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USACE / NAVFAC / AFCEA / NASA                      UFGS-23 82 16.00 40 (April 2006)  
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Preparing Activity:    NASA                      Superseding  
    NASA-15762S (December 2005)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are NOT in agreement with UMRL dated 01 April 2006

Revised throughout - changes not indicated by CHG tags

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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AIR COILS

04/06

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### SECTION 23 82 16.00 40

#### AIR COILS 04/06

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers coils for cold water, hot water, steam, and refrigerant.

Drawings or schedules must include all capacity conditions, media superheat if any, maximum airside pressure drops, number of passes, fins per linear inch millimeter, rows deep, face area, coil circuits, inlet and outlet connections, etc.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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## PART 1 GENERAL

### 1.1 REFERENCES

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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.

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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 AND REFRIGERATION INSTITUTE (ARI)

ARI 410 (2001; 2002a) Standard for  
Forced-Circulation Air-Cooling and  
Air-Heating Coils

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2004a) Standard Specification for Steel  
Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by  
the Hot-Dip Process

## 1.2 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-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Coil  
Coil Casings  
Coil Headers  
Coil Tubing  
Coil Circuiting

Fabrication Drawings and Record Drawings shall be submitted for coil units in accordance with paragraph entitled, "General Requirements," of this section.

Installation Drawings shall be submitted for coil systems in accordance with the paragraph entitled, "Installation," of this section.

#### SD-03 Product Data

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

Steam Heating  
Hot-Water Heating  
Chilled-Water Cooling  
Volatile Refrigerant Cooling

#### SD-05 Design Data

Design Analysis and Calculations shall be submitted for coils in accordance with paragraph entitled, "General Requirements," of this section.

#### SD-06 Test Reports

Test reports shall be submitted for the following tests in



accordance with the paragraph entitled, "Tests," of this section.

Pressure Tests  
Vacuum Tests

#### SD-07 Certificates

Records of Existing Conditions shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Coil  
Coil Casings  
Coil Headers  
Coil Tubing  
Coil Circuiting

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

### 1.3 GENERAL REQUIREMENTS

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NOTE: If Section 23 00 00.00 40 GENERAL MECHANICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.  
\*\*\*\*\*

Section 23 00 00.00 40 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

Fabrication Drawings shall be submitted for coil units consisting of fabrication and assembly details to be performed in the factory.

Record Drawings shall be submitted for coil systems providing current factual information including deviations from, and amendments to, the drawings and concealed and visible changes in the work.

Design Analysis and Calculations shall be submitted for coils.

Records of Existing Conditions shall be submitted consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

### 1.4 LABEL

Coils shall bear the ARI certification seal indicating compliance with ARI 410.



PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Coil Pressure and Temperature Ratings

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

Coils shall be designed for the following fluid operating pressures and temperatures.

| <u>Service</u>        | <u>Pressure<br/>(kPa)</u> | <u>Temperature<br/>(Degrees C)</u> |
|-----------------------|---------------------------|------------------------------------|
| 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                                |
| <u>Service</u>        | <u>Pressure<br/>(psi)</u> | <u>Temperature<br/>(Degrees F)</u> |
| 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                                |

Coils shall be air-pressure tested under water at the following minimum pressures:

| <u>Service</u>       | <u>Pressure<br/>(kPa)</u> |
|----------------------|---------------------------|
| Steam                | 1750                      |
| Hot water            | 1750                      |
| Chilled water        | 1750                      |
| Volatile refrigerant | 2800                      |
| <u>Service</u>       | <u>Pressure<br/>(psi)</u> |
| Steam                | 250                       |



| <u>Service</u>       | <u>Pressure<br/>(psi)</u> |
|----------------------|---------------------------|
| Hot water            | 250                       |
| Chilled water        | 250                       |
| Volatile refrigerant | 400                       |

#### 2.1.1.2 Coil Casings

Coil casing shall be mill-galvanized 1.6 millimeter 16-gage, minimum, sheet metal with not less than 380 gram per square meter 1.25 ounces of zinc per square foot of two-sided metal surface conforming to ASTM A 653/A 653M. Casing shall be flanged on four sides for bolted assembly, except as otherwise specified.

Where coils are stacked, casing shall be of double-bend construction.

Duct-mounted reheat coil casings not over 900 millimeter 36 inches in length shall be fabricated from a minimum 1.0 millimeter 20-gage galvanized steel conforming to above specified requirements; casings shall be flanged or suitable for drive-slip assembly.

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

Coil mounting within housing shall be either fixed or slide-out type, except as otherwise specified. Coils shall be slide-out type for ceiling-suspended package units, and for other package units whose capacity exceeds 7 cubic meter per second 15,000 cubic feet per minute.

#### 2.1.1.3 Coil Headers

\*\*\*\*\*  
**NOTE: Where corrosive-condensate conditions exist, only copper headers may be suitable.**  
 \*\*\*\*\*

Coil headers shall be cast iron, brass, copper, or aluminum casting.

Direct expansion, volatile refrigerant coils shall have copper or brass headers with necessary control connections.

Steam and water coil headers shall be fitted with DN8 1/4-inch iron pipe size spring-loaded plug drains and vent petcocks. Automatic vents shall be provided where indicated.

#### 2.1.1.4 Coil Tubing

Coils shall be constructed of copper tubing with aluminum or copper fins. Helical coil fins shall be wound tight to the tubes and solder-coated. Plate fins shall have spacer collars in metallic contact with the adjacent fin, and fins shall be mechanically bonded to the tube. No bare tube surface shall be visible within the finned portion of the coil.

Cooling coils of helical wound copper design shall be solder-coated.



Coil tubes in water and volatile refrigerant service shall be parallel and shall have sufficient intermediate full coil depth supports to prevent sagging of unsupported span due to working fluid pressures and temperatures and summer and winter coil-ambient conditions. Sagging shall be 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. Provisions for expansion and contraction shall be adequate to preclude sagging and distortion under thermal loads applied in indicated or specified service. Tubes shall be sloped to be free draining.

Heating-coil face tube spacing shall be a maximum 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.

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

Tubes shall be straight, turns shall be made through headers or return U-bends, and connections and joints shall be brazed, except as otherwise specified.

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

Coil tube material shall be seamless deoxidized copper.

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

\*\*\*\*\*  
NOTE: Select the following paragraph for low cost  
installation for steam, hot and chilled water, and  
dx coils, with the expectation that coil life will  
be long.  
\*\*\*\*\*

Raw coil tube stock wall minimum thickness shall be 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  
0.049-inch 1.24 millimeter walls are available.  
\*\*\*\*\*

Raw coil tube stock wall minimum thickness shall be 0.89 millimeter 0.035 inch.

Where mechanical insert devices are used to increase liquid turbulence within tubes, the wall thickness of these tubes shall be increased by 0.25



millimeter 0.010 inch over the minimum raw coil tube stock specified for the service.

Tube minimum od shall be 1/2 inch DN15, minimum.

#### 2.1.5 Coil Circuiting

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

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

#### 2.1.6 Drainable Coils

Drainable coils shall be capable of being purged free of water with compressed air.

Self-draining coils shall have a drain point at the end of every tube and shall be pitched to that point. Drain provisions shall include: drained headers; U-bends with integral plugs; or nonferrous plugs in cast-iron headers. Each tube shall drain substantially dry by gravity alone when drains and vents are open.

Where necessary, the coil shall be filled with water to the end of the manufacturer's header connections and drainage volume shall be checked against the manufacturer's data.

### 2.2 COIL TYPES

#### 2.2.1 Steam Heating

Type SA shall be steam distributing, tube-in-tube with multiple-orifice distributors. Minimum od Tube shall be 1 inch DN25, minimum wherever coil is exposed to airstream at freezing temperatures. For all other applications, minimum tube od shall be 5/8 inch DN18, minimum. Tubes shall be pitched 1/8 inch per foot 3.1 millimeter in 300 millimeter, and coil casing shall be level. Inlet and outlet connections shall be on the same side of the coil.

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

Type SC shall be single row, single circuit, for reheat service with two-position control.

Type SD shall be integral damper face and bypass type. Coil shall include headered, finned elements, with return bends pitched within the casing, and bypasses with interlocked dampers controlled by a damper motor and airstream thermostats.



Maximum fin spacing shall be 10 per linear inch 25 millimeter. Tubes shall be connected to supply and return headers by mechanical joints and shall be secured against vibration by a channel that permits expansion and contraction. Damper blades shall be 16-gage 1.6 millimeter cold-rolled steel. Damper rod bearings shall be graphite-impregnated nylon. Linkage bearings shall be oil-impregnated bronze. Proportioning of air shall be such that the average temperature at any point in a plane parallel to the coil face, 3 feet 900 millimeter downstream of the leaving side, shall vary not more than 5 degrees F 3 degrees C from the thermostat setting. Pressure-drop of air passing through the coil shall vary not more than plus or minus 5 percent, regardless of the position of the internal dampers.

#### 2.2.2 Hot-Water Heating

Type HA shall be continuous circuit type, limited to two rows depth.

Type HB shall be drainable counterflow type, with more than two rows.

#### 2.2.3 Chilled-Water Cooling

Type CA shall be continuous circuit, drainable type, limited to two rows depth.

Type CB shall be self-draining, counterflow type.

Type CC shall be self-draining, cleanable, counterflow type. Tubes shall be straight-through type, rolled or brazed into steel tube sheets. Headers shall be enclosed with gasketed and bolted removable cover plates to provide access to tube internals from either one end or both ends of coil.

#### 2.2.4 Volatile Refrigerant Cooling

Type DX shall be counterflow type, designed for use with refrigerant specified, with equal length circuiting arrangement. Number of distributors provided shall suit indicated refrigerant and shall eliminate trapping of refrigerant and oil. Coil capacity shall be obtained with expansion valve set for not less than 8 degrees F 5 degrees C of superheat.

Refrigerant distributor shall be furnished and installed by the coil manufacturer. Tube od shall be either 5/8 inch DN18 or 3/4 inch DN20.

[Refrigerant distributor shall be suitable for the thermostatic expansion valve recommended by the manufacturer for the service and capacity specified or indicated. Arrangement shall be capable of stable operation down to 40 percent or less of design capacity.]

[Refrigerant distributor shall be suitable for use with a balanced, double-ported thermostatic expansion valve or with a pilot-operated valve where indicated. Arrangement shall be capable of stable operation down to 15 percent of design capacity.]

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Coils shall be installed in accordance with the manufacturer's recommendations.

Installation Drawings shall be submitted for coil systems. Drawings shall indicate overall physical features, dimensions, ratings, service



requirements, equipment weights and layout and arrangement details of equipment room.

### 3.2 TESTS

\*\*\*\*\*  
NOTE: The Systems Engineer/Condition Monitoring Office/Predictive Testing Group should inspect the installation 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 types:

Coil pitch and leveling shall be field checked for drainability in the presence of the Contracting Officer.

Coils shall have [pressure tests](#) performed and be dehydrated. Coils shall also have [vacuum tests](#) performed, be purged with inert gas, and be sealed.

Final test reports shall be provided to the Contracting Officer. Reports shall have 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 OPERATION AND MAINTENANCE

Contractor shall submit [6] [\_\_\_\_\_] copies of the [Operation and Maintenance Manuals](#) 30 calendar days prior to testing the coil systems. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

-- End of Section --