

FORCED-CIRCULATION AIR-COOLING AND AIR-HEATING COILS

Section 1. Purpose

1.1 Purpose. The purpose of this standard is to establish for Forced-Circulation Air-Cooling and Air-Heating Coils: definitions; classifications; test requirements; rating requirements; minimum data requirements for Published Ratings; symbols and units; reference properties and conversion factors; marking and nameplate data; and conformance conditions.

1.1.1 Intent. This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 Review and Amendment. This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 Scope. This standard applies to Forced-Circulation Air-Cooling and Air-Heating Coils, as defined in Section 3 and classified in Section 4 of this standard, and for application under non-frosting conditions.

This standard documents a fundamental means for establishing coil performance by extension of laboratory test data to other operating conditions and other coil sizes and row depths.

Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* unless otherwise defined in this section.

3.1 Coil Line. For the purpose of this standard, a coil line is defined as having the following in common:

- a. Fluid (volatile refrigerant, water, steam, ~~or~~ aqueous ethylene glycol, or aqueous propylene glycol solutions)
- b. Tube size, spacing, arrangement (parallel or staggered) or internal construction
- c. Fin configuration (not spacing)

3.1.1 Examples of coil lines are:

- a. *Aqueous Ethylene Glycol or Aqueous Propylene Glycol Solutions.* If conditions b and c of 3.1 are satisfied, the following are types which may be part of one line:
 1. Continuous circuit type
 2. Self-draining type
 3. Cleanable type

- b. *Steam Distributing.*
- c. *Steam Single-Tube.*
- d. *Volatile Refrigerant.* Direct expansion coil with flow controlled by the expansion valve.
- e. *Water.* If conditions b and c of 3.1 are satisfied, the following are types which may be part of one line:
 - 1. Continuous circuit type
 - 2. Self-draining type
 - 3. Cleanable type

3.2 Cooling Capacity. The capacity associated with the change in air enthalpy which includes both the Latent and Sensible Capacities expressed in Btu/h [W].

3.2.1 Latent Capacity. Capacity associated with a change in humidity ratio.

3.2.2 Sensible Capacity. Capacity associated with a change in dry-bulb temperature.

3.3 Forced-Circulation Air Coil. A coil for use in an air stream whose circulation is caused by a difference in pressure produced by a fan or blower.

3.3.1 Forced-Circulation Air-Cooling Coil. A heat exchanger, with or without extended surfaces, through which either cold water, cold aqueous ethylene glycol or aqueous propylene glycol solutions, or volatile refrigerant is circulated, for the purpose of total cooling (sensible cooling plus latent cooling) of a forced-circulation air stream.

Table 1. Range of Standard Rating Conditions						
Item	Cooling Coils			Heating Coils		
	Volatile Refrigerant	Cold Water	Cold Ethylene and Propylene Glycol Solution	Steam	Hot Water	Hot Ethylene and Propylene Glycol Solution
Standard air face velocity, std. ft/min [std. m/s]	200 to 800 [1 to 4]	200 to 800 [1 to 4]	200 to 800 [1 to 4]	200 to 1,500 [1 to 8]	200 to 1,500 [1 to 8]	200 to 1,500 [1 to 8]
Entering air dry-bulb temp., °F [°C]	65 to 100 [18 to 38]	65 to 100 [18 to 38]	65 to 100 [18 to 38]	-20 to 100 [-29 to 38]	0.0 to 100 [-18 to 38]	-20 to 100 [-29 to 38]
Entering air wet-bulb temp., °F [°C]	60 to 85 [16 to 29]	60 to 85 [16 to 29]	60 to 85 [16 to 29]	-- --	-- --	-- --
Tube-Side fluid velocity, std. ft/s [std. m/s]	-- --	¹ 1.0 to 8.0 [0.3 to 2.4]	² 1.0 to 6.0 [0.3 to 1.8]	-- --	¹ 0.5 to 8.0 [0.1 to 2.4]	² 0.5 to 6.0 [0.1 to 1.8]
Entering fluid temp., °F [°C]	-- --	35 to 65 [1.7 to 18]	0.0 to 90 [-18 to 32]	-- --	120 to 250 [49 to 121]	0.0 to 200 [-18 to 93]
Saturated suction refrigerant temp. at coil outlet, °F [°C]	30 to 55 [-1.1 to 13]	-- --	-- --	-- --	-- --	-- --

Table 1. Range of Standard Rating Conditions						
	Cooling Coils			Heating Coils		
Minimum suction vapor superheat at coil outlet, °F [°C]	6.0 [3.3]	--	--	--	--	--
Steam pressure at coil inlet, psig [kPa gage]	--	--	--	2.0 to 250.0 [14 to 1723]	--	--
Maximum superheat in steam at coil inlet, °F [°C]	--	--	--	50 [28]	--	--
Concentration by mass, %	--	--	10 to 60	--	--	10 to 60
Minimum fin surface temperature, °F [°C]	> 32 [> 0.0]	> 32 [> 0.0]	> 32 [> 0.0]	> 32 [> 0.0]	> 32 [> 0.0]	> 32 [> 0.0]
Minimum tube wall surface temperature, °F [°C]	> 32 [> 0.0]	> 32 [> 0.0]	> ethylene glycol and propylene glycol sol. freeze point	> 32 [> 0.0]	> 32 [> 0.0]	> ethylene glycol and propylene glycol sol. freeze point
¹ On lower limit, Re shall exceed 3100 at t_{wm} . Predicted performance and actual performance in the water velocity range below the tube-side fluid velocity listed above is expected to show variations in excess of currently accepted tolerances for the following reasons: <ol style="list-style-type: none"> 1) Application of coils at low velocity can lead to excessive fouling. 2) Application of coils at low velocity can lead to possible air entrapment. 3) Differences in coil design/type affect the variation in low Re heat transfer coefficient. ² On lower limit, Re shall exceed 700 at t_{gm} .						
Note: Numbers in [] are in SI Units						

3.3.2 Forced-Circulation Air-Heating Coil. A heat exchanger, with or without extended surfaces, through which either hot water, hot aqueous ethylene glycol or aqueous propylene glycol solutions, or steam is circulated for the purpose of sensible heating of a forced-circulation air stream.

3.4 Heating Capacity. The capacity associated with the change in dry-bulb temperature expressed in Btu/h [W].

3.5 Laboratory Tests. Tests conducted by a manufacturer on representative coils to determine basic heat transfer and pressure drop characteristics that shall be used in developing Published Ratings.

3.6 Published Ratings. A compilation of the assigned values of those performance characteristics, under stated rating conditions, by which a coil may be chosen to fit its application. These values apply to all coils of like nominal size and type (identification) produced by the same manufacturer. As used herein, the term Published Ratings includes the ratings of all performance characteristics published in specifications, advertising or other literature controlled by the manufacturer or available through an automated rating/selection computer procedure.

3.6.1 Application Ratings. Ratings determined at conditions outside the range of standard rating conditions.

3.6.2 Standard Ratings. Ratings within the range of standard rating conditions (Table 1) and which are accurate representations of test data.

3.7 "Shall" or "Should". Shall or "should" shall be interpreted as follows:

3.7.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.7.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.8 *Standard Air.* Air weighing 0.075 lb/ft³ [1.2 kg/m³] which approximates dry air at 70°F [21°C] and at a barometric pressure of 29.92 in Hg [101.3 kPa].

3.9 *Standard Coil Orientation.* The standard coil position is that of horizontal tubes and vertical coil face with horizontal airflow.

3.10 *Test Series.* A group of related tests performed on the same test coil.

3.11 *Turbulators.* Mechanical devices inside tubes used to increase turbulence of fluids.

Section 4. Classifications

4.1 *Coil Surface Dimensions, Terminology and Surface Calculations.*

4.1.1 *Tube Arrangements and Types of Fin Combinations.*

4.1.1.1 Staggered tubes with:

- a. Continuous flat plate fins
- b. Continuous configured plate fins
- c. Crimped spiral fins
- d. Smooth spiral fins
- e. Flat plate fins on individually-finned tube
- f. Configured plate fins on individually-finned tube

4.1.1.2 Parallel (in-line) tubes with:

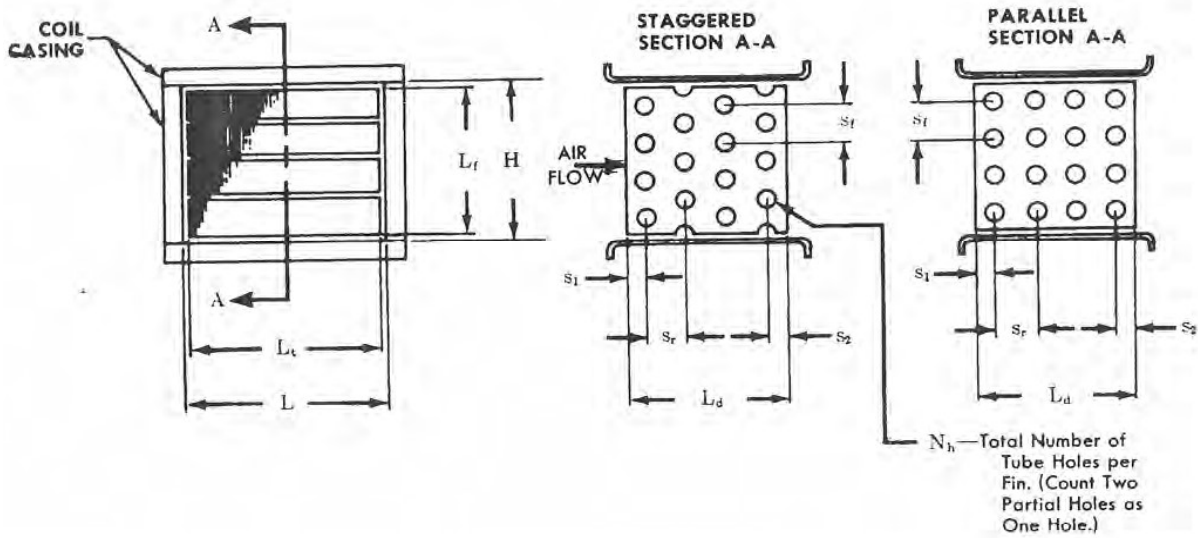
- a. Continuous flat plate fins
- b. Continuous configured plate fins
- c. Crimped spiral fins
- d. Smooth spiral fins
- e. Flat plate fins on individually-finned tube
- f. Configured plate fins on individually-finned tube

4.1.2 *Dimensions, Terminology and Fin Efficiency Calculations. (Note: Equations in [] are in SI Units)*

In the figures shown in 4.1.2.1, 4.1.2.2 and 4.1.2.3, *H* applies as shown whether channel flanges are turned inward or outward. Where an option is offered in the measurement of any dimension, the same basis shall be used to determine rating data as used in the evaluation of test results.

Dimensions L_f and L_d for a configured fin are determined, at the option of the manufacturer, from the blank fin sheet size prior to forming the configuration providing no edge trimming is performed after forming or from the finished fin size after forming.

4.1.2.1 Staggered tubes and parallel (in-line) tubes (as shown below) with continuous flat plate or configured plate fins.



4.1.2.2 Staggered tubes (as shown below) with smooth or crimped spiral fins or with flat plate or configured plate fins on individually-finned tube. Air baffles shown are to be considered optional and H may be the distance between channels as shown in 4.1.2.1.

