AHRI Standard 410-2001

(Formerly ARI Standard 410-2001)

2001 Standard for

Forced-Circulation Air-Cooling and Air-Heating Coils

AHRI Air-Conditioning, Heating, and Refrigeration Institute

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AHRI STANDARD 410-2001 WITH ADDENDUM 3,

Forced-Circulation Air-Heating and Air-Cooling Coils

June 2011

AHRI Standard 410-2001 with Addendum 3, Forced-Circulation Air-Heating and Air-Cooling Coils, is comprised of only the shaded portions shown. The June 2011 Addendum 3 has been incorporated into the already published 2001 version of AHRI Standard 410 to avoid confusion.

Particular additions (shown shaded in the standard), deletions ~~(shown with a strikethrough and shaded in the standard)~~, and corrections (shown shaded in the standard) are as follows:

1. In the following sections "propylene" was added

- Certified Ratings item c
- Table of Contents
  Figure 16
- Sections
  - 3.1.a
  - 3.1.1.a
  - 3.3.1
- Table 1
- Table 2
- Sections
  - 3.3.2
  - 5.2.7
  - 5.3.1
  - 5.4.3
  - 5.4.3.3
  - 5.4.3.3.2
  - 5.4.3.4
  - 5.4.4
  - 5.4.8
  - 6.2.2 Equations
    - (7b), (7c), (8a), (9a), (10a), figure before (15b), (17b), (18b), (19b), (20b), and (24a)
  - 6.3.7 (Form 410-7)
- Sections
  - 6.4.7
  - 7.1
    - K, l, m, n
  - 8.1
    - (c_{pg}), (f'), (Q_{gSTD}), (V_g), (w), and (x_g)
  - 8.2.2
    - (ffa) and (g)
- Figures 12, 13, 14, 15 and 16

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AHRI STANDARD 410-2001 WITH ADDENDUM 2,

Forced-Circulation Air-Heating and Air-Cooling Coils

May 2005

AHRI Standard 410-2001 with Addendum 2, Forced-Circulation Air-Heating and Air-Cooling Coils, is comprised of only the shaded portions shown. The May 2005 Addendum 2 has been incorporated into the already published 2001 version of AHRI Standard 410 to avoid confusion.

Particular additions (shown shaded in the standard), deletions ~~(shown with a strikethrough and shaded in the standard)~~, and corrections (shown shaded in the standard) are as follows:

1. In Section 5.2.5.1 the last sentence was replaced with the following :

   If the calculated capacity is less than 97.5%, new ratings shall be calculated.

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AHRI STANDARD 410-2001 WITH ADDENDUM 1,

Forced-Circulation Air-Heating and Air-Cooling Coils

May 2002

AHRI Standard 410-2001 with Addendum 1, *Forced-Circulation Air-Heating and Air-Cooling Coils*, is comprised of only the shaded portions shown. The May 2002 Addendum 1 has been incorporated into the already published 2001 version of AHRI Standard 410 to avoid confusion.

Particular additions (shown shaded in the standard), deletions ~~(shown with a strikethrough and shaded in the standard)~~, and corrections (shown shaded in the standard) are as follows:

1. In Section 6.4.1 the second sentence was replaced with the following:

   Published values of air-side pressure drop, under test, shall not be exceeded by more than 10%, or 0.05 in H2O [12.5 Pa], whichever is greater.

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IMPORTANT

SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that tests conducted under its standards/guidelines will be non-hazardous or free from risk.

AHRI CERTIFICATION PROGRAM PROVISIONS

Scope of the Certification Program

The Certification Program includes Forced-Circulation Air-Cooling Coils for application under non-frosting conditions, and Forced-Circulation Air-Heating Coils, as defined in Section 3 of the standard.

Coils Included. This program applies only to coils intended:

a. For field installation (built-up systems)
b. For use in central station air-conditioning units
c. For use in central station heating or heating and ventilating units

Exclusion. It does not include:

a. Coils sold to original equipment manufacturers for inclusion in packaged units
b. Coils installed in packaged air-conditioning or heating units by the manufacturer
c. Special coils: Coils of fin or tube material of special configuration not having cataloged performance data

Note: For the purpose of this program, a packaged unit is an assembly of components including coil(s) whose rating is based on a test of the complete assembly.

Certified Ratings

The following Certification Program ratings are verified by test:

a. Average total cooling or heating capacity, Btu/h [W]
b. Air pressure drop through coil at standard air density, in H_2O [kPa]
c. Water, ~~or~~ aqueous ethylene glycol, or aqueous propylene glycol solutions pressure drop through coil (including headers) at average fluid density, ft of fluid [m of fluid]

Note:
This standard supersedes ARI Standard 410-91.

Price $20.00 (M) $40.00 (NM)

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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

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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

	Cooling Coils			Heating Coils		
Item	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]	-- --	-- --	-- --	-- --	-- --

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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:

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:

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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/ft^3 [1.2 kg/m^3] 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 configurated plate fins
c. Crimped spiral fins
d. Smooth spiral fins
e. Flat plate fins on individually-finned tube
f. Configurated plate fins on individually-finned tube

4.1.1.2 Parallel (in-line) tubes with:

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

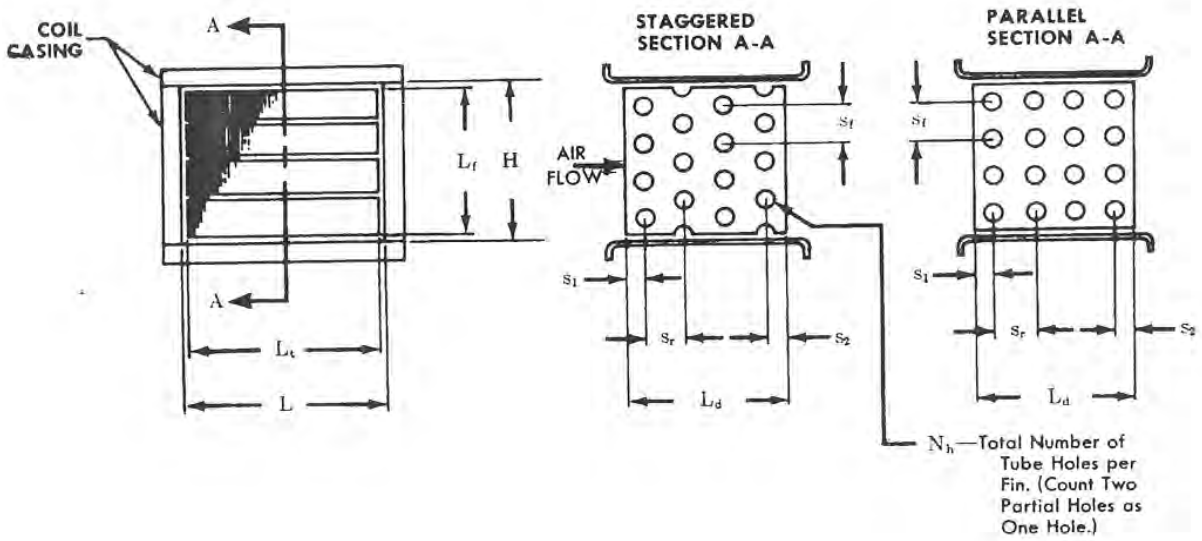
4.1.2 *Dimensions, Terminology and Fin Efficiency Calculations.* **(Note: Equations in [ ] are in SI Units)**

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.

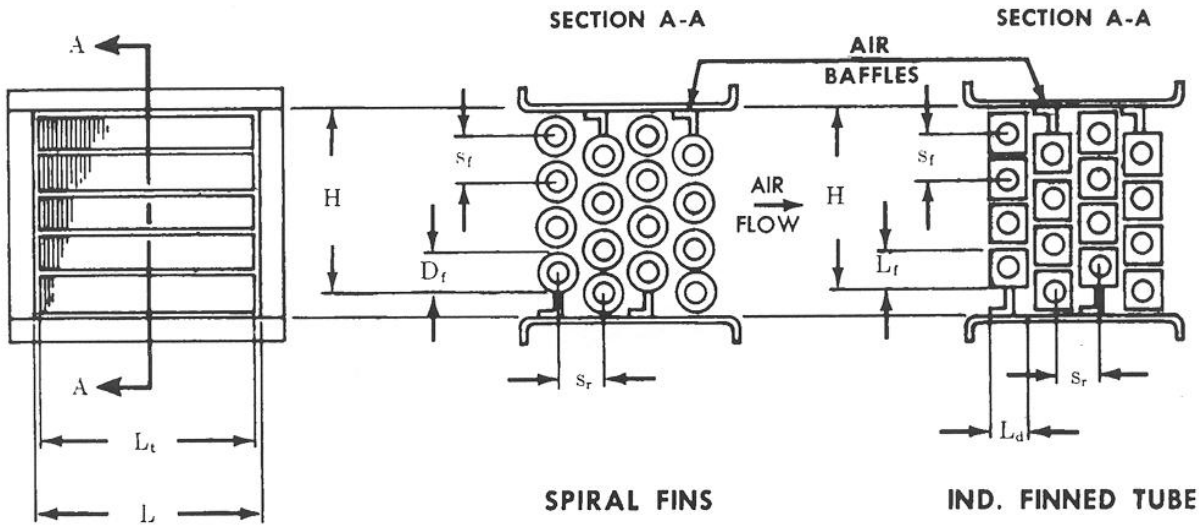
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Dimensions L_f and L_d for a configurated fin are determined, at the option of the manufacturer, from the blank fin sheet size prior to forming the configuration providing no edge trimming is performed after forming or from the finished fin size after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

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

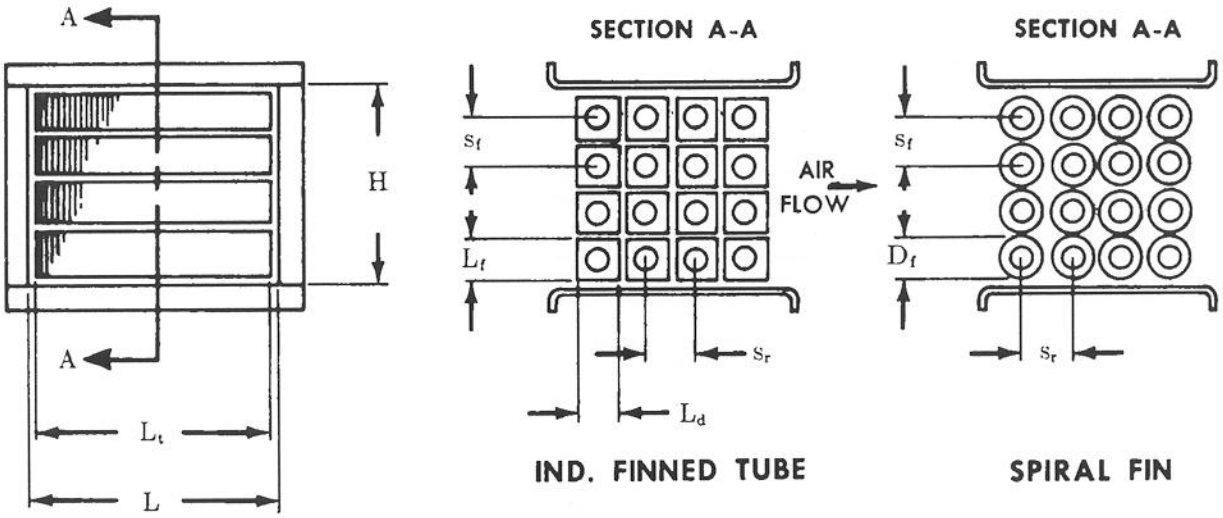


4.1.2.2 Staggered tubes (as shown below) with smooth or crimped spiral fins or with flat plate or configurated plate fins on individually-finned tube. Air baffles shown are to be considered optional and *H* may be the distance between channels as shown in 4.1.2.1.



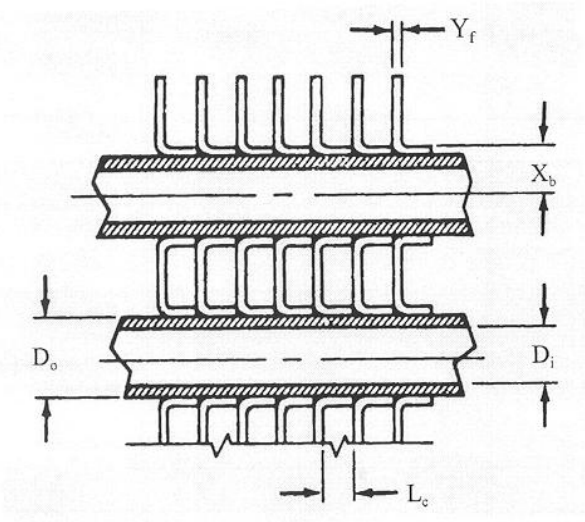
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4.1.2.3 Parallel (in-line) tubes (as shown below) with flat plate or configurated plate fin on individually-finned tube or with smooth or crimped spiral fins.



4.1.2.4 *Fin-Tube Assemblies*.

a. Plate fins with collars touching adjacent fin



Fin efficiency calculations:

$$x_e = \left(\frac{L_f L_d}{\pi N_t} \right)^{0.5}$$ for continuous plate fin

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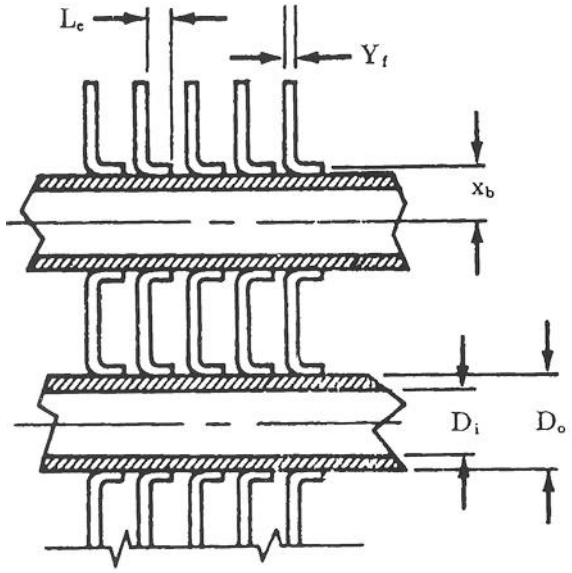
$$x_e = \left(\frac{L_f L_d}{\pi} \right)^{0.5}$$ for individually-finned tube

$$x_b = \frac{D_o + 2Y_f}{2}$$

$$w = x_e - x_b$$

From the curve of $w\left(\frac{f_a}{6k_f Y_f} \right)^{0.5}$ $\left[w\left(\frac{2f_a}{k_f Y_f} \right)^{0.5} \right]$ for various values of x_e/x_b, determine ϕ (Figure 10)

b. Plate fins with collars not touching adjacent fin

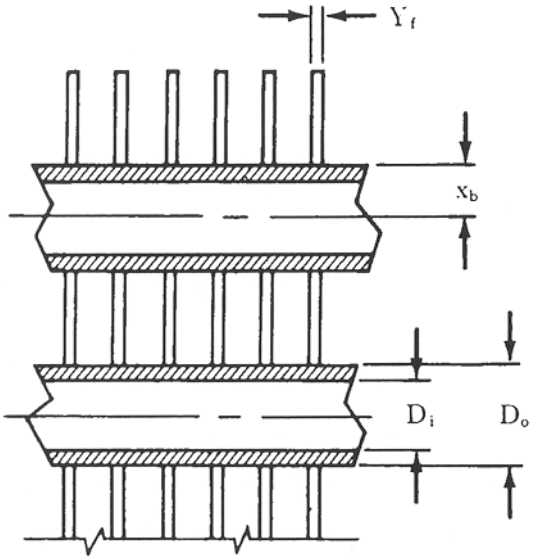


Fin efficiency calculations same as for plate fins with collars touching adjacent fin, except as follows:

$$x_b = \frac{D_o + Y_f}{2}$$

c. Plate fins without collars

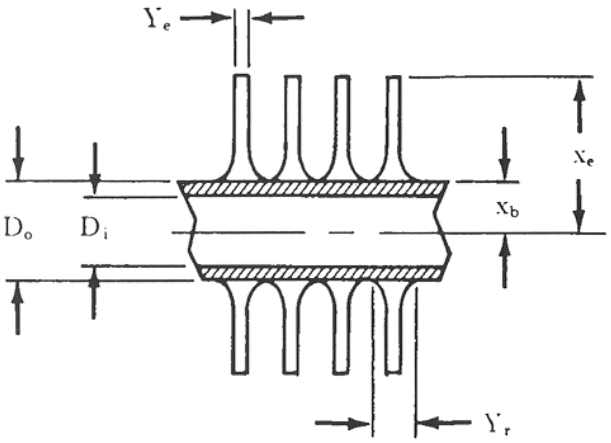
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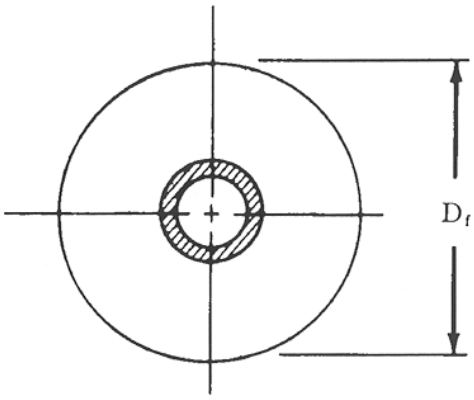


Fin efficiency calculations same as for plate fins with collars touching adjacent fin, except as follows:

$$x_b = \frac{D_o}{2}$$

d. Smooth spiral fins





Fin efficiency calculations

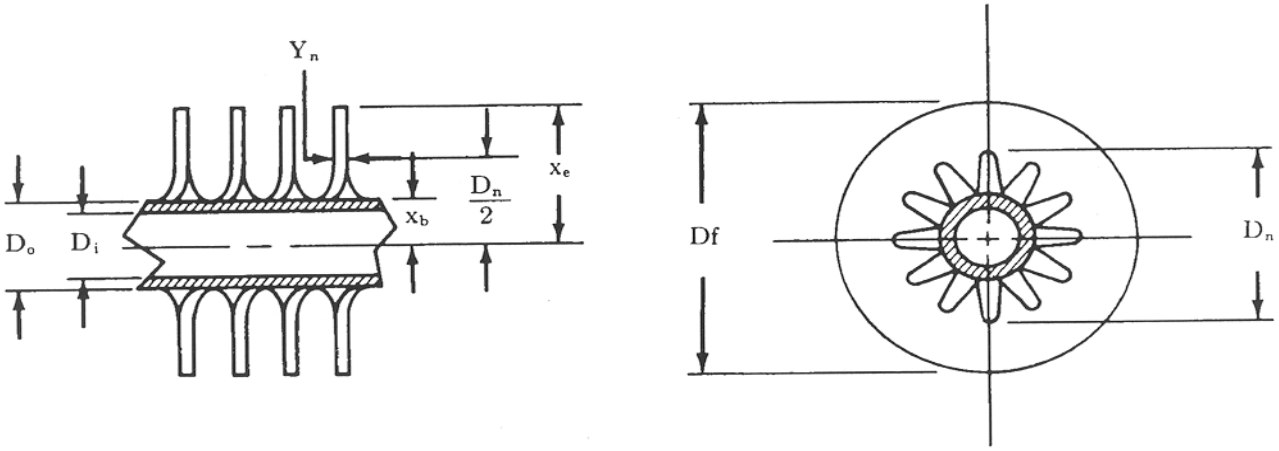
$$x_e = \frac{D_f}{2} \qquad x_b = \frac{D_o}{2} \qquad w = x_e - x_b$$

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From the curve of $w\left(\frac{f_a}{6k_f Y_r}\right)^{0.5}$ $\left[w\left(\frac{2f_a}{k_f Y_r}\right)^{0.5}\right]$ for various values of x_e/x_b, determine ϕ (Figure 11)

e. Crimped spiral fins

Fin efficiency calculations same as for smooth spiral fins except: $Y_r = \frac{Y_n D_n}{D_o}$



4.1.3 *Equations for Determining Coil Areas and Surface Ratio.* **(Note: Equations in [ ] are in SI Units)**

4.1.3.1 Determination of A_S and A_p

a. Continuous plate fins for staggered and parallel tube arrangements

$$A_s = N_f\left(\frac{L_f L_d}{72} - \frac{N_h(D_o + 2Y_f)^2}{91.68} + \frac{(D_o + 2Y_f)(N_h - N_t)L_c}{45.84}\right)$$

$$= \left[N_f\left(\frac{L_f L_d}{500000} - \frac{N_h(D_o + 2Y_f)^2}{636688} + \frac{(D_o + 2Y_f)(N_h - N_t)L_c}{318344}\right)\right]$$

$$A_p = \frac{N_t D_o L_t - N_t N_f Y_f (D_o - 2L_c)}{45.84}$$

$$= \left[\frac{N_t D_o L_t - N_t N_f Y_f (D_o - 2L_c)}{318344}\right]$$

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b. Smooth spiral fins

$$A_s = \frac{N_f N_t}{91.68}\left(D_f^2 - D_o^2 + 2D_f Y_e\right) = \left\lfloor \frac{N_f N_t}{636688}\left(D_f^2 - D_o^2 + 2D_f Y_e\right)\right\rfloor$$

$$A_p = \frac{D_o N_t}{45.84}\left(L_t - N_f Y_r\right) = \left\lfloor \frac{D_o N_t}{318344}\left(L_t - N_f Y_r\right)\right\rfloor$$

c. Crimped spiral fins

$$A_s = \frac{N_f N_t}{45.84}\left(D_n\left(D_n - D_o\right) + \frac{D_f^2 - D_n^2}{2} + D_f Y_e\right) = \left[\frac{N_f N_t}{318344}\left(D_n\left(D_n - D_o\right) + \frac{D_f^2 - D_n^2}{2} + D_f Y_e\right)\right]$$

$$A_p = \frac{D_o N_t}{45.84}\left(L_t - N_f Y_r\right) = \left\lfloor \frac{D_o N_t}{318344}\left(L_t - N_f Y_r\right)\right\rfloor$$

d. Plate fins on individually-finned tube

$$A_s = N_t N_f\left(\frac{L_f L_d}{72} - \frac{\left(D_o + 2Y_f\right)^2}{91.68} + \frac{\left(L_f + L_d\right)Y_f}{72}\right) = \left[N_t N_f\left(\frac{L_f L_d}{500000} - \frac{\left(D_o + 2Y_f\right)^2}{636688} + \frac{\left(L_f + L_d\right)Y_f}{500000}\right)\right]$$

$$A_p = \frac{\left(D_o + 2Y_f\right)N_t}{45.84}\left(L_t - N_f Y_f\right) = \left[\frac{\left(D_o + 2Y_f\right)N_t}{318344}\left(L_t - N_f Y_f\right)\right]$$

4.1.3.2 Determination of A_f, A_o, A_i, B, A_{ix}, N_p, N_b and L_e (all cases)

$$A_f = \frac{HL}{144} = \left\lfloor \frac{HL}{1000000}\right\rfloor$$

$$A_o = A_s + A_p$$

$$A_i = \frac{D_i N_t L_t}{45.84} = \left\lfloor \frac{D_i N_t L_t}{318344}\right\rfloor$$

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$$B = A_o / A_i$$

$$A_{ix} = 0.00545 D_i^2 N_c \qquad = \left[7.85 \text{x} 10^{-7} D_i^2 N_c\right]$$

$$N_p = N_t / N_c$$

$$N_b = N_p - N_{ih} - 1$$

$$L_e = 0.833\left(L_s N_p + L_{eb} N_b\right)$$
$$= \left[0.001\left(L_s N_p + L_{eb} N_b\right)\right]$$

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Table 2. Required Laboratory Tests

Type of Coil	One Row	Two Rows		Three Rows or More
		In-Line Tubes, Flat Plate Fins	All Other Configurations	
Steam (Distributing tube)	Test	Test	No Test[1]	No Test[1]
Steam (Single tube)	No Test[2]	No Test[2]	No Test[2]	No Test[2]
Hot Water	No Test[3]	No Test[4]	No Test[3]	No Test[3]
All Cooling	Test[5]	Test	Test[5]	Test four-row, or five-row, or six-row coil
Aqueous Ethylene Glycol and Aqueous Propylene Glycol Solutions	Test same coil as used for sensible cooling tests			

Where "No Test" is indicated, the manufacturer may, at his option, perform tests to establish performance factors, in which case notes 1-4 below do not apply:

[1] Steam ratings may be calculated using data from one-row tests.

[2] The same steam ratings may be used as determined for steam distributing tube coil of same surface geometry.

[3] The overall thermal resistance, R, may be determined by either of the following procedures:

(a) R_{aD} is determined from steam coil tests, assuming a steam-side heat transfer coefficient, f_v, of 2000 Btu /(h·ft^2·°F) [11360 W/(m^2·°C)]. One-row steam coil tests shall be used to determine R_{aD} for one-row hot water coils. One-row or two-row steam coil tests may be used to determine R_{aD} for two-row hot water coils.

(b) R_{aD} is determined from sensible cooling tests. One-row sensible cooling tests shall be used to determine R_{aD} for one-row hot water coils. One-row or two-row sensible cooling tests may be used to determine R_{aD} for two- or more-row hot water coils.

(c) For either (a) or (b) above, it is necessary to conduct isothermal water pressure drop tests per 5.4.7.

[4] The air-side thermal resistance, R_{aD}, may be determined as in [3] except that two-row coils shall be used.

[5] A complete set of tests is not required, provided the air-side heat transfer coefficients, f_a, as determined from a sensible cooling water test series, are within 2.5% of those from four- or more-row tests. If this agreement exists for a one-row coil, no test is required for a two-row coil.

Section 5. Test Requirements

5.1 *Method for Laboratory Tests of Testing for Rating.* Forced-Circulation Air-Cooling and Air-Heating Coils shall be tested in accordance with ANSI/ASHRAE Standard 33.

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5.2 *Test Coils and Laboratory Tests.*

5.2.1 *Dimensional Requirements.* All cooling and heating coil Laboratory Tests shall be conducted with a representative coil having a face area of 2 to 10 ft^2 [0.19 to 0.93 m^2].

5.2.2 *Required Laboratory Tests.* See Table 2.

5.2.3 *Turbulators.* If turbulators are offered as an option to increase the heat transfer coefficient of the fluid inside the coil tubes, only one coil need be tested to establish the correlation between the tube-side heat transfer coefficients, with and without turbulators.

5.2.4 *Fin Spacings.* Air film heat transfer coefficients and air-side pressure drops for various fin spacings may be determined without testing provided that the interpolated fin spacing is between two spacings previously tested which are not more than 8 fins/in [315 fins/m] apart.

5.2.5 *Optional Changes from Test Coil.*

5.2.5.1 *Changes Requiring No Test.* After establishing the original Standard Ratings, one or more of the following changes can be made or offered as an option in a coil line without changing Published Ratings, provided that the calculated influence of any or all of these changes does not reduce the capacity to less than 97.5% of the corresponding Standard Ratings.

a. Copper fin thickness may be decreased up to 30% below aluminum fin thickness
b. Fin thickness increase
c. Tube wall thickness between 0.016 and 0.049 in [0.406 and 1.254 mm]
d. Tube material, limited to types normally used in comfort air-conditioning, such as copper, red brass, admiralty metal, aluminum and cupro-nickel

If the calculated capacity is less than 97.5%, new ratings shall be calculated and submitted to AHRI for approval.

5.2.5.2 *Changes Requiring Tests.* After establishing the original Standard Ratings, one or more of the following changes can be made or offered as an option in one or more coil lines with the same surface geometry, provided a sensible cooling or heating Test Series of four face velocities is run and the test capacities are no less than 97.5% of the corresponding Standard Ratings:

a. Fin material other than copper
b. Method of bonding
c. Tube wall thickness outside the range of 5.2.5.1. c
d. Tube material other than as provided in 5.2.5.1.d
e. Fin thickness decrease

If the test capacities are less than 97.5% of Standard Ratings, or if other changes such as tube OD, tube spacing, fin configuration or tube arrangement are made, a complete set of Laboratory Tests shall be run and Published Ratings shall be changed accordingly. If the pressure drops are greater than 105% of Standard Ratings, a series of pressure drop tests shall be run and ratings shall be published accordingly.

5.2.6 *Refrigerant.* Separate Laboratory Tests must be conducted for each refrigerant covered by volatile refrigerant coil ratings.

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