





The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

ANSI/AHRI 460 (2005) Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34 (2010; Addenda a, b, c, d, e, f, g, h, and i ) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants

ASHRAE 23 (2005) Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units

ASHRAE EQUIP IP HDBK (2008; Errata 1 2010) Handbook, HVAC Systems and Equipment (IP Edition)

ASHRAE EQUIP SI HDBK (2008; Errata 1 2010) Handbook, HVAC Systems and Equipment (SI Edition)

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 90/A 90M (2009) Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1 (2003; Cor 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA MG 1 (2009) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J636

(1992; R 2001) V-Belts and Pulleys

UNDERWRITERS LABORATORIES (UL)

UL 1995

(2005; Reprint Jul 2009) Heating and Cooling Equipment

UL 207

(2009) Refrigerant-Containing Components and Accessories, Nonelectrical

1.2 SYSTEM DESCRIPTION

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NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Include in drawings or schedule total heat rejection capacity, capacity conditions, coil circuits, and control diagrams.

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Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Ensure results of Contractors survey of [existing conditions](#) include features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit [manufacturer's catalog data](#) for the following items, including the manufacturer's standard color selections and finishes for condensers within [manufacturer's standard color chart](#):

- a. Air-cooled condenser
- b. Motors
- c. Control panel
- d. Refrigerant-containing components
- e. Fans and drives
- f. Condensing pressure control
- g. Casing
- h. Vibration isolation
- i. Spare parts

Submit [material, equipment, and fixture lists](#) or air-cooled condenser units including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site

information.

Submit **control diagrams** for air-cooled condenser units showing the physical and functional relationship of equipment. Show size, type, and capacity of the system on electrical diagrams.

Submit **design analysis and calculations** for air-cooled condensers indicating the manufacturer's recommended **wattage horsepower** ratings, rotational speeds, and piston speeds.

Submit **equipment and performance data** for air-cooled condensers indicating use life, system functional flows, safety features, and other features such as electrical system protective device ratings.

Submit **equipment foundation data** including equipment weight and operation loads, location and projection of anchor bolts, and horizontal and vertical clearances for installation, operation, and maintenance for the following:

- a. Air-cooled condenser
- b. Fans and drives
- c. Motors
- d. Vibration isolation

Include dimensions of foundations and relative elevations, and installation requirements such as noise abatement, vibration isolation, and utility services.

Submit shop drawings, including the general physical layout of all controls, and internal tubing and wiring details, and connection diagrams indicating the relations and connections of the following items:

- a. **Motors**
- b. **Control panel**
- c. **Air-cooled condenser**
- d. **Refrigerant-containing components**

Submit **record drawings** for air-cooled condenser units and provide current factual information including deviations from, and amendments to, the drawings and concealed and visible changes in the work.

### 1.3 SUBMITTALS

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**NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.**

**A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not**

complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists[; G][; G, [\_\_\_\_]]

Existing Conditions[; G][; G, [\_\_\_\_]]

#### SD-02 Shop Drawings

Motors[; G][; G, [\_\_\_\_]]

Control Panel[; G][; G, [\_\_\_\_]]

Air-Cooled Condenser[; G][; G, [\_\_\_\_]]

Refrigerant-Containing Components[; G][; G, [\_\_\_\_]]

Control Diagrams[; G][; G, [\_\_\_\_]]

Installation Drawings[; G][; G, [\_\_\_\_]]

Record Drawings[; G][; G, [\_\_\_\_]]

#### SD-03 Product Data

Equipment Foundation Data[; G][; G, [\_\_\_\_]]

Equipment and Performance Data[; G][; G, [\_\_\_\_]]

Manufacturer's Catalog Data[; G][; G, [\_\_\_\_]]

#### SD-04 Samples

Manufacturer's Standard Color Chart[; G][; G, [\_\_\_\_\_]]

#### SD-05 Design Data

Design Analysis and Calculations[; G][; G, [\_\_\_\_\_]]

#### SD-07 Certificates

Listing of Product Installation[; G][; G, [\_\_\_\_\_]]

Certificates of Compliance[; G][; G, [\_\_\_\_\_]]

#### SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals[; G][; G, [\_\_\_\_\_]] in accordance with paragraph entitled, "Operation and Maintenance," of this section.

### 1.4 QUALITY ASSURANCE

Submit listing of product installation for air-cooled condenser units showing at least 5 installed units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Include purchaser, address of installation, service organization, and date of installation.

Submit certificates of compliance for following items showing conformance with the referenced standards contained in this section:

- a. Motors
- b. Control panel
- c. Air-cooled condenser
- d. Refrigerant-containing components
- e. Fans and drives
- f. Condensing pressure control
- g. Casing
- h. Vibration isolation

### PART 2 PRODUCTS

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NOTE: Ensure fan and motor balancing conform to ISO Std.1940/1 - (1986) Balance Quality Requirements of Rigid Rotors - Determination of Permissible Residual Unbalance unless otherwise noted. For motor vibration levels conform to NEMA Specification MG-1, Motors and Generators, Part 7 unless otherwise noted.  
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## 2.1 AIR-COOLED CONDENSER PACKAGE

Provide a packaged, self-contained air-cooled condenser assembly that includes fans, motors, drives, refrigerant condensing coils, controls, intercomponent piping and wiring, totally enclosed weatherproof casing, and frame mounting; ready for terminal field connections with fully automatic operation.

Ensure condenser and spare parts conform to the applicable requirements of UL 1995, UL 207, ANSI/ASHRAE 15 & 34, ASHRAE 23, ANSI/AHRI 460.

\*\*\*\*\*  
NOTE: Revise the following paragraphs as required to suit project conditions. A lower ambient temperature suitability will require a more expensive low-ambient control.  
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Provide a unit suitable for startup and operation in ambient temperatures as low as 7 degrees C 45 degrees F.

## 2.2 FANS AND DRIVES

\*\*\*\*\*  
NOTE: Select the first paragraph for on-the-roof and other applications where noise is not a factor. Select the second paragraph for on-grade locations adjacent to offices, situations requiring ducting, and generally for low-noise-level areas.  
\*\*\*\*\*

Where noise is a factor, show on drawings limiting speeds, outlet velocities, or noise criteria to suit project conditions.

\*\*\*\*\*  
[Provide propeller type fans, of corrosion-resistant construction, and statically and dynamically balanced to ISO 1940-1-1986, [G6.3] [G2.5] [\_\_\_\_\_] with vertical discharge and a maximum fan-tip speed of 51 meter per second 10,000 feet per minute.]  
\*\*\*\*\*

[Provide double-width, double-inlet, centrifugal-scroll type fan with forward curved or airfoil section bladed wheels of corrosion-resistant construction and statically and dynamically balanced to ISO 1940-1-1986, [G6.3] [G2.5] [\_\_\_\_\_]. Ensure fan shaft first-critical speed is at 20 percent above fan operating speed.]

\*\*\*\*\*  
NOTE: Select the first paragraph only for propeller fan units with ratings less than 3730 watt smaller than 5 horsepower. If the second paragraph is selected, specify with not less than two belts for critical operations.  
\*\*\*\*\*

[Provide direct drive.]

[Provide V-belt with corrosion-protected shaft and antifriction type bearings drive conforming to ASHRAE EQUIP SI HDBK ASHRAE EQUIP IP HDBK, Chapter 41; rated at not less than 1.5 times the identification plate motor

wattage horsepower, SAE J636. Provide bearings [sealed against moisture and dirt, prelubricated, and suitable for not less than 10,000 operating hours without need for relubrication] [of lubricable type with grease supply and relief fittings together with extension tubing for accessibility where necessary] [permanently lubricated and sealed]. Completely pack bearing cavity with a grease suitable for the service.]

\*\*\*\*\*  
NOTE: Modify or delete the following two paragraphs  
as required.  
\*\*\*\*\*

- [ Equip fan drive with an adjustable sheave sized for installation at its midpoint setting and able to provide 20-percent speed adjustment.
- ] [Mount motors on an adjustable base; mount motors with ratings larger than 7460 watt larger than 10 horsepower on a pivoted motor base.
- ] Provide weather-protected drive. Guard drive and fan discharge and inlet in accordance with the recommendations of the Occupational Safety and Health Act (OSHA). Provide fan guard that are hot-dip galvanized after fabrication and suitable for salt-air atmosphere; electrogalvanizing is not acceptable.

## 2.3 MOTORS

Provide motors conforming to NEMA MG 1; totally enclosed type.

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NOTE: Retain the following paragraph for direct  
drive units.  
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- [ Resiliently mount motors.

## ] [2.4 REFRIGERANT-CONTAINING COMPONENTS

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NOTE: Modify the following paragraphs as required  
to suit project. Check subcooling requirements for  
project.  
\*\*\*\*\*

Design and size condensing coils specifically for air-cooled condenser service. Construct with seamless copper tubing, with copper extended surface integral with or mechanically attached to the tube. Provide a coil frame not less than 2.8 millimeter 12-gage galvanized steel. [Factory test coils, pneumatically under water at not less than 2758 kilopascal 400 pounds per square inch gage. ]Provide a purging vent at the highest point of the entering refrigerant header of each coil circuit. Provide coil subcooling when a differential not greater than 7 degrees C below zero degrees C 20 degrees F exists between condensing and ambient temperatures.

Provide condenser coil and receiver with an excess capacity of not less than 20 percent for storage of pumped-down refrigerant.

Clean and factory charge condensing coil and remainder of refrigerant circuit with dry nitrogen or refrigerant.

Protect coil from physical damage.

## ] 2.5 CONDENSING PRESSURE CONTROL

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NOTE: Retain the following paragraph only for  
single-phase powered units.  
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[ Accomplish condensing pressure control by an electronic solid-state control system that modulates the motor speed conforming to requirements specified herein from 0 to 100 percent by fan cycling or by a combination of these methods.  
]

\*\*\*\*\*  
NOTE: Retain one of the following two paragraphs  
for single- or three-phase powered units.  
\*\*\*\*\*

[ Accomplish condensing pressure control by [condenser-coil flooding system] [modulation of dampers located in the discharge airstream].

] [Accomplish condensing pressure control by [fan cycling] [modulation of dampers located in the discharge airstream] [combination of fan cycling and discharge damper modulation].

] Where condenser is being used as a combination receiver, provide with pump-down capacity not less than 80 percent of the available refrigerant volume.

## 2.6 CASING

Construct casing of minimum 1.3 millimeter 18-gage mill-galvanized steel that has been phosphatized, primed, and finished with the manufacturer's standard enamel. [ Specially treat casing for use in a coastal environment.]

\*\*\*\*\*  
NOTE: Specify 71 gram 2.5 ounces of zinc  
specifications for "heavy-duty" heavier steel.  
\*\*\*\*\*

Ensure mill-galvanized steel conforms to ASTM A 653/A 653M and is coated with not less than 380 gram 1.25 ounces of zinc per square meter foot of two-sided surface when tested in accordance with ASTM A 90/A 90M.

Construct casing frame of mill-galvanized steel or hot-dip galvanized after fabrication to equal or exceed mill-galvanizing requirements.

Include access doors and coil end enclosure. Control panel may be located within or external to casing.

## 2.7 CONTROL PANEL

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NOTE: Modify the following paragraphs for remote  
location.  
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Provide condenser-mounted control panel and intercomponent piping and

wiring. For control panels exposed to the weather provide NEMA 250, Type 3 enclosures and NEMA 250, Type 1 enclosures if protected by casing. Conform to NFPA 70 requirements for electrical work and incorporate UL-listed components.

\*\*\*\*\*  
NOTE: Modify the following paragraph to suit  
project requirements.  
\*\*\*\*\*

Provide control panel with the following factory-mounted controls:  
115-volt control power transformer, fan contactors, fan controls for low ambient operation, and compressor interlock.

## 2.8 VIBRATION ISOLATION

Ensure vibration isolation provisions conform to requirements specified under Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Submit installation drawings for air-cooled condenser units. Indicate on drawings overall physical features, dimensions, ratings, service requirements, weights of equipment, and details of equipment room layout and arrangement.

### 3.2 OPERATION AND MAINTENANCE

Submit [6] [\_\_\_\_\_] copies of the operation and maintenance manuals 30 calendar days prior to testing the air-cooled condenser units. Update and resubmit record drawings and data for final approval no later than 30 calendar days prior to contract completion.

-- End of Section --