MBh (kW)**>.
   b. Energy-Efficiency Ratio (EER): <**Insert value**>.
   c. Seasonal Energy-Efficiency Ratio (SEER): <**Insert value**>.
   d. Coefficient of Performance (COP): <**Insert value**>.
   e. Compressor Suction Temperature: <**Insert deg F (deg C)**>.
   f. Capacity Steps: <**Insert number**>.

2. Refrigerant Connections:

   a. Liquid Pipe Size: <**Insert NPS (DN)**>.
   b. Suction Pipe Size: <**Insert NPS (DN)**>.

3. Compressors:

   a. Number of Compressors: <**Insert number**>.
   b. Rated-Load Amperes: <**Insert value**>.
   c. Locked-Rotor Amperes: <**Insert value**>.
   d. Power Input: <**Insert kilowatts**>.

4. Air-Cooled Condenser:

   a. Ambient-Air Temperature: <**Insert deg F (deg C)**>.
   b. Airflow: <**Insert cfm (L/s)**>.
   c. Number of Condenser Fans: <**Insert number**>.

d. Condenser Fan Motor Size: <**Insert horsepower**>.

5. Electrical Characteristics:

a. Kilowatt Input: <**Insert value**>.
b. Volts: <**Insert value**>.
c. Phase: <**Insert value**>.
d. Hertz: <**Insert value**>.
e. Maximum Circuit Ampacity: <**Insert value**>.
f. Maximum Instantaneous Current Flow during Startup: <**Insert value**>.
g. Maximum Overcurrent Protection: <**Insert amperage**>.

2.3 COMPRESSOR AND CONDENSER UNITS, WATER COOLED

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Factory assembled and tested, consisting of compressors, water-cooled condensers, bases, and unit controls.

C. Compressor: Hermetic or serviceable hermetic type; with oil pump, operating oil charge, and suction and discharge shutoff valves. Factory mounted on base using spring isolators. Include the following:

1. Thermally protected compressor motor.
2. Crankcase heater.
3. Capacity control using cylinder unloading, suction pressure controlled and discharge pressure operated, designed for unloaded start.

D. Refrigerant: [**R-22**] [**R-407C**] [**R-410A**] [**R-134a**] <**Insert type**>.

E. Refrigerant: R-407C, R-410A, or R-134a.

F. Condenser: Single-pass, tube-in-tube, coaxial type; with seamless, integral-finned, copper tube and steel outer shell with water-regulating valve.

G. Condenser: Multipass, shell-and-tube type; with replaceable, seamless, integral-finned copper tubes; positive-liquid subcooling circuit; pressure relief device; liquid-level test cock; purge connection; liquid-line shutoff valve; and angle valve for connection of water-regulating valve.

1. Unit Construction: ASME stamped for refrigerant-side working pressure of 385 psig (2650 kPa) and water-side working pressure of 250 psig (1720 kPa).

H. Condenser: Plate type, with brazed assembly of two end plates, one with threaded nozzles and pattern-embossed plates.

I. Accessories:

1. Discharge-line muffler.
2. Gage panel containing gages for suction, discharge, and oil pressure.
3. Electric solenoid cylinder unloaders.
4. Pump-down relay package.

5. Crankcase cover plates with equalizer connections.

J. Controls: Factory-mounted and -wired panel with the following:

1. Timer to prevent short cycling.
2. High- and low-refrigerant-pressure safety controls.
3. Power- and control-circuit terminal blocks.
4. Compressor motor starter.
5. Control-circuit on-off switch.
6. Control-circuit fuse.

K. Unit Casings: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

L. Capacities and Characteristics:

1. Compressor and Condenser Unit:

a. Full-Load Cooling Capacity: <**Insert MBh (kW)**>.
b. Energy-Efficiency Ratio (EER): <**Insert value**>.
c. Seasonal Energy-Efficiency Ratio (SEER): <**Insert value**>.
d. Coefficient of Performance (COP): <**Insert value**>.
e. Compressor Suction Temperature: <**Insert deg F (deg C)**>.
f. Capacity Steps: <**Insert number**>.

2. Refrigerant Connections:

a. Liquid Pipe Size: <**Insert NPS (DN)**>.
b. Suction Pipe Size: <**Insert NPS (DN)**>.

3. Compressors:

a. Number of Compressors: <**Insert number**>.
b. Rated-Load Amperes: <**Insert value**>.
c. Locked-Rotor Amperes: <**Insert value**>.
d. Power Input: <**Insert kilowatts**>.

4. Water-Cooled Condenser:

a. Condenser Temperature: <**Insert deg F (deg C)**>.
b. Entering-Water Temperature: <**Insert deg F (deg C)**>.
c. Leaving-Water Temperature: <**Insert deg F (deg C)**>.
d. Water Flow: <**Insert gpm (L/s)**>.
e. Water Pressure Drop: <**Insert feet of water (kPa)**>.
f. Fouling Factor: <**Insert number**>.
g. Pipe Connection Size: <**Insert NPS (DN)**>.

5. Electrical Characteristics:

a. Kilowatt Input: <**Insert value**>.

b. Volts: <**Insert value**>.
c. Phase: <**Insert value**>.
d. Hertz: <**Insert value**>.
e. Maximum Circuit Amperes: <**Insert value**>.
f. Maximum Instantaneous Current Flow during Startup: <**Insert value**>.
g. Maximum Overcurrent Protection: <**Insert amperage**>.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to [**ARI 206/110**] [**ARI 306/110**].

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to [**ARI 270**] [**ARI 370**].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated.

B. Install roof-mounting units on equipment supports specified in Section 077200 "Roof Accessories."

C. Equipment Mounting:

1. Install compressor and condenser units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Comply with requirements for piping in other Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

E. Connect refrigerant and condenser-water piping to water-cooled compressor and condenser units.[**Maintain clear tube removal space.**] Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping" and condenser-water piping and specialties are specified in [**Section 221116 "Domestic Water Piping."**] [**Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."**] Install shutoff valve and union or flange at each water supply connection; install balancing valve and union or flange at each return connection.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. [**Engage a factory-authorized service representative to perform**] [**Perform**] startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Inspect for physical damage to unit casing.
b. Verify that access doors move freely and are weathertight.
c. Clean units and inspect for construction debris.
d. Verify that all bolts and screws are tight.
e. Adjust vibration isolation and flexible connections.
f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 236200