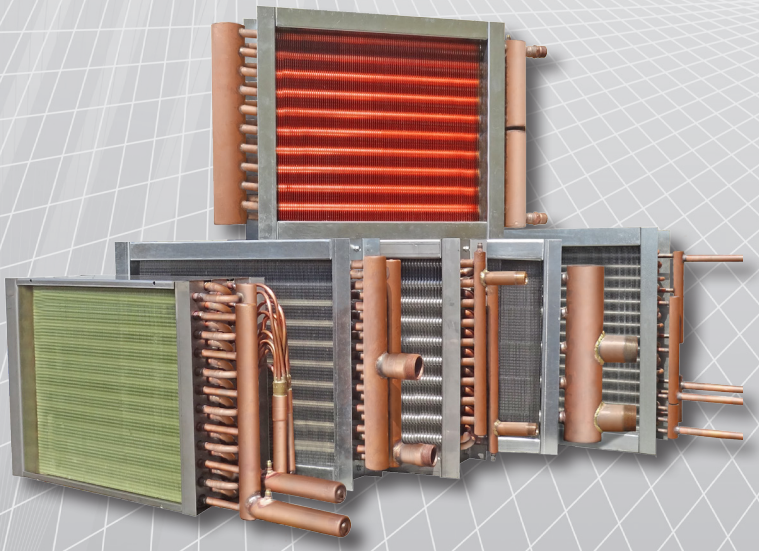
COILS

DIVISION RAE CORPORATION

Coil Handbook



The Definitive Guide to Replacement Coils

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THE RAE COILS PROMISE

About RAE Coils

RAE Coils is your one-stop shop for everything coils! We offer a complete line of HVAC heating and cooling coils for all your replacement and new construction needs. Whether it's a basic duct booster coil or a custom coil, we can meet all of your specifications with accuracy, ease, and at a competitive price. Our experts utilize state of the art selection software in order to help you customize the perfect coil! You can rest easy knowing all your RAE coils will be manufactured and perform to your exact specifications. We can provide booster, fluid, steam, evaporator, and condenser coils, as well as industrial coils offering stainless steel and carbon steel tube construction. We offer standard shipping as well as premium shipping options with our QuickDate Program!

RAE Coils is proud to participate in the AHRI certification program, providing coils and coil performance ratings for coils that fall within our scope of AHRI product offering and certified to AHRI Standard 410. RAE Coils is a division of RAE Corporation, a manufacturer of engineered cooling and refrigeration systems headquartered in Pryor, Oklahoma. The RAE goal is to provide properly designed systems that meet the specific needs of their customers, while maintaining the corporate Vision of Excellence. The company employs approximately 250 people, with representatives around the country.

The QuickDate Program

RAE Coils is now offering the most attractive dates...and every date is guaranteed to meet your expectations!

- Pay only for the speed you need!
- 1 day QuickDate - 300% premuium
- 3 day QuickDate - 75% premium
- 5 day QuickDate - 35% premium
- 7 day QuickDate - 25% premium
- 10 day Quickdate - 15% premium
- 14 day Quickdate - 6% premium

Our dates even come with a money back guarantee! If you're not completely satisfied with our QuickDate Program, RAE Coils will reduce your premium percentage paid to correlate with the date your coil actually ships. Some limitations apply. Contact RAE Coils for more information.

MEASURING COILS

1. Determine what type of coil you are measuring.

Water Coils

Supply connections are normally at the bottom of the coil, return bends are visible and the coil normally has vent and drain connections.

Standard Steam Coils

Coils have supply and return headers. Supply connection is normally located in the middle of the supply header and the condensate drain is located at the low point of the coil for complete drainablity Rows are limited to 4 and are connected by return bends. Coils can be same or opposite end connection construction.

Steam Distributing Coils

Supply connections are normally in the middle of the header with no return bends. Rows are limited to 2 rows with 5/8" construction and 1 row with 1" construction. Coils can be same or opposite end connection construction.

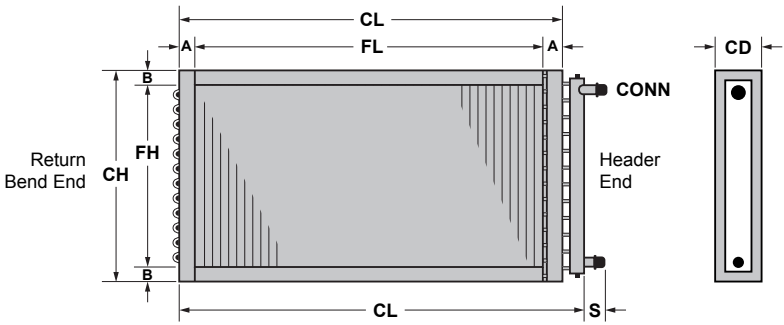
Direct Expansion (DX) Coils

Coils normally have distributor leads (spaghetti tubes) and expansion valves. These coils can have multiple distributor arrangements.

Condenser Coils

Supply connection normally enters at the top of coil. These coils look similar to a water coil, except for the location of the supply connection. Sub-cooler circuits typically have separate headers and represent a small portion of the coil surface.

Use the diagram below as a reference to measure the following portions of the coil.



MEASURING COILS

2. Determine finned height (FH) and finned length (FL).

Finned height is always measured in the direction of the fin. Finned length is always measured in the direction of tubes, regardless of which direction the tubes are running.

3. Determine number of rows.

Rows are always counted in the direction of air flow, regardless of how the coil is mounted. Count rows either by viewing the header end or the return bend end of the coil. When viewing either end, remember that return bends or headers may run unevenly across the coil.

4. Determine fins per inch (FPI).

Using a ruler, count the number of fins on the coil within one inch. Normal fin counts will be between 4 and 14 FPI. Refer to the back cover of this handbook for a fin per inch guide.

5. Determine casing height (CH).

Casing height is always measured in the same direction as finned height **(FH)**. It includes the casing/sideplate flanges **(B)** on the top and bottom of the coil. In some instances, the flanges may be flat at the top and bottom, so you are only measuring finned height plus the metal thickness.

6. Determine casing length (CL).

Casing length is always measured in the same direction as fin length **(FL)**. It includes the tube sheet flanges **(A)** on the ends of the coil. Some coils may actually have baffles covering the headers and should be included in your casing length measurement.

7. Determine casing depth (CD).

Casing depth is always measured in the direction of air flow. Casing depth will normally be 4” to 6” for hot water and steam coils , and 6” to 15” for chilled water and direct expansion coils.

8. Determine overall coil length, including headers (OL).

Overall length is one of the most important dimensions to be obtained because most coils only have connection stubs extending outside the walls of the unit. Overall length is measured from the outside edge of the header end - not including connections/stubs **(S)** - to the outside edge of the return bend end, plus any baffles extending beyond the header or return bends.

MEASURING COILS

9. Determine overall coil length, including connection.

Add the length of the connection stub **(S)** to the overall length **(OL)** determined in step 5. This measurement is important for two reasons: 1) because some manufacturers include connections within the casing length of the unit: and 2) because piping cannot be moved.

10. Determine connection size and type.

If necessary, remove insulation to see the incoming and outgoing lines. Measure the diameter of the outside of the line to help determine connection size.

Standard connection types are **MPT** (male pipe thread), **FPT** (female pipe thread), **ODS** (sweat connection,) and **Victaulic.** MPT is threaded on the outside, FPT is threaded on the inside, ODS connections have no threads, and Victaulic connections have a groove around the outside.

MPT Connection

FPT Connection

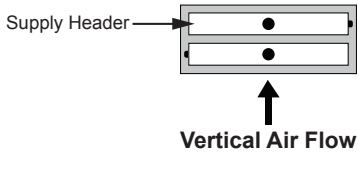
ODS Connection

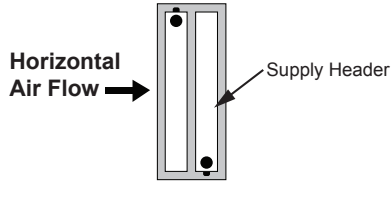
Victaulic Connection

11. Determine air flow.

Air flow is described by the direction in which air is flowing through the coil. Horizontal air flow is air running through the coil from wall to wall in the room. Floor to ceiling is vertical air flow. If the coil is mounted vertically (i.e. on the wall) air flow is horizontal. If the coil is mounted horizontally (i.e. on the floor or ceiling) the air flow is vertical.

Note: RAE Coils designates their “handing” of the coil based on airflow direction. If you are looking at the fin area of a RAE Coil, and the air is hitting you in the back of the head, observe which side of the coil the headers are on. If the headers are on the right side, then the coil is a right hand coil. If the headers are on the left side, it is a left hand coil. Airflow should always flow counter to fluid, refrigerant, and steam flow.





MEASURING COILS

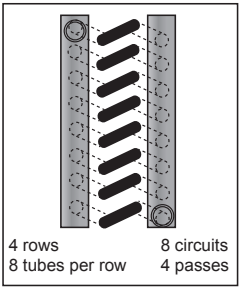
12. Determine the number of tubes per row.

Count the number of tubes that are in one row. The number of tubes is important when ordering an exact replacement.

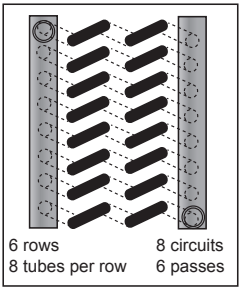
13. Determine the coil circuitry.

Coil circuitry is determined by the number of tubes in each row divided by the total number of tubes fed. See the diagrams below for typical coil circuiting.

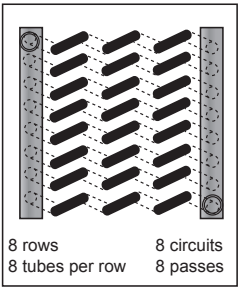
Single Serpentine



4 rows 8 circuits
8 tubes per row 4 passes

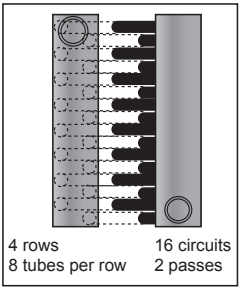


6 rows 8 circuits
8 tubes per row 6 passes

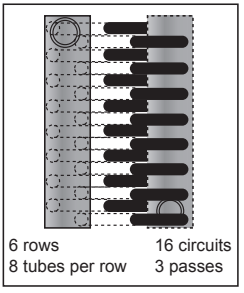


8 rows 8 circuits
8 tubes per row 8 passes

Double Serpentine

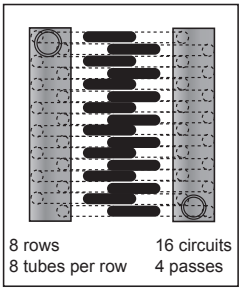


4 rows 16 circuits
8 tubes per row 2 passes



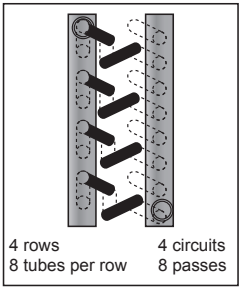
6 rows 16 circuits
8 tubes per row 3 passes

*Illustration shows opposite end connections

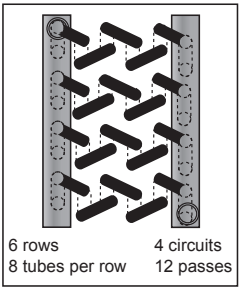


8 rows 16 circuits
8 tubes per row 4 passes

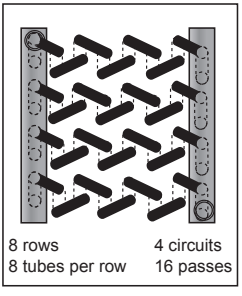
Half Serpentine



4 rows 4 circuits
8 tubes per row 8 passes



6 rows 4 circuits
8 tubes per row 12 passes



8 rows 4 circuits
8 tubes per row 16 passes

3/8” COIL CAPABILITIES

As the HVAC industry continues to advance, 3/8” coils have increased in popularity. The smaller tubes are more equipped to handle the high pressures associated with new refrigerants. These coils are most commonly seen in applications using direct expansion and condensing coils, but can also be useful in small water coils.

RAE Coils offers the following ***Series 38*** coils with 3/8” tubing:

- Direct expansion (DX) coils
- Condenser coils
- Hot water coils
- Chilled water coils

Series 38 Surface Coil Dimensions

	Casing Dimension Depth (in.)						
Rows Deep	1	2	3	4	5	6	8
Standard Casing Depth	3	3	4.5	6	7	8	10
Minimum Casing Depth	0.875	1.75	2.625	3.5	4.375	5.25	7

Intermediate Tube Sheets:

Under 70” finned length	None
71” thru 115” finned length	1 set
116” thru 144” finned length	2 sets

Series 38 Construction Data

Tube Centers (Vertical)	1”
Tube Centers (Horizontal)	0.866”
Tube Wall Thicknesses	.014”, .016” rifled; .016” smooth, .020” smooth
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Waffle, Flat with Ripple Edge*
Fins Per Inch (FPI)	6 to 20 (depending on application)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, Victaulic, ODS
Casing Materials	Galvanized Steel, 304 SS, 316 SS
Coatings	Epoxy or Phenolic, Dipped/Baked or Sprayed

**Flat fin is a non-configured fin and not available on one (1) row coils.*

1/2” COIL CAPABILITIES

Within the replacement coil industry, 1/2” tube coils are typically used for direct expansion and condenser coils. Half inch coils offer more primary surface via more tubes in the face of the coil, giving you the ability to vary your circuiting for the proper pressure drop requirements. Half inch coils can also be used for standard water coil applications. Please keep in mind that you have small diameter tube and water pressure drops or contaminated water may be a concern. For some applications, it would be best to go with a 5/8” tubing for these reasons.

RAE Coils offers the following ***Series 12*** coils with 1/2” tubing:

- Direct expansion coils
- Condenser coils
- Hot water coils
- Chilled water coils

Series 12 Surface Coil Dimensions

	Casing Dimension Depth (in.)									
Rows Deep	1	2	3	4	5	6	7	8	10	12
Casing Depth	4	4	5.5	7	8	9	10	11	13	15

Intermediate Tube Sheets:

Under 70” finned length	None
71” thru 115” finned length	1 set
116” thru 144” finned length	2 sets

Series 12 Construction Data

Tube Centers (Vertical)	1.25”
Tube Centers (Horizontal)	1.0825”
Tube Wall Thicknesses	.017”, .025”, .032”
Turbulators	Brass
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Waffle, Flat with ripple edge*
Fins Per Inch (FPI)	4 to 14 (depending on fin thickness)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, Victaulic, ANSI Flange, ODS
Casing Materials	Galvanized Steel, 304 SS, 316 SS
Coatings	Epoxy or Phenolic, Dipped/Baked or Sprayed

**Flat fin is a non-configured fin and not available on one (1) row coils.*

5/8” COIL CAPABILITIES

The majority of coils you will encounter in the HVAC replacement industry are 5/8” tube coils. These coils can be used for a broad range of applications from steam to direct expansion. However, the main usage of 5/8” coils is for water/glycol solution applications. Typically, 5/8” coils allow you to circuit for the lowest pressure drops available and keep the coils drainable. In most cases, 5/8” coils provide more capacity than smaller diameter tubed coils.

RAE Coils offers the following ***Series 58*** coils with 5/8” tubing:

- Booster/stock coils
- Direct expansion (DX) coils
- Condenser coils
- Hot water coils
- Chilled water coils
- Standard steam and steam distributing coils

Series 58 Surface Coil Dimensions

	Casing Dimension Depth (in.)									
Rows Deep	1	2	3	4	5	6	7	8	10	12
Casing Depth	5	5	6	7.5	9	10	11.5	12.5	15.5	18

Intermediate Tube Sheets:

Under 70” finned length	None
71” thru 115” finned length	1 set
116” thru 144” finned length	2 sets

Note: number of intermediate tube sheets dependent on weight of casing construction

Series 58 Construction Data

Tube Centers (Vertical)	1.5”
Tube Centers (Horizontal)	1.299”
Tube Wall Thicknesses	.020”, .025”, .035”, .049”
Turbulators	Brass
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Waffle, Flat with ripple edge*, Sine
Fins Per Inch (FPI)	4 to 14 (depending on fin thickness)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, Victaulic, ANSI Flange, ODS
Casing Materials	Galvanized Steel, 304 SS, 316 SS
Coatings	Epoxy or Phenolic, Dipped/Baked or Sprayed

**Flat fin is a non-configured fin and not available on one (1) row coils.*

1” COIL CAPABILITIES

The design of choice for steam distributing coils is the 1” tubed coil. The majority of the HVAC industry utilizes 1” coils over 5/8” coils for the majority of steam distribution applications. This is because the larger tube sizing allows a much greater area for condensate return, as well as a larger inner distributing tube for disbursement. This also allows for a longer finned length to be used.

RAE Coils offers ***Series 11*** steam distributing and standard steam coils with 1” tubing.

Series 11 Construction Data

Tube Wall Thicknesses	.035”, .049”
Tube Material	Copper
Fin Thicknesses	.008”, .010”
Fin Materials	Aluminum, Copper
Fin Patterns	Waffle, Flat with ripple edge
Fins Per Inch (FPI)	4 to 14 (depending on fin thickness)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, ANSI Flange
Casing Materials	Galvanized Steel, 304 SS, 316 SS
Coatings	Epoxy or Phenolic, Dipped/Baked or Sprayed

WATER COILS

Water coils can be offered as chilled water, hot water, or glycol applications. It is recommended that face velocities of chilled water or glycol coils be maintained between 450 and 550 feet per minute (FPM) for the most effective coil selection. At face velocities over 550 FPM, “moisture carry over” may be significant. The term “moisture carry over” is used to describe the action of condensate being blown off the leaving air side or downstream side of the coil.

Chilled Water & Glycol Coils

Chilled water and glycol coils are more often used in commercial buildings; direct expansion (DX) coils are usually found in residential buildings. Chilled water and glycol coils respond to the cooling effect of surfaces when dampened by moisture condensed from the air. See page 15 for glycol freeze points and page 16 for general water coil heat transfer formulas.

The system characteristics that affect the performance of chilled water and glycol coils are:

- Gallons per minute (GPM) of fluid through the tubes
- Velocity of fluid through the tubes
- Temperature range of fluid through the tubes
- Cubic feet per minute (CFM) of air across the coil fins
- Velocity of air across the coil fins
- Temperature of air across the coil fins

Hot Water Coils

Hot water coils will generally be found in a reheat portion of a heating system due to the ability of the water to freeze. Normally, air comes into contact with the reheat coil at a temperature between 45ºF and 75ºF. Hot water coils are typically located in duct work where zone heating (booster coils) takes place.

Turbulators

A spiral wound wire placed inside each tube to help prevent laminar flow of water to promote more efficient energy transfer from the fluid to the tube/fin assembly. Turbulators are used frequently with glycol applications.

WATER COILS

RAE Coils offers of full line of chilled water, glycol, and hot water coils with the following features and options:

RAE Water Coil Standard Construction Options

Standard Tube Sizes*	3/8” OD x .014”, 1/2” OD x .017”, 5/8” OD x .020”
Tube Material	Copper
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Water, Flat with ripple edge**, Sine[1]
Fins Per Inch (FPI)	4 to 14 (depending on fin thickness)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, Victaulic, ANSI Flange
Casing Materials	Galvanized Steel, 304 SS, 316 SS

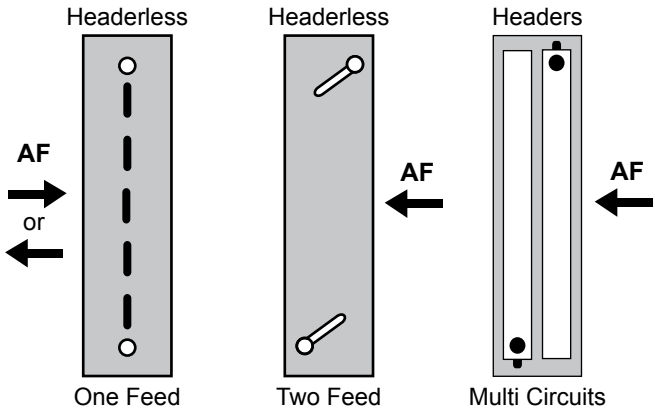
**Additional tube sizes available. Contact RAE Coils for more information.*
***Flat fin is a non-configured fin and not available on one (1) row coils.*
[1] Sine fin available on 5/8” coils only.

Nominal Water Coil Connection Sizes

Gallons per Minute (GPM)	Connection Size (MPT)
1.0 - 4.0	1/2”
4.1 - 8.0	3/4”
8.1 - 14.0	1”
14.1 - 23.0	1-1/4”
23.1 - 35.0	1-1/2”
35.1 - 75.0	2”
75.1 - 125.0	2-1/2”
125.1 - 185.0	3”

WATER COILS

Typical Water Coil Header Arrangements



Glycol Solution Freeze Points

Ethylene Glycol			Propylene Glycol		
Weight (%) Glycol	Volume (%) Glycol	Freeze Point (ºF)	Weight (%) Glycol	Volume (%) Glycol	Freeze Point (ºF)
0	0	32	0	0	32
5	4.4	29.4	5	4.8	29.3
10	8.9	26.2	10	9.6	26.4
15	13.6	22.2	15	14.5	21.6
20	18.1	17.9	20	19.4	17.8
25	22.9	12.7	25	24.4	12
30	27.7	6.7	30	29.4	6.4
35	32.6	-0.2	35	34.4	-1.3
40	37.5	-8.1	40	39.6	-8.8
45	42.5	-17.5	45	44.7	-19.4
50	47.6	-28.9	50	49.9	-34.2

WATER COILS

General Water Coil Heat Transfer Formulas

Total BTUH = 4.5 x SCFM x
(Total Heat Entering Air - Total Heat Leaving Air)
Where 4.5 = Density Std. Air x 60
Density Std. Air = .075 lbs./cubic ft.
Minutes/Hour = 60

Total BTUH = 500 x GPM x
(Leaving Water Temp. - Entering Water Temp).
Where 500 = lbs./gal. x min./hr. x Specific Heat Water
lbs. gal = 8.33
Minutes/Hour = 60
Specific Heat Water = 1

Sensible BTUH = 1.08 x SCFM x
(Entering Air Dry Bulb - Leaving Air Dry Bulb)
Where 1.08 = (Specific heat of air at 70ºF) x
(Min./Hr.) x Density Std. Air
Specific Heat of Air = 0.24 at 70ºF
Minutes/Hour = 60
Density Std. Air = .075 lbs./cubic ft.

Water Velocity FPS (3/8" Tubes) = (3.02 x GPM) / (# of Tubes Fed)

Water Velocity FPS (1/2" Tubes) = (1.68 x GPM) / (# of Tubes Fed)

Water Velocity FPS (5/8" Tubes) = (1.07 x GPM) / (# of Tubes Fed)

Face Area (FA) = (SCFM) / (Face Velocity [FPM])

Face Velocity (FV) = (SCFM) / (Face Area [Sq. Ft.])

Sensible Total (S/T) Ratio = (Sensible BTUH) / (Total BTUH)

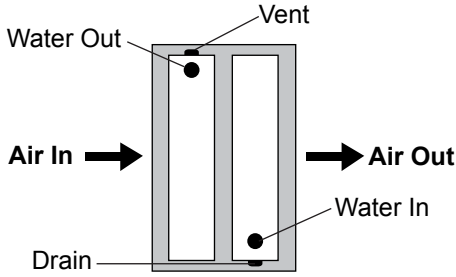
$$\textbf{MBH Per Sq. Ft. of Face Area} = \frac{\text{(Total BTUH)}}{\text{(Face Area [Sq. Ft.] x 1000)}}$$

Note: The sum of sensible and latent heat transferred by a dehumidifying cooling coil represents total heat values. Sensible heat transfer, whether cooling or heating, refers to the change in dry bulb temperature only.

WATER COILS

Application & Installation Recommendations

- All incoming coils should be inspected for concealed or visible damage.
- Piping should be in accordance with accepted industry standards and local codes.
- Provide adequate water treatment to protect the various coil components against corrosion, scale, slime, and algae. Water treatment should always be conducted under the supervision of a water conditioning specialist.
- Coils must be piped with water supply connection on the air leaving side of coil and return connection on the air entering side. Connections should be arranged for water flow from bottom to top.



- Coils must be vented of air on initial start-up and each time the coil is drained. This can be a manual process, or an automatic air vent can be installed on the vent connection.
- Coils must be protected from freezing if applied where ambient temperatures are expected to go below 32ºF. This can be done by completely draining the coil, or by using a suitable antifreeze solution.
- Dehumidifying coils must be provided with a drain pan.
- It is recommended that piping have shut off valves and union fittings to facilitate coil removal, should repairs be necessary.
- Periodically check and clean the fin surface of coils if necessary.
- Inlet duct (if used) should be arranged to give equal air flow to the entire coil surface.

STEAM & STEAM DISTRIBUTING COILS

5/8" OD Standard Steam Coils

Standard steam coils are intended for use in above freezing applications. This coil requires standard oversized holes in tube sheets for expansion and contraction requirements.

5/8" OD Steam Distributing Coils

Steam Distributing coils are used primarily for below freezing air applications. A minimum steam pressure of 5 psig is recommended for systems with entering air temperatures below freezing. The inner distributing tubes supply hot steam down the entire length of tubes thus warming the condensate that has been formed inside the tubes.

1" Steam Distributing Coils

1" coils have larger (5/8") inner distributing tubes, but also offer a much larger area for condensate return. Most HVAC preheat coils use 100% outside air with low pressure steam. In very large HVAC systems, longer coils (over 60" long) are required to meet the performance. These longer lengths could cause the 5/8" steam distributing coils to clog with condensate. This clogging reduces the coil capacity because steam and condensate may take up the same space at the same time. It also may cause condensate to freeze up. Therefore, 1" steam distributing coils are recommended for use in larger HVAC systems.

*Preferred Operating Limits for Continuous-Duty Steam Coil Materials in Commercial & Industrial Applications**

Pressure (psi)	Material	Tube Wall Thickness (in.)
≤ 20	Copper	.020*
20 to 50		.025*
50 to 75		.035
75 to 100		.049**

**Tube thickness not available in 1" tube diameters.*
***Tube thickness not available in 5/8" SD.*

Notes:
- *Consider heavier tube thickness when close to maximum*
- *Increased thickness helps to extend tube life at higher temperatures associated with higher pressures*
- *Consult factory for high superheat applications*

STEAM & STEAM DISTRIBUTING COILS

Steam coils are selected with dry steam velocities not exceeding 6000 FPM and with acceptable condensate loading per coil core tube depending on the type of steam coil (standard steam or steam distributing.) The table below shows typical maximum condensate loads.

Steam coil performance is maximized when the supply is dry, saturated steam, and condensate is adequately removed from the coil and continuously returned to the boiler. See page 22 for more information about the properties of saturated steam.

Although steam quality may not significantly affect the heat transfer of the coil, the back-up effect of too rapid a condensate rate, augmented by a wet supply stream, can cause a slug of condensate to travel through the coil and condensate return. This situation can result in noise and possible coil damage.

Vertical tube coils, regardless of standard steam or steam distributing coil, have an advantage of not holding excessive condensate. This advantage is based on a workable trap, piping, etc. All standard steam coils and steam distributing coils should be supplied in the top and out the bottom.

Another option for steam distributing coils is to utilize two supply connections, one at each end of the coil, to properly distribute steam evenly across the entire coil face. This is a necessity on all 5/8” coils over 60” finned length and all 1” coils over 136” finned length.

Using heavier wall tubes can increase the life span of 5/8” standard steam or steam distributing coils. The maximum wall thickness for 5/8” steam distributing coil is .035” due to the fact that there must be room between the inner and outer tubes to return condensate.

*Typical Maximum Condensate Loads**

Tube Outside Diameter	Maximum Allowable Condensate Load (lb/h)	
	Standard Steam Coil	Steam Distributing Coil
5/8”	68	40
1”	168	95

**Source: 2004 ASHRAE Handbook*

STEAM & STEAM DISTRIBUTING COILS

RAE Coils offers of full line of standard steam and steam distributing coils with the following features and options:

RAE Steam & Steam Distributing Coil Standard Construction Options

Standard Tube Sizes*	5/8” OD x .020”, 1” OD x .035”
Tube Material	Copper
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Waffle, Flat with ripple edge**
Fins Per Inch (FPI)	4 to 14
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, ANSI Flange
Casing Materials	Galvanized Steel, 304 SS, 316 SS

**Additional tube thicknesses available. Contact RAE Coils for more information.*
***Flat fin is a non-configured fin and not available on one (1) row coils.*

Standard steam coils are limited to 4 rows with 2-pass or less being optimal.

Typical 5/8” Standard Steam Coil Connections

Fin Height	Inlet Conn. (MPT)	Outlet Conn. (MPT)
6” thru 12”	1”	3/4”
15” thru 18”	1-1/4”	1”
21” thru 24”	1-1/2”	1”
27” thru 39”	2”	1-1/2”

Typical 5/8” Steam Distributing Coil Connections

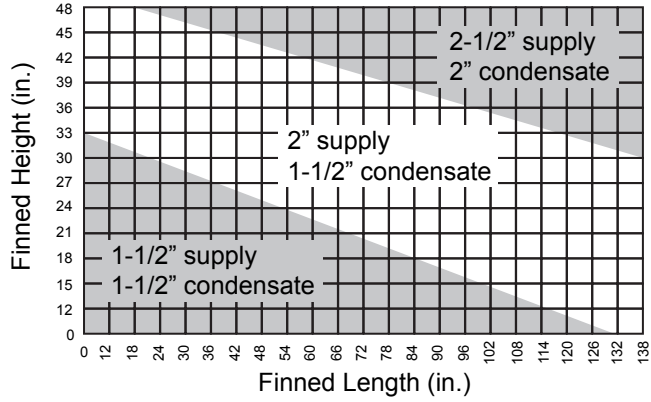
Fin Height	Inlet Conn. (MPT)	Outlet Conn. (MPT)
6” thru 12”	1-1/2”	1”
15” thru 18”	1-1/2”	1”
21” thru 24”	2”	1-1/2”
27” thru 39”	2-1/2”	1-1/2”

STEAM & STEAM DISTRIBUTING COILS

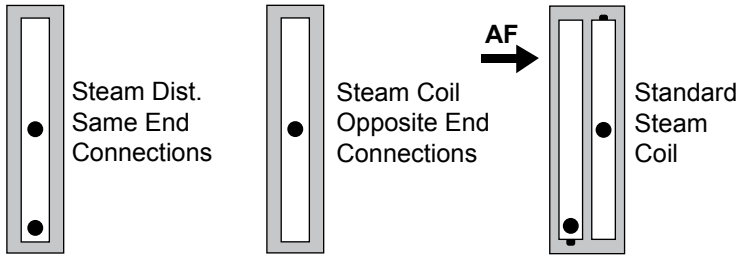
- All 5/8” steam distributing coils in excess of 48” finned height are recommended to have 2 supply connections for proper steam distribution.
- All 5/8” steam distributing coils with finned length over 60” are recommended to have supply connections at each end of the coil.
- All 5/8” steam distributing coils must have floating tube sheets at the following locations:

Supply & Return Location	Floating Tube Sheet Location
Same end	Opposite header end
Opposite ends	Return end
Both ends	Both ends
Two supplies, one return	Both ends

Typical 1” Steam Distributing Coil Connections



Typical Steam Coil Header Arrangements



Properties of Saturated Steam

Pressure (PSIG)	Temperature		Latent Heat (BTU/Lb.)
	°F	°C	
0	212	100	970
2	218	103	966
5	227	108	961
6	230	110	959
7	232	111	957
8	235	113	956
9	237	114	954
10	239	115	953
15	250	121	946
20	259	126	940
25	267	130	934
30	274	134	929
35	281	138	924
40	287	142	920
45	292	144	916
50	298	148	912
55	303	150	908
60	307	153	905
65	312	156	901
70	316	158	898
75	320	160	895
80	324	162	892
85	328	164	889
90	331	166	886
95	335	168	883
100	338	170	881
105	341	172	878
110	344	173	876
115	347	175	873
120	350	177	871
125	353	178	868
130	355	179	866
135	358	181	864
140	361	183	862
145	363	184	859
150	366	186	857

STEAM & STEAM DISTRIBUTING COILS

General Steam Coil Heat Transfer Formulas

Total BTUH = 1.09 x CFM x Temperature Rise

Where 1.09 = .242 x 60 x .075

.242 = Specific heat of air at 70ºF

Minutes/Hour = 60

.075 = Density std. air (lbs.) / Cu. ft.

Temperature Rise = Leaving Air Temp. - Entering Air Temp.

Temperature Rise (TR) = (BTUH) / (2.09 x CFM)

Leaving Air Temp. = Entering Air Temp. + Temp. Rise

Initial Temperature Difference (ITD) = Sat. Steam Temp. - Entering Air Temp.

Face Velocity (FPM) = (CFM) / (Face Area [Sq. Ft.])

Pounds Condensate: $\frac{\text{BTUH}}{\text{(Latent heat of steam x No. of tubes fed}}$

Application & Installation Recommendations

- Coil piping should be supported independently from the coil.
- Steam coils, regardless of design or circuiting, must have a trap for the steam supply and condensate return connections.
- All coils in a bank arrangement must be properly vented by use of vacuum breakers or other means to provide free flow of the steam and condensate.
- Each coil in a bank arrangement must have its own steam trap, sized to function based on the system design and operation.
- Check for any modifications within the system.
- It is recommended that control valves for standard steam coils be the two positive types (open or closed.) It is recommended that control valves for inner distributing tube coils at reduced load conditions be of the gradual acting automatic or modulating types.
- Do not reduce condensate line size below the coil connection stub size for all type systems.
- Check any deposit on fin tube for corrosion. Copper and sulfur can be problematic.

DIRECT EXPANSION (DX) COILS

Also known as evaporator coils, direct expansion (DX) coils are commonly used in air conditioning applications and many types of commercial refrigeration systems. Air to be cooled or dehumidified is circulated through the finned surface. Multiple rows and various tube patterns are used to achieve the desired heat transfer from the air to the circulating refrigerant. Copper tubes with copper or aluminum fins are most commonly used for efficient heat transfer. Tube sizes available are ***3/8", 1/2", and 5/8" OD.***

Low pressure liquid refrigerant coming from the thermal expansion valve is piped into various types of liquid distributors. These distributors feed the refrigeration circuits required to handle the cooling loads.

Air conditioning systems need to operate efficiently at maximum design loads as well as partial load conditions. Many types of system capacity controls are used to match the load requirement with system capacity. With refrigerant evaporator coils, this generally takes place in the form of surface reduction and/or one of the following:

- Single circuit
- Row split circuits
- Face split circuits
- Intertwined circuits

Variable Air Volume (VAV) systems use buildup coil banks or large air handling units with one refrigeration system. To balance system capacity to load requirements, some form of face or row control is required. During the time of reduced capacity, it is imperative to maintain a fully active dehumidification process at the heat transfer coil. This is best accomplished by row control on standard DX coils or by use of "intertwined" refrigerant circuits. Row control is used for partial load surface balance. Whichever circuit is deactivated first results in full face area operation of the remaining circuit, keeping the full volume of air in contact with active coil surfaces.

Intertwined circuiting is a way of achieving good partial load dehumidifying. It is especially useful in balancing coil and system performance when using two independent refrigeration systems for redundancy.

When placing an order for a DX coil, the following information must be included:

- Refrigerant
- Suction temperature
- Total capacity
- Circuiting requirements

RAE engineering will need this data to properly select nozzle, distributor, and thermal expansion valve size.

DIRECT EXPANSION (DX) COILS

RAE Coils offers of full line of direct expansion (DX) coils with the following features and options:

RAE DX Coil Standard Construction Options

Standard Tube Sizes*	3/8” OD x .014”, 1/2” OD x .017”, 5/8” OD x .020”
Tube Material	Copper
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Waffle, Flat with ripple edge, Sine***
Fins Per Inch (FPI)	4 to 20 (depending on tube size and fin thickness)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, ANSI Flange

**Additional tube sizes available. Contact RAE Coils for more information.*
***Flat fin is a non-configured fin and not available on one (1) row coils.*
****Sine is only available on 5/8” tube coils*

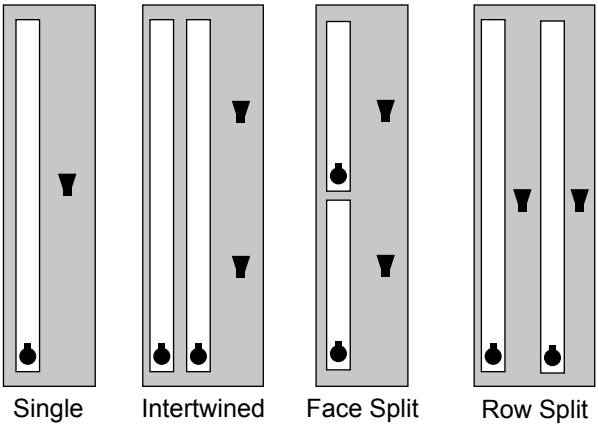
DX Coil Suction Connection & Header Sizes

Type L Cu Suction Header OD	Maximum Tonnage*		
	R-22 / 407c / 404a / 507	410a	134a
7/8”	5	5	1
1-1/8”	7.5	7.5	5
1-3/8”	15	15	7.5
1-5/8”	20	25	15
2-1/8”	40	50	20
2-5/8”	60	90	40
3-1/8”	90	n/a	60

**The tonnage listed is the suggested maximum tonnage per header at standard air conditioning conditions.*

DIRECT EXPANSION (DX) COILS

Typical DX Coil Header Arrangements



Application & Installation Recommendations

- Larger DX coils are normally supplied with liquid distributors for the specific circuiting requirements. Thermostatic expansion valves (TXVs) should be sized according to distributor and load conditions.
- DX coils are frequently exposed to temperatures and mechanical stresses during installation and operation. It is imperative that the system is checked for leaks during and after startup.
- DX coils should be periodically inspected at the distributor, valving, and return bends. Check coil casing and support for excessive vibration.
- Control systems should be inspected to ensure no icing conditions are present and that all circuits are operating properly.

CONDENSER COILS

Refrigerant condenser coils are built to suit the load conditions and space configurations for existing condensing units or remote air cooled condensers. Condenser coils are circuited for the specific compressorized refrigerant flow.

The condenser coil for air cooled or evaporative condensers essentially performs two important functions:

- Removes the heat from the refrigerant generated by the evaporator coil load conditions.
- Removes the heat generated by the compressor (heat of compression.) This additional heat will be in the range of 20% to 70% above the evaporator load, depending upon the specific operating characteristics of the compressor.

Most air cooled condenser coils are commonly constructed of copper tubing with corrugated aluminum fins. The headers are constructed of copper tubing with copper OD sweat connections. Casings are normally galvanized steel.

RAE Coils offers of full line of condenser coils with the following features and options:

RAE Condenser Coil Standard Construction Options

Standard Tube Sizes*	3/8” OD x .014”, 1/2” OD x .017”, 5/8” OD x .020”
Tube Material	Copper
Fin Thicknesses	.006”, .008”, .010”
Fin Materials	Aluminum, Copper, Acrycoat Aluminum
Fin Patterns	Waffle, Flat with ripple edge, Sine***
Fins Per Inch (FPI)	4 to 20 (depending on tube size and fin thickness)
Header Material	Copper
Connection Materials	Copper, Steel, Brass
Connection Types	MPT, FPT, ANSI Flange

**Additional tube sizes available. Contact RAE Coils for more information.*
***Flat fin is a non-configured fin and not available on one (1) row coils.*
****Sine is only available on 5/8” tube coils*

CONDENSER COILS

Condenser Coil Fin Pattern Applications

The chart below shows fin patterns normally used on condenser coils and where they are usually found:

Tube Dia.	Pattern*	Typical Application - Capacity
3/8”	1” x 0.866”	Residential/Light comm. - Small to medium
1/2”	1.25” x 1.082”	Commercial - Small, medium, or large
5/8”	1.5” x 1.299”	Commercial - Medium or large tonnage

**Center to center, height x depth*

General Issues Associated with Condenser Coils

- **Bent fins -** Fins bend, especially during cleaning, causing higher air pressure drop. Thinner fin material causes fins to bend easily
- **Clogged fins -** Air pressure drop can double causing higher refrigerant head pressure.
- **Excessive vibration -** This often happens when the coils and the compressor are both mounted to the same frame. Coils may develop leaks at the end tube sheet and the intermediate tube supports. Vibration can also cause potential leaks at the tube to header joints.
- **Area corrosion -** Most condensing units are fabricated for commercial environments. They sometimes are mounted in corrosive and/or salt-laden atmospheres. This may cause fin or tube corrosion.

CONDENSER COILS

Selecting Replacement Condenser Coils

There is one specific design criteria in condenser coils that must be reviewed on almost every change-out with propeller-type condensers. Propeller fans are low resistance fans and are usually selected (along with motor) according to the condenser CFM verses pressure design. It is therefore imperative that the new condenser coil has the same resistance as the old one.

The following are potential solutions to some of the issues that have already been reviewed:

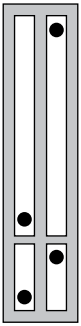
- **Use heavier fin material when high pressure cleaning is required.** The heavier fin material allows high pressure cleaning without destroying fins.
- **Reduce fins per inch (FPI) from 12 or 16 FPI to 8 or 10 FPI.** To do this, you will probably have to increase the number of rows. However, overall ability to clean the coil will be much better and coil air pressure drop will be stabilized over a much longer period of time.
- **Construct condenser coils with slightly oversized holes and/ or fully extruded sheet metal collars in tube sheets and tube supports.** This allows the coil tubes to float within the casing and will help alleviate most of the problems related to tube sheet piercing holes.
- **It is best to use copper fins and stainless steel casing for corrosive or salt-laden atmospheres.**

When placing an order for a condenser coil, the following information must be included:

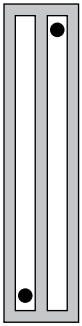
- Refrigerant
- Ambient temperature
- Total capacity
- Type of arrangement

CONDENSER COILS

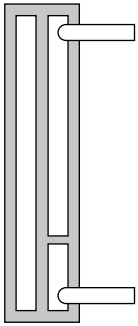
Typical Condenser Coil Header Arrangements



With Independent Sub Cooling Circuits



Without Sub Cooling Circuits



With Integral Sub Cooling Circuits

Application & Installation Recommendations

- The coil should be inspected on a monthly basis or more frequently, depending upon the system operation and duty ranges.
- Coils should be free to float due to expansion and contraction of the connecting piping.
- Refrigerant leaks may be caused by excessive vibration. Check all tube joints periodically for leaks.
- Clean the coil tubes and fins at least once each year. If black deposits are prevalent on any copper or brazed joint, beware of sulfur or other attacking chemicals in the area.

3/8” Tube

1” Tube

4 FPI

6 FPI

8 FPI

10 FPI

12 FPI

1/2” Tube

5/8” Tube


3/8” Tube


1” Tube

www.RAE-Coils.com
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Phone: (918) 825-7222
Fax: 1 (800) COIL-FAX
(264-5329)


5/8” Tube


1/2” Tube

Bulletin# RC-CHB-1017