Preparing Activity: NASA

Superseding
UFGS-23 82 16.00 40 (May 2016)
UFGS-23 82 16 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 82 16.00 40

AIR COILS

08/22

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SECTION 23 82 16.00 40

AIR COILS
08/22

NOTE: This guide specification covers the requirements for coils for cold water, hot water, steam, and refrigerant.

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 item(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

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

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 Reference Identifier (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 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B43	(2020) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D2247	(2015; R 2020) Standard Practice for Testing Water Resistance of Coatings in 100?Percent Relative Humidity
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 12944-9	(2018) Paints and Varnishes - Corrosion Protection of Steet Structures by Protective Paint Systems - Part 9: Protective Paint Systems and Laboratory Performance Test Methods for Offshore and Related Structure

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal

items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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

Record of Existing Conditions

SD-02 Shop Drawings

Fabrication Drawings; G[, [____]]

Connection Diagrams; G[, [____]]

Controls Layout; G[, [____]]

Internal Tubing and Wiring; G[, [____]]

Installation Drawings; G[, [____]]

SD-03 Product Data

Steam Heating; G[, [____]]

Hot-Water Heating; G[, [____]]

Chilled-Water Cooling; G[, [____]]

Volatile Refrigerant Cooling; G[, [____]]

SD-05 Design Data

Design Analysis and Calculations

SD-06 Test Reports

Final Test Reports

SD-07 Certificates

Certificates of Conformance

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

1.3 QUALITY CONTROL

Submit a record of existing conditions consisting of the results of a survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite.

Provide coils that bear the ARI certification seal indicating compliance with AHRI 410. Submit Certificates of Conformance for following items showing conformance with AHRI 410:

a. Coil

b. Coil casings

c. Coil headers

d. Coil tubing

e. Coil circuiting

Indicate the general physical controls layout, and internal tubing and wiring details on the drawings. Submit design analysis and calculations for coils.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit manufacturer's catalog data for the following coil types indicating, when applicable, coil pressure and temperature ratings, coil casings, headers, tubing, circuiting, and drainable coils.

a. Steam heating

b. Hot-water heating

c. Chilled-water cooling

d. Volatile refrigerant cooling

Submit fabrication drawings for coil units consisting of fabrication and assembly details to be performed in the factory. Include connection diagrams indicating the relations and connections of the following items:

a. Coil

b. Coil casings

c. Coil headers

d. Coil tubing

e. Coil circuiting

2.1.1 Coil Pressure and Temperature Ratings

****
NOTE: Delete ratings not applicable to project.
****

Provide coils designed for the following fluid operating pressures and temperatures:

Service	Pressure (kPa)	Temperature (Degrees C)
Steam - low pressure	175	131
Steam - high pressure	1050	186
Steam - superheated	2400	260
Hot water	1400	121
Chilled water	1400	7
Volatile refrigerant	1400	149

Service	Pressure (psi)	Temperature (Degrees F)
Steam - low pressure	25	267
Steam - high pressure	150	366
Steam - superheated	350	500
Hot water	200	250
Chilled water	200	45
Volatile refrigerant	200	300

Air-pressure test coils under water at the following minimum pressures:

Service	Pressure (kPa)
Steam	1750
Hot water	1750
Chilled water	1750
Volatile refrigerant	2800

Service	Pressure (psi)
Steam	250
Hot water	250
Chilled water	250
Volatile refrigerant	400

2.2 COMPONENTS

2.2.1 Coil Casings

Provide coil casings that are mill-galvanized, 1.6 millimeter 16-gage, minimum. Ensure sheet metal has not less than 380 gram per square meter 1.25-ounces of zinc per square foot of two-sided metal surface conforming to ASTM A653/A653M. Provide a casing flanged on four sides for bolted assembly, except as otherwise specified.

Where coils are stacked, provide a double-bend construction casing.

Provide casings with end supports and top and bottom channels of rigid construction that provide allowance for thermal expansion and contraction. Coil supports, channels and blank-off plates shall be the same metal as the coil casing.

Provide duct-mounted reheat coil casings not over 900 millimeter 36-inches in length, fabricated from a minimum 1.0 millimeter 20-gage galvanized steel conforming to above specified requirements. Provide casings that are flanged or suitable for drive-slip assembly.

****
NOTE: Coordinate clearance with drawings.
****

Provide coil mounting within the housing that is either fixed or slide-out type, except as otherwise specified. Provide slide-out type coils for ceiling-suspended package units, and for other package units whose capacity exceeds 7 cubic meter per second 15,000 cubic-feet per minute.

2.2.2 Coil Headers

****
NOTE: Where corrosive-condensate conditions exist, only copper headers are suitable.
****

Provide direct expansion, volatile refrigerant coils with necessary

control connections.

Fit steam and water coil headers with DN8 1/4-inch iron pipe size(ips) spring-loaded plug drains and vent petcocks. Provide automatic vents where indicated.

2.2.3 Coil Tubing

Install coils constructed of copper tubing with aluminum or copper fins. Provide helical coil fins that are wound tight to the tubes and solder-coated. Provide plate fins that have spacer collars in metallic contact with the adjacent fin. Plate fins shall be continuous. Ensure fins are mechanically bonded to the tube. Ensure bare tube surface is not visible within the finned portion of the coil.

Provide solder-coated cooling coils of helical wound copper design.

For coil tubes in water or volatile refrigerant service, provide tubes that are parallel. Ensure coil tubes have sufficient intermediate full coil depth supports to prevent sagging of unsupported span due to: working fluid pressures, temperatures, and summer and winter coil-ambient conditions. Sagging is unacceptable if tube centerline is displaced by more than 5 millimeter 3/16-inch from centerline of tube connection at outlet header when coils are more than two rows deep and when installed in accordance with the manufacturer's instructions. Make adequate provision for expansion and contraction that precludes sagging and distortion under thermal loads applied in indicated or specified service. Slope tubes to be free draining.

Provide maximum heating-coil face tube spacing of 75 millimeter 3-inches on center for DN25 1-inch outside-diameter (od) tubes, 50 millimeter 2-inches for DN20 3/4-inch od tubes, and 38 millimeter for DN18 1-1/2-inches for 5/8-inch od tubes.

Provide coil face tube spacing for cooling coils and for helically wound heating coils immediately followed by water-cooling coils that do not exceed 38 millimeter 1-1/2-inches on center.

Ensure tubes are straight, with turns made through headers or return U-bends, with brazed connections and joints, except as otherwise specified.

****
NOTE: Select the following paragraph for standard hot and chilled water and saturated steam conditions.
****

Ensure coil tube material is seamless deoxidized copper.

Ensure coil tube material is seamless 90-10 copper-nickel with 0.89 millimeter 0.035-inch wall thickness for superheated-steam service to 2500 kilopascal 350-pounds per square inch (psi) at 260 degrees C 500 degrees F.

****
NOTE: Select the following paragraph for low cost installation for steam, hot and chilled water, and DX coils, with the expectation of a long coil life.
****

[Provide raw coil tube stock wall with a minimum thickness of 0.64

millimeter 0.025-inch.]

****
NOTE: Select the following paragraph for general construction for steam, hot and chilled water and DX coils. Standard copper heavy duty coils with 1.24 millimeter 0.049-inch walls are available.
****

[Provide raw coil tube stock wall with a minimum thickness of 0.89 millimeter 0.035-inch.]

Where mechanical insert devices are used to increase liquid turbulence within tubes, increase the wall thickness of these tubes by 0.25 millimeter 0.010-inch over the minimum raw coil tube stock specified for the service.

Provide minimum tube outside diameter of DN15 1/2-inch.

2.2.4 Coil Circuiting

[Provide standard or full-circuited water coils that have as many full-length tubes in each circuit as the number of tubes in the depth of the coil face.][Provide double-circuit water coils that have twice as many tubes as standard coils.][Provide half-circuit water coils that have half as many tubes as standard coils and to the next larger whole number where odd numbers are involved.]

Provide counterflow type coils when more than two rows deep, except that in the case of double- or half-circuit coils, reasonable deviation from counterflow arrangement is permitted, provided the pressure drop and capacity requirements are met.

2.2.5 Drainable Coils

Provide drainable coils that are capable of being purged free of water with compressed air.

Provide self-draining coils with a drain point at the end of every tube and sloped to that point. Provide drain provisions that include: drained headers, U-bends with integral plugs; or nonferrous plugs in cast-iron headers. Provide tubes that drain substantially dry by gravity alone when drains and vents are open.

Where necessary, fill the coil with water to the end of the manufacturer's header connections and check drainage volume against the manufacturer's data.

2.2.6 Coil Types

2.2.6.1 Steam Heating

[For Type SA, provide steam distributing, tube-in-tube with multiple-orifice distributors. Provide a tube with a minimum outside-diameter of DN25 1-inch wherever coil is exposed to airstream at freezing temperatures. For all other applications, provide a minimum outside-diameter of DN18 5/8-inch. Provide tubes that are sloped 3.1 millimeter in 300 millimeter 1/8-inch per foot, and coil casing that is level. Provide coil with inlet and outlet connections on the same side.

][For Type SB, provide tube-in-tube type, for reheat service, with modulating control. When located in ductwork over 1800 millimeter 6-feet in total width, provide either two separate coils or one coil with supply to both ends and a single return. Provide coil with inlet and outlet connections on the same end and on opposite sides of the two-coil assembly.

][For Type SC, provide single row, single circuit, for reheat service with two-position control.

][For Type SD, provide integral damper face and bypass type. Provide coil that includes finned elements with headers. Ensure return bends are pitched within the casing; and bypasses with interlocked dampers are controlled by a damper motor and airstream thermostats.

] Provide a maximum fin spacing of 10 per 25 millimeter linear inch. Provide tubes that are connected to supply and return headers by mechanical joints and are secured against vibration by a channel that permits expansion and contraction. Provide 1.6 millimeter 16-gage cold-rolled steel damper blades. Provide graphite-impregnated nylon damper rod bearings. Provide oil-impregnated bronze linkage bearings. Proportion air such that the average temperature at any point in a plane parallel to the coil face, 900 millimeter 3-feet downstream of the leaving side, does not vary more than 3 degrees C 5 degrees F from the thermostat setting. Vary pressure-drop of air passing through the coil no more than plus or minus 5 percent, regardless of the position of the internal dampers.

[Casings shall be minimum 1.6 millimeter16-gauge, galvanized steel.

][Casings shall be minimum 1.6 millimeter16-gauge, 304 stainless steel.

] Coil headers shall be cast iron with tubes expanded into headers, steel pipe with brazed tube connections, or heavy seamless copper with tubes brazed to header.

2.2.6.2 Hot-Water Heating

[For Type HA, provide continuous circuit type, limited to two rows depth.

][For Type HB, provide drainable counterflow type, with more than two rows.

][Casings shall be minimum 1.6 millimeter16-gauge, galvanized steel.

][Casings shall be minimum 1.6 millimeter16-gauge, 304 stainless steel.

] Coil headers shall be Type L seamless copper conforming to ASTM B88, with tubes brazed to header.

Coil connections shall be Schedule 40 red brass conforming to ASTM B43, threaded end for 50 millimeters2-inch and smaller and [flanged][grooved] end for 65 millimeters2-1/2-inch and larger.

2.2.6.3 Chilled-Water Cooling

[For Type CA, provide continuous circuit, drainable type, limited to two rows depth.

][For Type CB, provide self-draining, counterflow type.

][For Type CC, provide self-draining, cleanable, counterflow type. Provide straight-through type tubes, rolled or brazed into steel tube sheets. Enclose headers with gasketed and bolted removable cover plates to provide access to tube internals from either one end or both ends of coil.

] Casings shall be minimum 1.6 millimeter16-gauge, 304 stainless steel.

Coil headers shall be Type L seamless copper conforming to ASTM B88, with tubes brazed to header.

Coil connections shall be Schedule 40 red brass conforming to ASTM B43, threaded end for 50 millimeters2-inch and smaller and [flanged][grooved] end for 65 millimeters2-1/2-inch and larger.

Maximum allowable fin spacing shall be 394 fins per meter10 fins per inch. Coil depth shall not exceed [8][10] rows to allow for the cleaning of the coil in place.

2.2.6.4 Volatile Refrigerant Cooling

[For Type DX, provide counterflow type, designed for use with refrigerant specified, with equal length circuiting arrangement. Provide the number of distributors that suit indicated refrigerant and that eliminate trapping of refrigerant and oil. Obtain coil capacity with an expansion valve set for not less than 5 degrees C 8 degrees F of superheat. Provide a refrigerant distributor that is furnished and installed by the coil manufacturer. Provide a tube outside diameter that is either DN18 5/8-inch or DN20 3/4-inch.

] Coils shall be constructed of 13 millimeters1/2-inch OD min. seamless copper tubes with aluminum fins and tested at 1720 kPa250 psi prior to dehydration after which they are to be purged and sealed with inert gas prior to shipment.

Suction header shall be constructed of extra heavy seamless copper tubing.

Distributors shall be low pressure drop Venturi type design with male sweat connection to distribute refrigeration equally to multiple circuits.

[Provide refrigerant distributor that is suitable for the thermostatic expansion valve recommended by the manufacturer for the service and capacity specified or indicated. Ensure arrangement is capable of stable operation down to 40 percent or less of design capacity.

][Provide refrigerant distributor suitable for use with a balanced, double-ported thermostatic expansion valve or with a pilot-operated valve where indicated. Ensure arrangement is capable of stable operation down to 15 percent of design capacity.

]2.2.6.5 Corrosion Protection Coating

[Protective coil coating shall be baked phenolic epoxy. Coil and casing shall receive a uniform coating on all surfaces including fin edges. Coating shall be by full immersion or flow coating to film thickness of approximately 0.050 millimeters1.0 mil. Coating shall be formulated to mee 5B cross-hatch adhesion rating per ASTM D3359 on coil construction materials; aluminum, copper, steel stainless, galvanized, etc.. Coating shall provide corrosion protection in not less than 6,000 hour salt spray test in accordance with ASTM B117 and humidity resistance of not less that

2,000 hours per ASTM D2247. Coating shall meet ISO 12944-9 cyclical offshore standard. Coils subjected to direct ultraviolet (UV) exposure shall have a UV-resistant topcoat.

][Protective coil coating shall be a flexible cationic epoxy polymer electro-coating uniformly applied to all metallic surfaces with no material bridging between fins. Electro-coat process shall ensure complete encapsulation of conductive surfaces with uniform dry film thickness from 15-25µm0.6-1.2 mils. E-coating shall meet 4B-5B rating from cross-hatch adhesion per ASTM D3359. Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray resistance per ASTM B117 using scribed aluminum test coupons. After e-coat cure, coil shall receive spray-applied, 2K polyurethane black topcoat to prevent UV degradation of epoxy e-coat film.

] Coating shall not impact the heat transfer performance of the coil by more than 1 percent.

PART 3 EXECUTION

3.1 INSTALLATION

Install coils in accordance with the manufacturer's recommendations.

Submit installation drawings for coil systems. Indicate overall physical features, dimensions, ratings, service requirements, equipment weights and layout and arrangement details of equipment room on drawings.

Clean oil film from coil fins with hot water/detergent as recommended by coil manufacturer.

Comb out fins when bent or crushed before enclosing coils in housing. Clean dust and debris from each coil to ensure its cleanliness.

Provide offsets in piping and physical space adjacent to the installed coil to facilitate coil removal.

Provide flexible piping connections and/or piping vibration isolation supports where specified or shown.

[Provide where indicated cooling coils with 40 millimeters1-1/2-inch deep welded stainless steel drain pans. Drain pans shall be an integral part of the coil support. Provide condensate drain piping with drain traps to the indicated drain location.

]3.2 FIELD QUALITY CONTROL

****

NOTE: Conduct inspection of the installation by the Systems Engineer/Condition Monitoring Office/Predictive Testing Group during acceptance testing using advanced monitoring technologies such as Infrared Imaging or Ultrasonic Listening. These technologies can identify plugged or restricted tubing and system/pressure/vacuum leaks.

****

For drainable coils:

a. Field check coil pitch and leveling for drainability in the presence of the Contracting Officer.

b. Perform pressure tests and dehydrate coils.

c. Perform vacuum tests, purge with inert gas, and seal coils.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

3.3 CLOSEOUT ACTIVITIES

3.3.1 Operation and Maintenance

Submit [6] [_____] copies of the operation and maintenance manuals 30 calendar days prior to testing the coil systems. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

3.3.2 Record Drawings

Submit record drawings for coil systems providing current factual information including deviations from, and amendments to, the drawings and concealed and visible changes in the work.

-- End of Section --