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USACE / NAVFAC / AFCEC / NASA | **UFGS-23 81 00.00 20 (November 2009) Change 1 - 11/13**

Preparing Activity: NAVFAC | **Superseding UFGS-23 81 00.00 20 (July 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2014
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SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 81 00.00 20

UNITARY AIR CONDITIONING EQUIPMENT

11/09

-- End of Section Table of Contents --

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****

SECTION 23 81 00.00 20

UNITARY AIR CONDITIONING EQUIPMENT
11/09

****
NOTE: This guide specification covers the requirements for room air conditioners, packaged terminal units, heat pumps, and air conditioners of the single package or split system type.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the

Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

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)

AHRI 350	(2008) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
AHRI DCAACP	(Online) Directory of Certified Applied Air-Conditioning Products
AHRI DCUP	(Online) Directory of Certified Unitary Products
ANSI/AHRI 210/240	(2008; Add 1 2011; Add 2 2012) Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment
ANSI/AHRI 340/360	(2007) Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ANSI/AHRI/CSA 310/380	(2004) Standard for Packaged Terminal Air-Conditioners and Heat Pumps

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

ANSI/ASHRAE 15 & 34	(2013) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 52.2	(2012; Errata 2013) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 55	(2010; Errata 2011; Addenda A 2011; Addenda B, C, D, E and F 2012; Errata 2012; Addenda G, H, I, J, K, L, M, N, O, P, Q and R) Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1	(2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality
ASHRAE 90.1 - IP	(2010; Errata 1-4 2011; INT 1-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y,

Z, BZ, CG, CI and DS 2012; Errata 5-9 2012; INT 13-16 2012; Errata 10-12 2013; INT 17-18 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASHRAE 90.1 - SI (2010; Errata 1-2 2011; INT 2-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI and DS 2012; Errata 3-9 2012; INT 13-16 2012; Errata 10-15 2013; INT 17 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME B16.22 (2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B31.5 (2013) Refrigeration Piping and Heat Transfer Components

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

AHAM RAC-1 (1982; R2008) Directory of Certified Room Air Conditioners

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B117 (2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B280 (2013) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM B88 (2009) Standard Specification for Seamless Copper Water Tube

ASTM B88M (2013) Standard Specification for Seamless Copper Water Tube (Metric)

ASTM C534/C534M (2013) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E84	(2013a) Standard Test Method for Surface Burning Characteristics of Building Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2008; E 2010) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA MG 1	(2011; Errata 2012) Motors and Generators

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-5541	(2006; Rev F) Chemical Conversion Coatings on Aluminum and Aluminum Alloys

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50502	(Basic) Air Conditioners, (Unitary Heat Pump), Air to Air (3,000 to 300,000 BTU)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

UNDERWRITERS LABORATORIES (UL)

UL 109	(1997; Reprint Aug 2013) Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use
UL 484	(2014) Standard for Room Air Conditioners
UL 873	(2007; Reprint Aug 2013) Standard for Temperature-Indicating and -Regulating Equipment
UL 900	(2004; Reprint Feb 2012) Standard for Air Filter Units

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

****
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.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, 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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.
****

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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Field-assembled refrigerant piping

Control system wiring diagrams

SD-03 Product Data

Room air conditioners

Packaged terminal units

Heat pumps, air to air

Air conditioners

Submit documentation for Energy Star qualifications or meeting FEMP requirements. Indicate Energy Efficiency Rating.

Filters; (LEED NC)

[Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project. Submit documentation indicating relative dollar value of rapidly renewable materials to total dollar value of products included in project.]

Thermostats

Refrigerant piping and accessories

Coatings for finned tube coils

For packaged terminal units, include indoor noise rating.

[Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data]

SD-06 Test Reports

Salt-spray tests

Start-up and initial operational tests

SD-08 Manufacturer's Instructions

Room air conditioners

Packaged terminal units

Heat pumps, air to air

Air conditioners

Filters

Thermostats

Refrigerant piping and accessories

SD-10 Operation and Maintenance Data

Room air conditioners, Data Package 3

Packaged terminal units, Data Package 3

Heat pumps, air to air, Data Package 3

Air conditioners, Data Package 3

Filters, Data Package 2

Thermostats, Data Package 2

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Posted operating instructions

1.4 QUALITY ASSURANCE

1.4.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Detail Drawing

For refrigerant piping, submit piping, including pipe sizes. Submit control system wiring diagrams.

1.4.3 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ANSI/ASHRAE 15 & 34.

1.4.4 Posted Operating Instructions

Submit posted operating instructions for each packaged air conditioning

unit.

1.4.5 Sizing

Size equipment based on Design Manual CS from the Air Conditioning Contractors of America; do not oversize.

1.5 REFRIGERANTS

****
NOTE: EPA, per the Significant New Alternative Policy rule, reviews refrigerant substitutes on the basis of ozone depletion potential, global warming potential, toxicity, flammability, and exposure potential. Lists of acceptable and unacceptable substitutes are updated several times each year. A chronological list of SNAP updates is available at http://www.epa.gov/ozone/snap/refrigerants/lists/index.html or from the stratospheric ozone information hotline at 1 (800) 296-1996. Reducing ozone depletion and global warming potential by reducing or eliminating CFC, HCFC, and Halon use in air conditioning equipment contributes to the following LEED credits: EA Prerequisite 3; EA4.
****

Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme. CFCs[and HCFCs][and Halons] shall not be permitted. Refrigerant shall be an approved alternative refrigerant per EPA's Significant New Alternative Policy (SNAP) listing. [Use HCFC-22 refrigerant.]

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Ventilation shall meet or exceed ASHRAE 62.1 and all published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2. Thermal comfort shall meet or exceed ASHRAE 55.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

****
NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor.
****

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800][_____] kilometer [500][_____] mileradius from the project site, if available from a minimum of three sources.

1.7.2 Environmental Data

****
NOTE: ASTM E2129 provides for detailed

documentation of the sustainability aspects of products used in the project. This level of detail may be useful to the Contractor, Government, building occupants, or the public in assessing the sustainability of these products.

****

[Submit Table 1 of ASTM E2129 for the following products: [_____].

]PART 2 PRODUCTS

****

NOTE: Equipment having a higher efficiency than required by ASHRAE 90.1 - SI ASHRAE 90.1 - IP or CID A-A-50502 shall be specified if shown to be life-cycle cost effective. Minimum efficiencies shall be according to Energy Star (http://www.energystar.gov/index.cfm?fuseaction=find_a_product.) and FEMP (https://www1.eere.energy.gov/informationcenter/) recommendations. The Energy Policy Act of 2005 requires new buildings to use 30 percent less energy than the ASHRAE 90.1 - SI ASHRAE 90.1 - IP level. Efficient cooling equipment and components contribute to the following LEED credits: EA Prerequisite 2; EA1.

****

2.1 ROOM AIR CONDITIONERS

****

NOTE: FEMP recommends a SEER of 12.0 for air conditioners smaller than 65 MBtu/hr, an EER of 11.0 and IPLV of 11.4 for 65 to 135 MBtu/hr air conditioners, and an EER of 10.8 and IPLV of 11.2 for 135 to 240 MBtu/hr air conditioners. Air conditioners with a SEER of 14.0 are readily available.

****

AHAM RAC-1 and UL 484. Minimum [seasonal]energy efficiency ratio ([S]EER) shall be [in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [[_____] [S]EER.] [Minimum integrated part load value (IPLV) shall be [in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [[_____] IPLV.]] Provide units removable from inside the building for servicing without removing the outside cabinet. Construct outside cabinets, including metal grilles to protect condenser coils, of zinc-coated steel or aluminum. Steel and zinc-coated surfaces shall receive at least one coat of primer and manufacturer's standard factory-applied finish Insulate cabinets to prevent condensation and run off of moisture. Provide mounting hardware made of corrosion-resistant material or protected by a corrosion-resistant finish. Provide air filters of the [throw-away] [or] [permanent washable] type removable without the use of tools and arranged to filter both room and ventilating air. Remove condensate by means of a drain or by evaporation and diffusion. Provide with metal or plastic mounting flanges on each side, top, and bottom of unit. For thru-the-wall installations provide aluminum or shop painted zinc-coated steel flanged telescopic wall sleeves. Design wall sleeves to

restrict driving rain. For window mounted units provide shop-painted metal mounting brackets, braces, and sill plates. Mount compressors on vibration isolators. Minimum cooling capacity shall be not less than that indicated. Provide units listed in the AHAM RAC-1. [Provide light tight units serving dark rooms.]

2.1.1 Units for Operation on 115 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15- or 20-amp, 3-pole, 125-volt ground type plug to match receptacle.

2.1.2 Units for Operation on 208 or 230 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15-, 20-, or 30-amp, 3-pole, 250-volt ground type plug to match receptacle.

2.1.3 Controls

Mount controls in cabinet. Manual controls shall permit operation of either the fan or the fan and refrigerating equipment. Fan control shall provide two fan speed settings. Automatic controls shall include a thermostat for controlling air temperature. Thermostat shall have an adjustable range, including 22 to 27 degrees C 72 to 80 degrees Fand shall automatically turn the refrigeration system on or off to maintain the preselected temperature within plus or minus 20 degrees C 4 degrees F.

2.2 PACKAGED TERMINAL UNITS

****
NOTE: Equipment having a higher efficiency than required by ASHRAE 90.1 - SI ASHRAE 90.1 - IP or CID A-A-50502 shall be specified if shown to be life-cycle cost effective. The Energy Policy Act of 2005 requires new buildings to use 30 percent less energy than the ASHRAE 90.1 - SI ASHRAE 90.1 - IP level.
****

****
NOTE: Include "suitability for ductwork" requirement when part of conditioned air is to be ducted to an adjacent room. Require factory fabricated duct package.
****

2.2.1 Heat Pumps

****
NOTE: FEMP recommends 12.0 SEER and 7.7 HSPF for small (less than 65 MBtu/hr) air-cooled heat pumps; 10.1 EER, 10.4 IPLV, and 3.2 COP for medium (65-135 MBtu/hr) air-cooled heat pumps; and 9.3 EER, 9.5 IPLV, and 3.1 COP for large (136-240 MBtu/hr) air-cooled heat pumps.
****

ANSI/AHRI/CSA 310/380, UL 484, air-cooled, thru-wall type, AHRI certified, and UL listed. [Minimum energy efficiency shall be in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [Heat pumps shall have a minimum energy efficiency ratio (EER) of [_____], a minimum Coefficient of Performance (COP) of [_____], and a minimum integrated part load value (IPLV) of [_____].] Provide units listed in AHRI DCAACP. [Provide supplemental electric resistance heaters integral with unit.] [Provide units suitable for use with minimal ductwork having a total external static resistance up to 25 Pa 0.1 inch of water.]

2.2.2 Air Conditioners

****
NOTE: FEMP recommends a SEER of 12.0 for air conditioners smaller than 65 MBtu/hr, an EER of 11.0 and IPLV of 11.4 for 65 to 135 MBtu/hr air conditioners, and an EER of 10.8 and IPLV of 11.2 for 135 to 240 MBtu/hr air conditioners. Air conditioners with a SEER of 14.0 are readily available.
****

ANSI/AHRI/CSA 310/380, UL 484, air-cooled, thru-wall type, AHRI certified, and UL listed. Provide units with [heating only] [cooling only] [combination heating and cooling] section with indicated capacity. Minimum [seasonal]energy efficiency ratio ([S]EER) shall be [in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [[_____] [S]EER.] [Minimum integrated part load value (IPLV) shall be [in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [[_____] IPLV.]] Provide units listed in AHRI DCAACP. [Provide units suitable for use with minimal ductwork having a total external static resistance up to 25 Pa 0.1 inch of water.]

2.2.3 Indoor Noise Rating

****
NOTE: Develop and specify the sound level requirements for specific equipment applications. Ensure at least three manufacturers can meet the noise rating specified.
****

Rate in accordance with AHRI 350. Indoor rating shall not exceed [_____] bels while entire unit is operating at any fan or compressor speed.

2.2.4 Room Cabinets

Fabricate of 18-gage minimum steel (MSS). Provide removable front panel and access panels for equipment machinery, coils, controls, and filters. In lieu of steel, front panel may be constructed of high impact styrene structural foam conforming to requirements of UL 484. Structural foam shall pass tests specified in UL 484 for classification of 94 HB. Line interior of steel cabinets with insulation having a fire hazard rating not exceeding 25 for flame spread, and 50 for smoke developed, as determined by ASTM E84. Caulk around floor mounted units at the floor. Locate wall-mounted units 65 mm 2 1/2 inches minimum above the floor.

2.2.5 Grilles

Provide manufacturer's [standard] [architectural] anodized aluminum outdoor grilles and caulk and seal on all sides when required by manufacturer's instructions. Provide both horizontal and vertical adjustable deflection inside air supply grilles. Provide for air return under the front panel or a return air grille in the lower part of the front panel.

2.2.6 Wall Sleeves and Mounts

Provide manufacturer's standard wall sleeves and mounts. Wall sleeves shall have seals designed to restrict driving rain and wind. [Provide unit subbase of the same construction and finish as the sleeve to provide for concealed electrical connection, cord storage, and equipped with unit leveling legs.] [Provide subbase with 24-volt remote control circuitry and wall mounted thermostat.]

2.2.7 Heating Section for Air Conditioners

****
NOTE: Choose the applicable text from the following.
****

[a. Electric Coils: Electric resistance heating elements with high temperature-limit safety device, factory-mounted, and wired to chassis.

][b. Hot Water Coils: Serpentine type constructed of seamless copper tubes with aluminum fins mechanically or hydraulically bonded to tubes. Provide factory-furnished tee and manual air vent on return connection. Factory test coils at twice maximum operating pressure.

][c. Steam Coils: Serpentine type constructed of red brass or seamless copper tubes with aluminum fins mechanically or hydraulically bonded to tubes. Factory test coils at twice the maximum operating pressure.

] d. Heating unit shall have internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84.

2.2.8 Refrigeration Sections

****
NOTE: Several manufacturers' units have a low operating temperature of 2 degrees C 35 degrees F as standard. For areas where the temperature will be below 2 degrees C 35 degrees F and year round operation of the unit is essential, special accessories will have to be specified for operation below 2 degrees C 35 degrees F.
****

Completely self-contained, slide-in assembly or removable chassis with welded, hermetically sealed, air-cooled refrigeration system, outdoor fan, indoor fan, control box, and ventilation damper. Provide refrigeration sections capable of installation or removal without the use of tools. Refrigeration sections shall include refrigeration circuit tubing, wiring, and safety controls, and shall operate down to 2 degrees C 35 degrees F outdoor temperature and 21 degrees C 70 degrees F indoor temperature, without compressor short cycling while delivering not less than 100 percent

of rated cooling capacity. Units shall have drains to the building exterior to eliminate excess driving rain. Condensate shall not drain onto building exterior or interior.

a. Compressors: Hermetic type with vibration isolation devices.

****
NOTE: Research project location conditions to determine the environmental effects on finned tube coils. The research should include a survey of existing similar equipment. If needed, rewrite the specifications based on the conclusions of the research. Consideration should be given to the following combinations based on past experience of these materials in dealing with the local conditions.

1. Copper tube and aluminum fins, coated;

2. Copper tube and copper fins, coated;

3. Aluminum tube and aluminum fins, coated;

4. Aluminum tube and aluminum fins, uncoated;

5. Copper tube and copper fins, uncoated; and

6. Copper tube and aluminum fins, uncoated.
****

b. Coils: Constructed of seamless copper or aluminum tubing with copper or aluminum fins bonded to tubes. [Coat outdoor air coils with factory applied corrosion resistant treatment. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

c. Outdoor Fans: Direct connected centrifugal type with aluminum or plastic wheel and forward curved blades or direct connected aluminum propeller type. Design fans so that condensate will evaporate without drip, splash, or spray on building exterior.

d. Indoor Fans: Direct connected centrifugal type with aluminum, galvanized steel, or plastic wheel and forward curved blades. Provide minimum two-speed motor with built-in overload protection.

2.2.9 Ventilation Damper Assembly

****
NOTE: Delete requirement for ventilation damper when outside air is supplied to the space by a central system.
****

Operated by automatic actuator. Dampers shall close on unit shutdown or loss of power and shall open on heating or cooling start-up.

2.2.10 Air Filters

Removable without use of tools, and shall filter both recirculated and ventilating air.

2.2.11 Controls

Provide controls including, an adjustable thermostat, and switches, to regulate room air temperature through control of refrigerant compressors or heating elements. Controls shall at least have positions for off, high or low fan speed for [heating] [and] [cooling], and fan only operation. [Provide remote mounted night set-back thermostat.]

2.3 HEAT PUMPS, AIR TO AIR

****
NOTE: Equipment having a higher efficiency than required by ASHRAE 90.1 - SI ASHRAE 90.1 - IP or CID A-A-50502 shall be specified if shown to be life-cycle cost effective. The Energy Policy Act of 2005 requires new buildings to use 30 percent less energy than the ASHRAE 90.1 - SI ASHRAE 90.1 - IP level.
****

****
NOTE: Refer to Military Handbook 1190, "Facility Planning and Design Guide," for restrictions on heat pump usage. Select the appropriate Type and Class from the latest edition of CID A-A-50502.
****

CID A-A-50502, except as modified in this article; Type [_____], Class [_____]. List units with capacities smaller than 39,555 watt 135,000 Btu/hr in the [AHRI DCUP]; in lieu of listing in the AHRI Directory, a letter of certification from AHRI that the units have been certified and will be listed in the next Directory will be acceptable. Provide factory assembled units complete with accessories, wiring, piping, and controls. Provide units with [outlet grilles.] [supplemental electric heaters.] [humidifiers.] [air filters as specified in the paragraph entitled "Filters."]

2.3.1 Energy Performance

****
NOTE: FEMP recommends 12.0 SEER and 7.7 HSPF for small (less than 65 MBtu/hr) air-cooled heat pumps; 10.1 EER, 10.4 IPLV, and 3.2 COP for medium (65-135 MBtu/hr) air-cooled heat pumps; and 9.3 EER, 9.5 IPLV, and 3.1 COP for large (136-240 MBtu/hr) air-cooled heat pumps. Heat pumps with a SEER of 14.0 are readily available.
****

[Energy performance shall be in accordance with CID A-A-50502.][Minimum energy efficiency shall be in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP.][Heat pumps shall have [a minimum [seasonal] energy efficiency ratio ([S]EER) of [_____],] [a minimum Heating Seasonal Performance Factor (HSPF) of [_____],] [a minimum Integrated Part Load Value (IPLV) of [_____],] and [a minimum COP of [_____].]]

2.3.2 Air Coils

****

NOTE: Research project location conditions to determine the environmental effects on finned tube coils. The research should include a survey of existing similar equipment. If needed, rewrite the specifications based on the conclusions of the research. Consideration should be given to the following combinations based on past experience of these materials in dealing with the local conditions.

1. Copper tube and aluminum fins, coated;

2. Copper tube and copper fins, coated;

3. Aluminum tube and aluminum fins, coated;

4. Aluminum tube and aluminum fins, uncoated;

5. Copper tube and copper fins, uncoated; and

6. Copper tube and aluminum fins, uncoated.

****

Extended-surface fin and tube type with seamless copper or aluminum tubes with copper or aluminum fins securely bonded to the tubes. On coils with all-aluminum construction, provide tubes of aluminum alloy 1100, 1200, or 3102; provide fins of aluminum alloy 7072; and provide tube sheets of aluminum alloy 7072 or 5052. [Provide a coating on [outdoor air] [and] [indoor air] coils as specified in the paragraph entitled "Coatings for Finned Tube Coils." Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

2.3.3 Supplemental Electric Heaters

****

NOTE: Determine if supplemental electric heaters are required.

****

Provide electrical resistance heaters [integral with the unit] [for remote installation in ductwork]. Heaters shall have a total capacity as indicated. Provide internal fusing for heaters.

2.3.4 Compressors

For compressors above 70 kW 20 tons, compressor speed shall not exceed 3450 rpm. For equipment over 35 kW 10 tons, provide automatic capacity reduction of at least 50 percent of rated capacity. Capacity reduction may be accomplished by cylinder unloading, use of multiple, but not more than four compressors, or a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have a means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shutdown by safety controls. Provide reciprocating compressors with crankcase heaters, and vibration isolators.

2.3.5 Mounting Provisions

Provide units that permit mounting as indicated. [Provide suitable lifting attachment plates to enable equipment to be lifted to normal position.]

2.3.6 Temperature Controls

****
NOTE: This is an example temperature controls paragraph for a simple air-source heat pump system. Modify it, or add to it, to suit the requirements of the actual system as designed. For complex, systems write a temperature controls paragraph as required.
****

Provide controls as specified in CID A-A-50502 and as modified herein. Provide indoor thermostats of the adjustable type that conform to applicable requirements of UL 873. Provide manual means for temperature set-back. Provide thermostats capable of controlling supplemental heat as specified in CID A-A-50502. Provide a manual selector switch or other means to permit the supplementary heater to be energized when the heat pump compressor and associated equipment are inoperative. Control supplementary heater with the room thermostat while bypassing the outdoor thermostat. Locate switch adjacent to or as an integral part of the room thermostat. An indicator light on the room thermostat or manual heat switch shall indicate when supplementary heaters are operating.

2.3.7 Accessories

In addition to accessories specified in CID A-A-50502, provide the following accessories for heat pump units.

a. Protective grille around outside unit coils

[b. Start capacitor kit

]2.4 AIR CONDITIONERS

****
NOTE: Equipment having a higher efficiency than required by ASHRAE 90.1 - SI ASHRAE 90.1 - IP or CID A-A-50502 shall be specified if shown to be life-cycle cost effective. The Energy Policy Act of 2005 requires new buildings to use 30 percent less energy than the ASHRAE 90.1 - SI ASHRAE 90.1 - IP level.
****

****
NOTE: For units 39,555 watt 135,000 Btu/hrand larger, include bracketed sentence concerning liquid subcooling.
****

2.4.1 Single Package Type

****
NOTE: FEMP recommends a SEER of 12.0 for air conditioners smaller than 65 MBtu/hr, an EER of 11.0

and IPLV of 11.4 for 65 to 135 MBtu/hr air conditioners, and an EER of 10.8 and IPLV of 11.2 for 135 to 240 MBtu/hr air conditioners. Air conditioners with a SEER of 14.0 are readily available.

****

Provide factory packaged [cooling] [combination heating and cooling] units. Provide units suitable for [indoor] [outdoor] [roof top] installation. [Provide units with suitable lifting attachments, [remote control panel] [roof curb and flashing], [and] [transition plenums].] [Minimum energy efficiency shall be in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [Units shall have a minimum [SEER of [_____]] [EER of [_____]] [IPLV of [_____]] when tested in accordance with ANSI/AHRI 210/240 or ANSI/AHRI 340/360 as applicable.] List units with capacities smaller than 39,555 watt 135,000 Btu/hr in the AHRI DCUP; in lieu of listing in the AHRI Directory, a letter of certification from AHRI that the units have been certified and will be listed in the next Directory will be acceptable. Provide capacity, electrical characteristics, and operating conditions as indicated. [Condensers shall provide not less than minus 12 degrees C 10 degrees F liquid subcooling at standard ratings.]

2.4.2 Split-System Type

****

NOTE: FEMP recommends a SEER of 12.0 for air conditioners smaller than 65 MBtu/hr, an EER of 11.0 and IPLV of 11.4 for 65 to 135 MBtu/hr air conditioners, and an EER of 10.8 and IPLV of 11.2 for 135 to 240 MBtu/hr air conditioners.

****

Provide separate assemblies designed to be used together. Base ratings on the use of matched assemblies. Provide performance diagrams for units with capacities not certified by AHRI to verify that components of the air conditioning system furnished will satisfy the capacity requirement specified or indicated. [Minimum energy efficiency shall be in accordance with ASHRAE 90.1 - SI ASHRAE 90.1 - IP, at a minimum.] [Units shall have a minimum [SEER] [EER] of [_____] when tested in accordance with ANSI/AHRI 210/240 or ANSI/AHRI 340/360 as applicable.] List units with capacities smaller than 135,000 Btu/hr in the AHRI DCUP; in lieu of listing in the AHRI Directory, a letter of certification from AHRI that units have been certified and will be listed in the next Directory will be acceptable. Provide capacity, electrical characteristics and operating conditions as indicated. [Condensers shall provide not less than 10 degrees F liquid subcooling at standard ratings.]

2.4.3 Single Zone Units

****

NOTE: In high humidity areas, use draw-thru type in order to utilize the fan energy for reheat.

****

Provide single zone type units arranged to [draw] [or] [blow] through coil sections. [Air may be blown or drawn through heating section.]

2.4.4 Multizone Units

Provide multizone type units arranged to [blow through the cooling and heating sections] [draw through the cooling and heating sections] [blow through the individual cooling and heating coils of each zone].

2.4.5 Heaters

Provide as [an integral part of the evaporator-blower unit] [a separate unit for installation in the duct work]. Provide [steam coils] [hot water coils] [gas heaters] [oil heaters] [electric open coils] [electric strip tubular heaters] [electric fin tubular heaters].

2.4.6 Compressors

For compressors over 70 kW 20 tons, compressor speed shall not exceed 3450 rpm. For systems over 35 kW 10 tons provide automatic capacity reduction of at least 50 percent of rated capacity. Capacity reduction may be accomplished by cylinder unloading, use of multi- or variable speed compressors, use of multiple, but not more than four compressors, or a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shut down by safety controls. Device shall delay operation of compressor motor for at least 3 minutes but not more than 6 minutes. Provide a pumpdown cycle for units 70 kW 20 tons and over. Provide reciprocating compressors with crankcase heaters in accordance with the manufacturer's recommendations. If compressors are paralleled, provide not less than two independent circuits.

2.4.7 Coils

****

NOTE: Research project location conditions to determine the environmental effects on finned tube coils. The research should include a survey of existing similar equipment. If needed, rewrite the specifications based on the conclusions of the research. Consideration should be given to the following combinations based on past experience of these materials in dealing with the local conditions.

1. Copper tube and aluminum fins, coated;

2. Copper tube and copper fins, coated;

3. Aluminum tube and aluminum fins, coated;

4. Aluminum tube and aluminum fins, uncoated;

5. Copper tube and copper fins, uncoated; and

6. Copper tube and aluminum fins, uncoated.

****

On coils with all-aluminum construction, provide tubes of aluminum alloy 1100, 1200, or 3102; provide fins of aluminum alloy 7072; and provide tube sheets of aluminum alloy 7072 or 5052. Provide a separate air cooled

condenser circuit for each compressor or parallel compressor installation. [Provide a coating on [condenser] [and] [evaporator] coils and fins as specified in the paragraph entitled "Coatings for Finned Tube Coils." Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

2.4.8 Condenser Controls

****
NOTE: Insert minimum temperature at which the mechanical cooling equipment will be required to operate.
****

Provide start-up and head pressure controls to allow for system operation at ambient temperatures down to [_____] degrees C degrees F.

2.4.9 Fans

Provide belt-driven evaporator fans with adjustable pitch pulleys; except for units less than 17 1/2 kW 5 ton capacity, direct drive with at least two speed taps may be used. Select pulleys at approximately midpoint of the adjustable range.

2.4.10 Filters

Provide filters of the type specified in this section.

2.4.11 Filter Boxes

Provide when filters are not included integral with air conditioning units. Construct of not less than No. 20 US gage steel with track, hinged access doors with latches, and gaskets between frame and filters. Arrange filters to filter outside and return air. Provide removable filter assemblies, replaceable without the use of tools.

2.4.12 Mixing Boxes

Provide of the physical size to match the basic unit and include equal sized flanged openings, sized to individually handle full air flow. Arrange openings as indicated. Provide openings with dampers of parallel or opposed blade type. Provide opposed blade type for modulating dampers and parallel type for two-position dampers. Connect damper shafts together by one continuous linkage bar. Arrange dampers for [automatic] [or] [manual] operation so that when one starts to close from its opened position, the other starts to open from its closed position.

2.4.13 Thermostats

****
NOTE: Typical specifications for a simple system with both single-stage cooling and single-stage heating. Modify as required to suit the project.
****

Provide adjustable type that conforms to applicable requirements of UL 873. Provide combination heating-cooling type with contacts hermetically sealed against moisture, corrosion, lint, dust, and foreign material. Design to operate on not more than 0.83 degrees C 1.5 degrees Fdifferential and of

suitable range calibrated in degrees C degrees F. Provide adjustable heat anticipation and fixed cooling anticipation. Provide two independent temperature sensing elements electrically connected to control the compressor and heating equipment, respectively. Accomplish manual switching for system changeover from heating to cooling or cooling to heating and fan operation through the use of a thermostat subbase. Provide system selector switches to provide "COOL" and "OFF" and "HEAT" and fan selector switches to provide "AUTOMATIC" and "ON." Provide relays, contactors, and transformers located in a panel or panels for replacement and service.

2.4.13.1 Cooling

a. When thermostat is in "COOL" position with fan selector switch in "AUTO" position, compressor, evaporator fan, and condenser fan shall cycle together.

b. When thermostat is in "COOL" position with fan selector switch in "ON" position, compressor, and condenser fan shall cycle together and evaporator fan shall run continuously.

2.4.13.2 Heating

a. When thermostat is in "HEAT" position with fan selector switch in "AUTO" position, heater and supply air fan shall cycle together. Provide a separate thermostat to keep the fan running until the heater cools.

b. When thermostat is in "HEAT" position with fan selector switch in "ON" position, heater shall cycle and supply air fan shall run continuously.

2.4.13.3 Supply Air Fan

a. When fan selector switch is in "AUTO" position with thermostat in "OFF" position, fan shall not run.

b. When fan selector switch is in "ON" position, fan shall run continuously.

2.5 FILTERS

****
NOTE: MERV 13 filters are typically at least 152 mm 6 inches deep with 0.8 inch wg pressure drop or higher, making them only feasible in applied, belt-driven central station air handling units. Terminal equipment or smaller packaged rooftop equipment cannot achieve this level of filtration or generate the static pressure needed to deliver proper airflow when using this high efficiency filtration. Typically MERV 6 or 8 is the highest efficiency filter that can be applied for that equipment.
****

****
NOTE: Use of biobased materials that are rapidly renewable contributes to the following LEED credit: MR6. Coordinate with Section 01 33 29 LEED(tm)

DOCUMENTATION.
****

Provide filters to filter outside air and return air and locate [as indicated] [inside air conditioners] [inside filter box] [inside combination air filter mixing box]. Provide [replaceable (throw-away)] [high efficiency] [cleanable (reusable)] type. Filters shall conform to UL 900, [Class 1] [or] [Class 2]. Polyurethane filters shall not be used on units with multiframe filters.[Filters shall contain a minimum of [85][95][_____] percent biobased material like cotton.]

2.5.1 Replaceable Type Filters

Throw-away frames and media, standard dust holding capacity, 1.79 m/s 350 fpm maximum face velocity, and [25 mm one inch] [50 mm 2 inches] thick. Filters shall have a minimum efficiency reporting value (MERV) of [6][8][_____] when tested in accordance with ASHRAE 52.2.

2.5.2 High Efficiency Filters

Filters shall have a MERV of 17 when tested in accordance with ASHRAE 52.2. Filter assembly shall include; holding frame and fastener assembly, filter cartridge, mounting frame, and retainer assembly. Reinforce filter media with glass fiber mat. Pressure drop across clean filter shall not exceed [_____] Pa inches of watergage. Precede high efficiency filters with a UL Class 2 replaceable type filter.

2.5.3 Cleanable Type Filters

Provide sufficient oil to coat filters six times based on one pint of oil per each 0.93 square meter 10 square feet of filter area. Provide washing and charging tanks for cleaning and coating filters. Filters shall have a MERV of [6][8][_____] when tested in accordance with ASHRAE 52.2.

2.5.4 Manometers

****
NOTE: Prohibit the use of mercury as the operating fluid when air handling units are to be in areas designated as "mercury-free."
****

Provide inclined-type manometers for filter stations of 944 L/s 2,000 cfm capacity or larger including filters furnished as integral parts of air-handling units and filters installed separately. Provide sufficient length to read at least 250 Pa one inch of water column with 10 major graduations, and equipped with spirit level. Equip manometers with overpressure safety traps to prevent loss of fluid, and two three-way vent valves for checking zero setting. [Mercury shall not be used as the operating fluid.]

2.6 COATINGS FOR FINNED TUBE COILS

****
NOTE: Include this article when coating of finned tube coils is required by the equipment specifications paragraph.
****

****

NOTE: Research project location conditions to determine the environmental effects on finned tube coils. The research should include a survey of existing similar equipment. If needed, rewrite the specifications based on the conclusions of the research. Consideration should be given to the following combinations based on past experience of these materials in dealing with the local conditions.

1. Copper tube and aluminum fins, coated;

2. Copper tube and copper fins, coated;

3. Aluminum tube and aluminum fins, coated;

4. Aluminum tube and aluminum fins, uncoated;

5. Copper tube and copper fins, uncoated; and

6. Copper tube and aluminum fins, uncoated.

****

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.6.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness shall be 0.064 to 0.076 mm 2.5 to 3.0 mils.

2.6.2 Chemical Conversion Coating with Polyelastomer Finish Coat

Dip coils in a chemical conversion solution to molecularly deposit a corrosion resistant coating by electrolysis action. Chemical conversion coatings shall conform to MIL-DTL-5541, Class 1A. Cure conversion coating at a temperature of 43 to 60 degrees C 110 to 140 degrees F for a minimum of 3 hours. Coat coil surfaces with a complex polymer primer with a dry film thickness of 0.025 mm 1 mil. Cure primer coat for a minimum of 1 hour. Using dip tank method, provide three coats of a complex polyelastomer finish coat. After each of the first two finish coats, cure the coils for 1 hour. Following the third coat, spray a fog coat of an inert sealer on the coil surfaces. Total dry film thickness shall be 0.064 to 0.076 mm 2.5 to 3.0 mils. Cure finish coat for a minimum of 3 hours. Coating materials shall have 300 percent flexibility, operate in temperatures of minus 46 to plus 104 degrees C 50 to plus 220 degrees F, and protect against atmospheres of a pH range of 1 to 14.

2.6.3 Vinyl Coating

****
NOTE: Include the paragraph below only in NAVFAC PAC projects.
****

Apply coating using an airless fog nozzle. For each coat, make at least two passes with the nozzle. Materials to be applied are as follows:

Total dry film thickness, 0.165 mm 6.5 mils maximum.

Vinyl Primer, 24 percent solids by volume: One coat 0.051 mm 2 mils thick

Vinyl Copolymer, 30 percent solids by volume: One coat 0.114 mm 4.5 mils thick.

2.7 MOTORS AND STARTERS

****
NOTE: Reduced voltage starters should be specified when voltage-regulation problems are anticipated including inadequate power supply, poor distribution facilities, and presence of electrical or electronic equipment sensitive to voltage fluctuation.
****

NEMA MG 1, NEMA ICS 1, and NEMA ICS 2. Variable speed. Motors less than 3/4 kW 1 hp shall meet NEMA High Efficiency requirements. Motors 3/4 kW 1 hp and larger shall meet NEMA Premium Efficiency requirements. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. [Provide reduced voltage type motor starters.] Provide [general-purpose] [weather-resistant] [watertight] [explosion proof] type starter enclosures in accordance with NEMA ICS 6.

2.8 REFRIGERANT PIPING AND ACCESSORIES

****
NOTE: Include and edit this paragraph when refrigerant piping is not included in other project specifications.
****

Provide accessories as specified in [CID A-A-50502 and] this section. Provide suction line accumulators as recommended by equipment manufacturer's installation instructions. [Provide a filter-drier in the liquid line.]

2.8.1 Factory Charged Tubing

Provide extra soft, deoxidized, bright annealed copper tubing conforming to ASTM B280, factory dehydrated and furnished with a balanced charge of refrigerant recommended by manufacturer of equipment being connected. Factory insulate suction line tubing with 9.52 mm 3/8 inchminimum thickness of closed cell, foamed plastic conforming to ASTM C534/C534M with a permeance rating not to exceed 1.0. Provide quick-connectors with caps or plugs to protect couplings. Include couplings for suction and liquid line connections of the indoor and outdoor sections.

2.8.2 Field-Assembled Refrigerant Piping

Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings, and accessories shall conform to ANSI/ASHRAE 15 & 34 and ASME B31.5, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type K or L, conforming to ASTM B88M ASTM B88, except that tubing with outside diameters of 6.35 mm 1/4 inch and 9.52 mm 3/8 inch shall have nominal wall thickness of not less than 7.62 mm 0.030 inch and 0.81 mm 0.032 inch, respectively. Soft annealed copper tubing conforming to ASTM B280 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.

2.8.3 Fittings

ASME B16.22 for solder-joint fittings. UL 109 for flared tube fittings.

2.8.4 Brazing Filler Material

AWS A5.8/A5.8M.

2.8.5 Pipe Hangers and Supports

MSS SP-69 and MSS SP-58, Type [_____], except as indicated otherwise.

2.8.6 Pipe Sleeves

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 6.35 mm 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

2.8.6.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide Schedule 40 or Standard Weight zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 80 mm 3 inches above finished floor.

2.8.6.2 Sleeves in Partitions and Non-Masonry Structures

Provide zinc-coated steel sheet sleeves having a nominal weight of not less than 4.39 kg per square meter 0.90 pound per square foot, in partitions and other than masonry and concrete walls, floors, and roofs.

2.9 FINISHES

Provide steel surfaces of equipment including packaged terminal units, heat pumps, and air conditioners, that do not have a zinc coating conforming to \&[ASTM A123/A123M] [ASTM A653/A653M]&\, or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.10 SOURCE QUALITY CONTROL

2.10.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including packaged terminal units, heat pumps, and air conditioners in accordance with ASTM B117. Conduct test for 500 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Test specimens shall have a standard scribe mark as defined in ASTM D1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D1654. Rating of failure at the scribe mark shall not be less than six, average creepage not greater than 3.18 mm 1/8 inch. Rating of the unscribed area shall not be less than 10, no failure.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinking type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

3.1.1 Packaged Terminal Air Conditioners and Heat Pumps

Wall sleeve installation shall provide a positive weathertight and airtight seal.

3.1.2 Unitary Air Conditioning System

Install as indicated, in accordance with requirements of ANSI/ASHRAE 15 & 34, and the manufacturer's installation and operational instructions.

3.1.3 Room Air Conditioners

Install units in accordance with manufacturer's instructions. Provide structural mountings, closures, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

3.2 PIPING

Brazing, bending, forming and assembly of refrigerant piping shall conform to ASME B31.5.

3.2.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58. Installation of hanger types and supports for bare and covered pipes shall conform to MSS SP-69 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58.

3.2.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder complying with AWS A5.8/A5.8M. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with ASME B31.5.

3.2.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.

3.2.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in

refrigerant piping in accordance with [CID A-A-50502] [and] [this section] when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be determined by piping and installation of the unit on location. Install dryers of 820 mL 50 cubic inches and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed.

3.2.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

3.2.6 Solenoid Valve Installation

Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening. Traps and piping to drainage disposal points shall conform to Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.4 ACCESS PANELS

Provide access panels for concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

3.5 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air.

3.6 FLASHING AND PITCH POCKETS

****
NOTE: Show details of flashings and pitch pockets on drawings.
****

Provide flashing and pitch pockets for equipment supports and roof penetrations and flashing where piping or ductwork passes through exterior walls in accordance with Section 07 60 00 FLASHING AND SHEET METAL.

3.7 IDENTIFICATION TAGS AND PLATES

Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide minimum letter and numeral size of 3.18 mm 1/8 inch high.

3.8 FIELD QUALITY CONTROL

3.8.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ANSI/ASHRAE 15 & 34, except that test pressure shall not exceed 1034 kPa (gage) 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.8.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 133 Pa one mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.8.3 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

3.8.4 Performance Tests

****
NOTE: List the readings desired for a particular system if not covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.
****

Upon completion of evacuation, charging, startup, final leak testing, and proper adjustment of controls, test the systems to demonstrate compliance with performance and capacity requirements. Test systems for not less than 8 hours, record readings hourly. At the end of the test period, average the readings, and the average shall be considered to be the system performance. Record the following readings:

[_____]
[_____]

3.9 WASTE MANAGEMENT

****
NOTE: Diverting waste from the landfill contributes to the following LEED credit: MR2. Coordinate with Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.
****

Separate waste in accordance with the Waste Management Plan, placing copper materials in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

3.10 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurements commonly agreed on by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:

Products	Inch-Pound	Metric
a. [_____]	[_____]	[_____]

-- End of Section --