HEATCRAFT™

Fluid Coils

LUVATA

Partnerships beyond metals

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NOMENCLATURE

5 W S 14 06 C 24.00 x 144.00

Tube O.D.
3 = 0.375
4 = 0.500
5 = 0.625

Coil Type
W Standard Water
M Splayed Headers
B Booster
K Cleanable Both Ends
P Cleanable Supply End
Q Cleanable Opp. Supply End

Circuiting
Q - 1/4 serp
H - 1/2 serp
L - 3/4 serp
S - 1 serp
M - 1 1/2 serp
D - 2 serp
T - 3 serp
B - skip tube

Booster
S - 1 circuit
D - 2 circuits
B - skip tube

Finned Length (inches)

Fin Height (inches)

Fin Design
A - flat (Al, Cu)
B - corrugated (Al, Cu)
C - sine wave (Al, Cu)
D - raised lance (Al) 3/8 only
F - flat (SS, CS)
G - corrugated (SS, CS)
H - sine wave (SS, CS, Al, Cu)

Rows Deep

Fins Per Inch

STANDARD FLUID COILS

Luvata's fluid coils are specifically designed for your particular application. Flexibility is built into all of our manufacturing processes, offering variations in fin type, fin density, circuitry arrangement, coil casing, and materials of construction. The fluid coils include two basic styles. The standard water, type "W", coils utilize a collection header for one and two row applications. This type also uses return bends for circuiting in coils with three rows or more. The splayed header, type "M", is only used for one or two row coils. Type "M" coils are always same end connections and use return bends for circuiting in lieu of a collection header. The term splayed means that the coil headers are offset outward from the coil tubes. Non-headered Booster, "B" type coils are also available for one and two row applications.

Figure 1 - Standard Coil Types

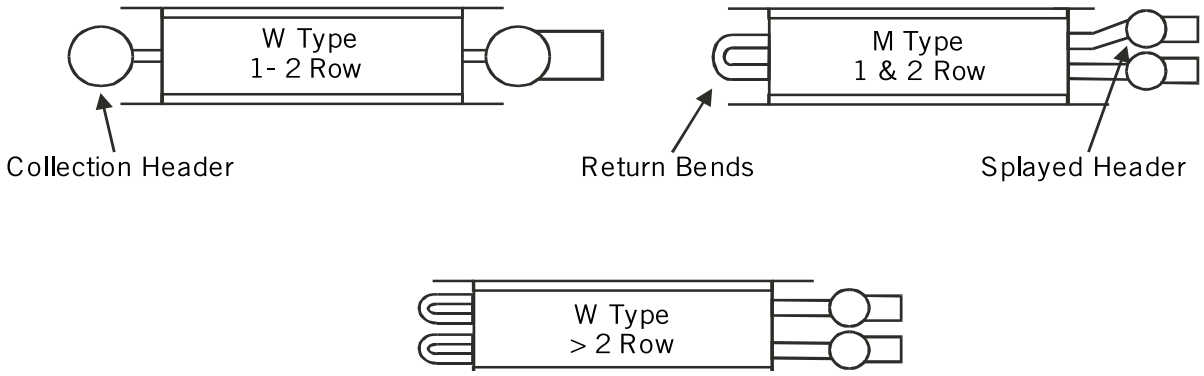
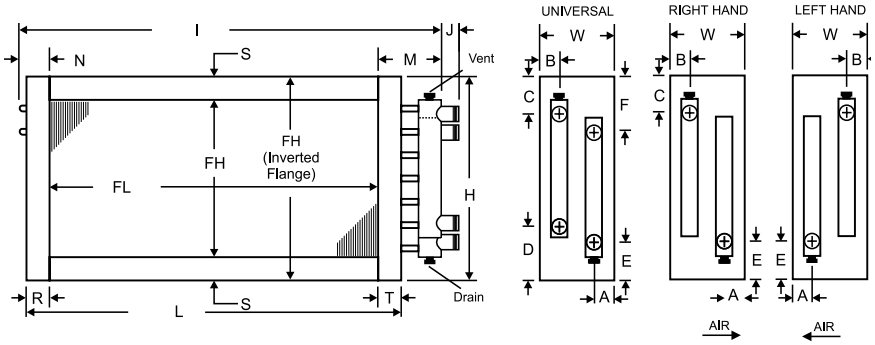


Table 1 - Standard Fluid Coil Dimensions

Case Type	Standard Dimensions						
	H	J	M	N	R	S	T
Flanged	FH + (Sx2)				1.50	1.50	1.50
Inverted Flanges	<= 48" FL = FH + 0.189 > 48" FL = FH + 0.309	3.00	Hdr. OD + 2.50	2.50	1.50	1.50	1.50
End Plates	FH or H				1.50	1.50	1.50

Figure 2 - Same End Connections

Model	Rows
MS	2
MH, MQ	1, 2
WQ, WH, WL	3, 4, 5, 6, 8, 10, 12
WS	4, 6, 8, 10, 12
WM	3*, 4, 5, 6, 8, 10, 12
WD	4*, 5*, 8, 12
WT	5*, 6*, 10, 12
*Left and Right Hand Only	



STANDARD FLUID COILS

Figure 3 - Opposite End Connections

Model	Rows
WS	3, 5
WD	6, 10
WT	9

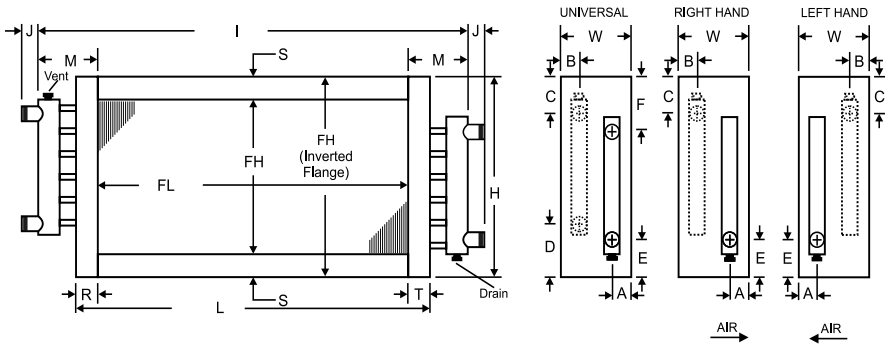


Figure 4 - Collection Header - Same End Connections

Model	Rows
WS	2
WB, WH, WQ	1, 2

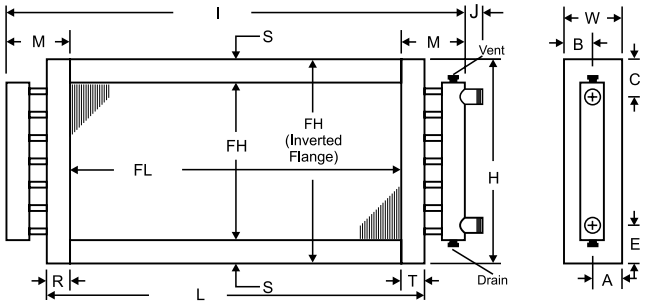
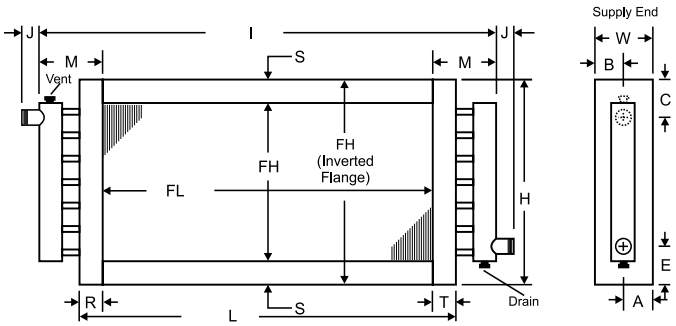


Figure 5 - Collection Header - Opposite End Connections

Model	Rows
WS	1
WD	2
WT	3



BOOSTER COILS

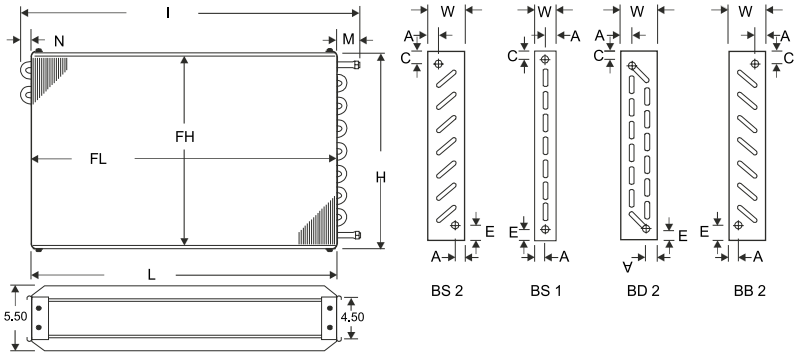
Table 2 - Standard Booster Dimensions

Case Type	Standard Dimensions for Booster Coils						
	H	J	M	N	R	S	T
Slip & Drive	FH + 0.312	3.00	*	2.00	N/A	N/A	N/A
Flanged	FH + (Sx2)				1.50	1.50	1.50
Inverted Flanges	<= 48" FL = FH + 0.189 > 48" FL = FH + 0.309						
End Plates	FH					N/A	

Table 2a - Booster "M" Dmensions

Coil Type	Connection	M Dim
BB/BS	< 1"	3.00
BB/BS/BD	= 1"	4.12
BD	< 1"	3.50

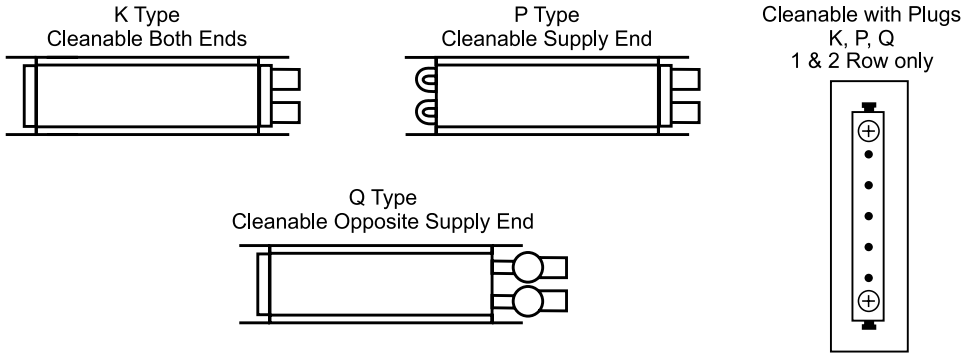
Figure 6 - Booster Coil - Slip & Drive shown



CLEANABLE COILS

Cleanable tube fluid coils with 0.625 inch tubing are available with a minimum 0.025 tube wall, for applications where mechanical cleaning of the coil tubes is required. Our cleanable coils utilize a removable steel header box in lieu of coil headers. This box contains baffles to provide coil circuitry and is removable for easy access to coil tubes. Model type "Q" is cleanable from the end opposite the supply connection. The mode type "P" is cleanable from the supply end. The model type "K" is cleanable from both ends. Our standard cleanable coils should only be used for operating pressures less than 100 psig. We offer a high-pressure design, type "K" cleanable coil with operating pressures up to 300 psig depending upon coil construction.

Figure 7 - Cleanable Coil Types



CLEANABLE COILS

Note: The standard type “W” coils can be made cleanable by installing cleanable plugs for each tube. This is an alternative to the steel head plate design and has a higher working pressure.

Table 3 - Standard Cleanable Coils with Plugs

Case Type	Standard Dimensions for Cleanable with Plugs								
	H	I (Same End)	I (Opp End)	J	L	M	R	S	T
Flanged	FH + (Sx2)	FL + (Mx2)	FL + (Mx2)	3.00	FL + R + T	Hdr. OD + 2.50	1.50	1.50	1.50
Inverted Flanges	<= 48” FL = FH + 0.189 > 48” FL = FH + 0.309								
End Plates	FH							N/A	

Figure 8 - Collection Header with Plugs- Same End Connections

Model	Rows
KS	2
KH, KQ	1, 2
QS	2
QH, QQ	1, 2
PS	2
PH, PQ	1

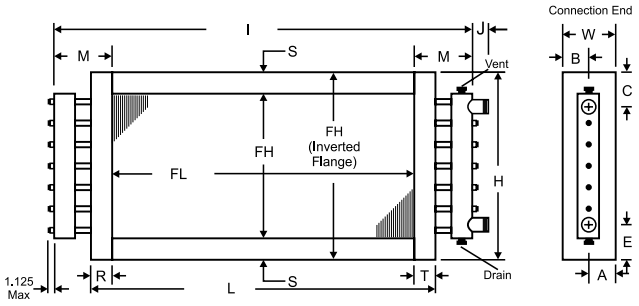
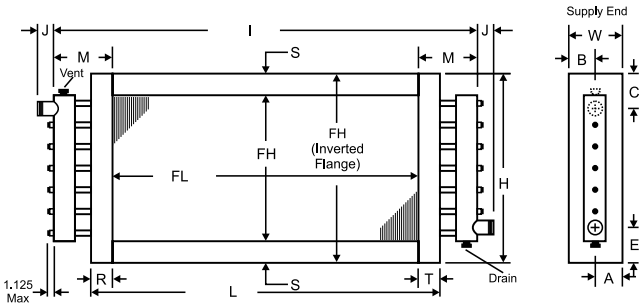


Figure 9 - Collection Header with Plugs - Opposite End Connections

Model	Rows
KS, PS, QS	1
KD, PD, QD	2



Model “K” coils have plugs on both ends (as shown above)
Model “P” coils have plugs on the supply end only
Model “Q” coils have plugs on the return end only

CLEANABLE COILS

Table 4 - Standard Cleanable Coils with Header Plates

Case Type	Standard Dimensions for Cleanable with Plugs								
	H	I (Same End)	I (Opp End)	J	L	N	R	S	T
Flanged	FH + (Sx2)	FL + N + M	FL + (Mx2)	3.00	FL + R(T) + T	2.50	1.50	1.50	1.50

Table 5 - Connection “M”

Connection	M Dimension
2.00	5.00
2.50	5.25
3.00	5.62

Figure 10 - Cleanable Both Ends - Same End Connections - Single & Double Serp

Model	Rows
KS	4, 6, 8, 10, 12
KD	4, 8, 12
KT	6, 12

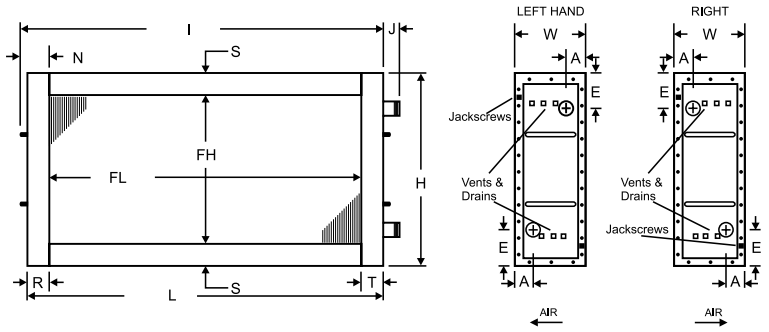
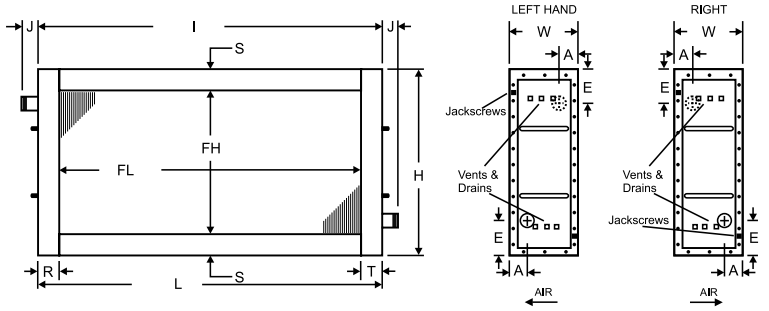


Figure 11 - Cleanable Both Ends - Opposite End Connections

Model	Rows
KD	6, 10



CLEANABLE COILS

Figure 12 - Cleanable Both Ends - Same End Connection - Half Serp

Model	Rows
KH	4, 6, 8, 10, 12

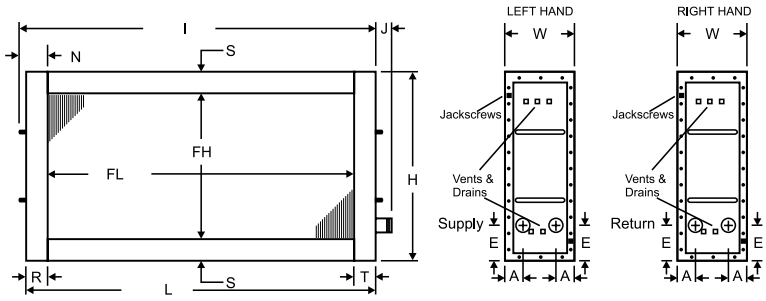


Figure 13 - Cleanable Opposite Supply End - Same End Connections - Single & Double Serp

Model	Rows
QD	4, 8, 12
QS	4, 6, 8, 10, 12
QT	6, 12

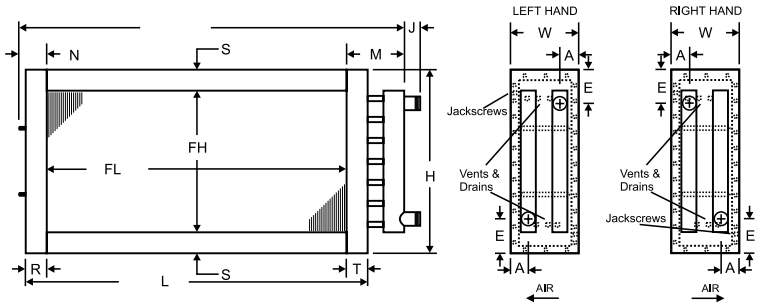
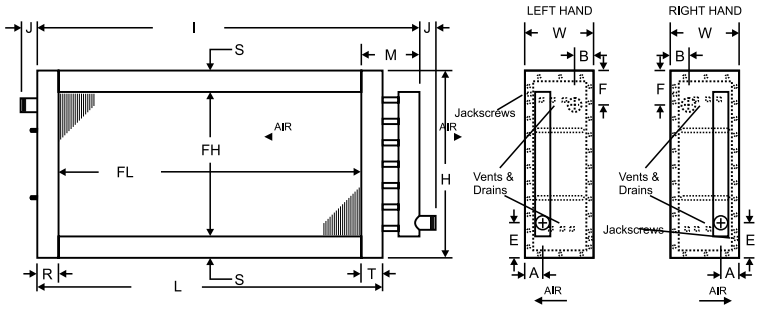


Figure 14 - Cleanable Opposite Supply End - Opposite End Connections

Model	Rows
QD	6, 10



CLEANABLE COILS

Figure 15 - Cleanable Opposite Supply End - Same End Connection - Half Serp

Model	Rows
QH	4, 6, 8, 10, 12

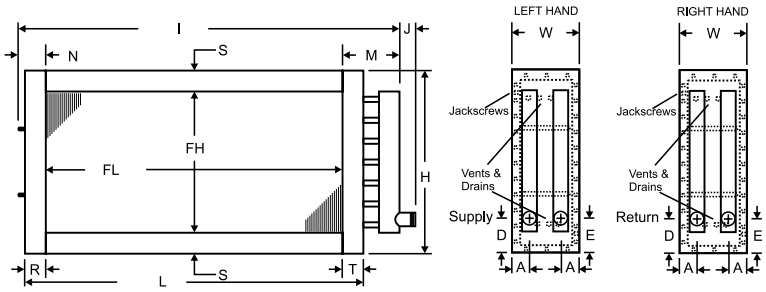


Figure 16 - Cleanable Supply End - Same End Connections

Model	Rows
PS	4, 6, 8, 10, 12
PD	4, 8, 12
PT	6, 12

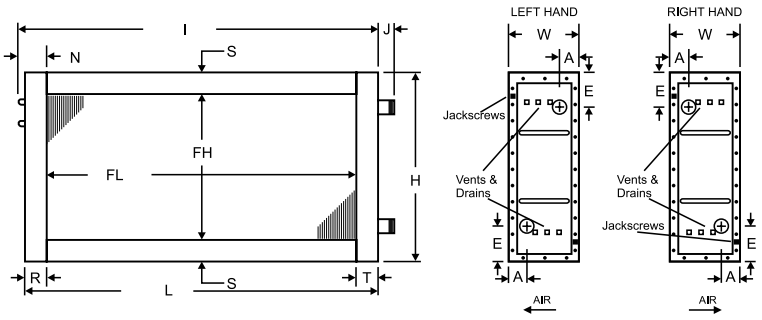
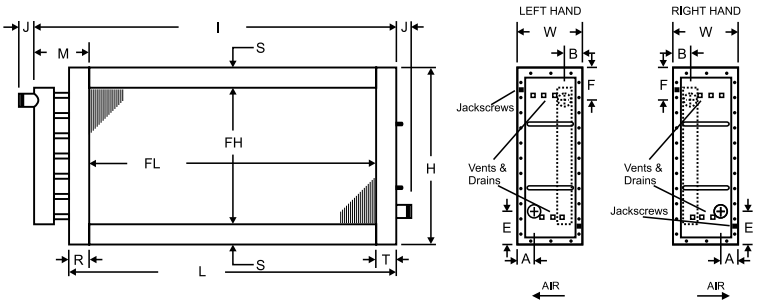


Figure 17 - Cleanable Supply End - Opposite End Connections

Model	Rows
PD	6, 10



CONNECTIONS

Connections are constructed of carbon steel, red brass, copper sweat or stainless steel material. All connections are male pipe thread (MPT), unless specified otherwise. Female pipe thread, grooved and butt-welded connections are also available. Supply connections are located at the bottom of the coil and the return connections are located at the top of the coil, unless stated otherwise.

Coils with universal connection have 2 supply and 2 return connections. The coil is either left or right hand. This option is used when the coil hand is not available or if the coil is to be used as a backup for quick replacement of either a right or left hand coil. Using universal connections can cut inventory by providing the flexibility of one coil for either hand connections. Upon installation the extra connections are capped since they are not needed.

Table 6 - Material Options

Material
Copper Sweat UNS # 12200, ASTM B-75, with a H55 Temper
Stainless Steel 304L or 316L ASTM A312 Sch 40 or Sch 80
Carbon Steel A53A Sch 40
Cupro-nickel UNS# C70600, 90/10, ASTM B-111
Admiralty Brass UNS # c44400, ASTM B-111, Type B

Figure 18 - Connection Location

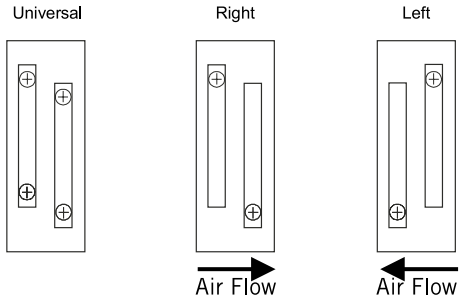


Table 7 - Connection Size vs. GPM

Conn Size	Max GPM	Conn Size	Max GPM
0.50	7.5	2.00	83.7
0.75	13.3	2.50	119.4
1.00	21.5	3.00	184.3
1.25	37.3	3.50	246.5
1.50	50.8	4.00	317.4

Based on standard Schedule 40 steel pipe.

Table 8 - Tube & Header Material

Coil Type	Tube Dia	Tube Matl	Tube Thickness	Header End Cap	Max Std Operating Limits	
					PSIG	Temp
3W, 3M, 3B	0.375	CU	0.013, 0.016, 0.020, 0.025, 0.030	CU	250	300°F
4W, 4M, 4B	0.500	CU	0.016, 0.022, 0.030	CU	250	300°F
5W, 5M, 5B	0.625	CU	0.020, 0.025, 0.035, 0.049	CU	250	300°F
		CN	0.020, 0.035, 0.049	Monel		
		AB	0.049			
		SS	0.035, 0.049, 0.065	SS	Consult Factory	Consult Factory
		CS	0.049, 0.065	CS		
5K, 5P, 5Q	0.625	CU	0.025, 0.035, 0.049	CU	250	300°F
		CN	0.035, 0.049	Monel	100	150°F
		AB	0.049			
		SS	0.035, 0.049, 0.065	SS		
		CS	0.035, 0.049, 0.065	CS		

HEADERS

Material	Material Type	ASTM Rating
Copper	UNS 12200 Seamless Copper	ASTM B75 & ASTM B251
Cupronickel	Seamless 90/10 Cupronickel Alloy C70600	ASTM B111
Stainless Steel	Stainless Steel 304L & 316L, Sch-5 or Sch-10	ASTM-A312
Carbon Steel	Carbon Steel Sch-10	ASTM-A135A
Carbon Steel	Carbon Steel Sch-40	ASTM A53A

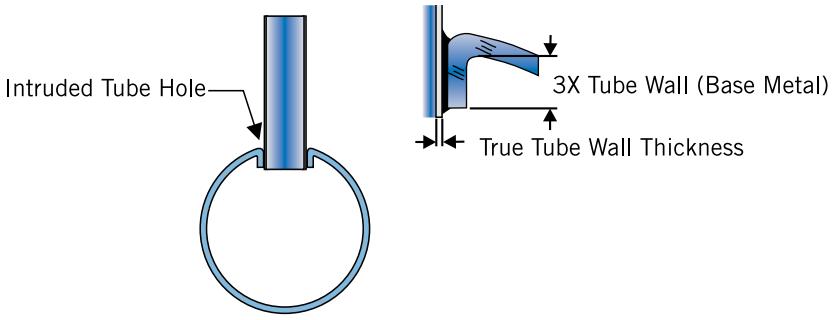
END CAPS

End caps will be die-formed and installed on the inside diameter of the header such that the landed surface area is three times the header wall thickness.

BRAZED COPPER TUBES TO-COPPER HEADER JOINT

Seamless copper tubes are brazed into heavy gauge seamless drawn copper headers. This combination of similar metals eliminates unequal thermal expansion and greatly reduces stress in the tube-header joint. When possible, intruded tube holes in the header allow an extra landed brazing surface for increased strength and durability. The landed the surface area is three times the core tube thickness to provide enhanced header-to-tube joint integrity. All core tubes are evenly extended within the inside diameter of the header no more than 0.12 inch.

Figure 19 - Brazed Joint



FLUID CONSTRUCTION

COIL CASE

Casings and endplates are made from 16-gauge galvanized steel unless otherwise noted. Double-flanged casings on top and bottom of finned height are to be provided, when possible, to allow stacking of the coils. All sheet metal brakes shall be bent to 90 degrees +/- 2 degrees and coils shall be constructed with intermediate tube support sheets fabricated from a heavy gauge sheet stock of the same material as the case, when possible.

Figure 20 - Coil Case

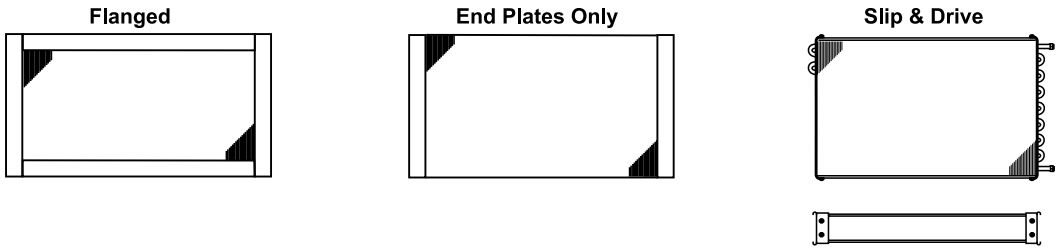


Table 9 - Coil Case Material

Material	Gauge		
	16	14	12
Galvanized Steel, ASTM A-924 and A-653	X	X	*X
Copper ASTM B-152	X	X	X
Aluminum Alloy-3003, Embossed Finish Alloy-5052, Mill Finish (.125 only)	X	X	X
Stainless Steel 304L (or) 316L, 2B-Finish, ASTM A-240	X	*X	*X

*Not available in pierce and flare header plates

TUBE SUPPORTS

Table 10 - Tube Support Quantity

Finned Length (FL)	< 48	> 48 ≤ 96	> 96 ≤ 144	> 144
Tube Supports	0	1	2	4

TUBING

Tubing and return bends are be constructed from seamless copper, cupro-nickel, admiralty brass, stainless steel or carbon steel tubing. Copper tube temper is light annealed with a maximum grain size of 0.040 mm and a maximum hardness of Rockwell 65 on the 15T scale. Tubes are mechanically expanded to form an interference fit with the fin collars. Unless otherwise specified, tubes will have a nominal thickness of 0.020 inch.

FLUID CONSTRUCTION

Table 11 - Tubing Material

Tubing Type	Connections	Tube O.D.	Tube Thickness
Copper	Carbon Steel, Red Brass, Copper Sweat	0.375	0.013, 0.016, 0.020, 0.025, 0.030
		0.500	0.016, 0.022, 0.030
		0.625	0.020, 0.025, 0.035, 0.049
Copper - Rifled	Copper Sweat	0.375	0.012, 0.016
		0.500	0.016
Cupronickel	Carbon Steel, Red Brass	0.625	0.020, 0.035, 0.049
Admiralty Brass	Carbon Steel, Red Brass	0.625	0.049
Stainless Steel	Stainless Steel	0.625	0.035, 0.049, 0.065
Carbon Steel	Stainless Steel	0.625	0.035, 0.049,0.065

FINS

Coils are built of plate-fin type construction providing uniform support for all coil tubes. Coils are manufactured with die-formed aluminum, copper, cupro-nickel, stainless steel or carbon steel fins with self-spacing collars, which completely cover the entire tube surface, providing metal-to-metal contact. Unless otherwise specified, the fin thickness will be 0.0075 +/- 5%.

Table 12 - Fin Material

Material	Fin Thickness (in.)			
	0.0060	0.0075	0.0095	0.0160
Aluminum Alloy-1100	X	X	X	X*
Copper Alloy-110	X	X	X	X*
Cupro-nickel 90/10 Alloy-706		X		
Stainless Steel 302-2B		X	X	
Carbon Steel ASTM A109-83		X	X	

*0.625" A and B surface only

Table 13 - Fin Size

Tube Dia	Fin Matl	Fin Size	FPI	Fin Style	Fin Thickness			
					0.0060	0.0075	0.0095	0.0160
0.375	AL	1.00 x 0.866	6-24	A, B, C, D	x	x		
		1.25 x 1.083	6-16	H	x	x	x	
	CU	1.00 x 0.866	6-24	A, B, C	x	x		
		1.25 x 1.083	6-16	H	x	x		
0.500	AL, CU	1.25 x 1.083	6-20	A, B, C	x	x	x	x
0.500	AL, CU	1.50 x 1.299	4-5	A, B			x	x
				C			x	x
			6-14	A, B	x	x	x	x
				C	x	x	x	
0.625	AL, CU	1.50 x 1.299	4-5	A, B			x	x
				C			x	
			6-14	A, B	x	x	x	x
				C	x	x	x	
	SS, CS	1.50 x1.50	4-5	F, G, H			x	
						x	x	

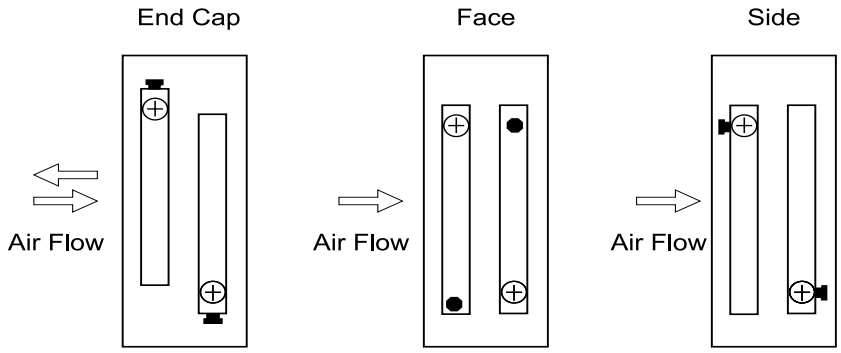
FLUID CONSTRUCTION

COIL OPTIONS

VENT AND DRAIN CONNECTIONS are standard on all fluid coils except booster-type coils, which do not have headers. The standard vent and drain connections are 0.5" female pipe thread with a hex head MPT plug. 0.5" male pipe connection is also available. The standard location for the vent and drain is on the end of the supply and return headers. For horizontal air flow with the headers standing vertically, the vent is located on the top of the return header in the end cap. The drain connection is located on the bottom of the supply header in the end cap. Note that one and two row heating coils with a collection header, type "W", will have both connections on one header for same end connection coils.

The vent and drain connections can be placed on the face of the header facing parallel to the coil tubes; these connections can be extended to the same length as the supply and return connections for easy access. Another option is to locate the vent and drain connections on the side of the coil headers facing outward, with the drain connection facing in the direction of the air flow, and the vent connection facing upstream from airflow. This is usually done for vertical airflow applications.

Figure 21 - Vent and Drain



BRASS TURBOSPIRALS can be installed within the coil tubes. These turbospirals increase the amount of turbulence in the fluid flow and thus increase the rate of heat transfer. This allows for an increase in capacity without affecting the external coil dimensions or increasing air pressure drop. Note that the increase in turbulence will also increase the fluid pressure drop.

CLEANABLE PLUGS can be installed on standard water coils to allow for mechanical cleaning of the internal surface of the coil tubes. The plugs can be installed on one end or both ends as needed. These brass plugs offer a more economical option to attain cleanability as compared to the removable steel baffllle plate design, (Heatcraft coil type 'P', 'Q' or 'K'). The cleanable plugs generally require more labor to clean than the steel header box design.

COATINGS can be applied to the entire external coil surface after fabrication. These coatings are typically applied for additional protection from corrosion or cosmetic reasons. Contact factory for application assistance or further information on this and other available special coil coatings, as well as lead-time.

SCHEDULE 40 PIPE DIMENSIONS

Table 14 - Schedule 40

Pipe Size (in.)	External Dia. (in.)	Internal Dia. (in.)	Internal Area (in^2)	Volume ft^3/ft	Weight lbs/ft	Threads per inch
0.250	0.540	0.364	0.104	0.00072	0.424	18
0.375	0.675	0.493	0.191	0.00133	0.564	18
0.500	0.840	0.622	0.304	0.00211	0.850	14
0.750	1.050	0.824	0.533	0.00370	1.130	14
1.000	1.315	1.049	0.864	0.00600	1.678	11.50
1.500	1.900	1.610	2.038	0.01414	2.717	11.50
2.000	2.375	2.067	3.355	0.02330	3.652	11.50
2.500	2.875	2.469	4.788	0.03250	5.793	8
3.000	3.500	3.068	7.393	0.05134	7.575	8
3.500	4.000	3.548	9.886	0.06866	9.109	8
4.000	4.500	4.026	12.730	0.88400	10.790	8

Note: Pipe threads listed are N.P.T.

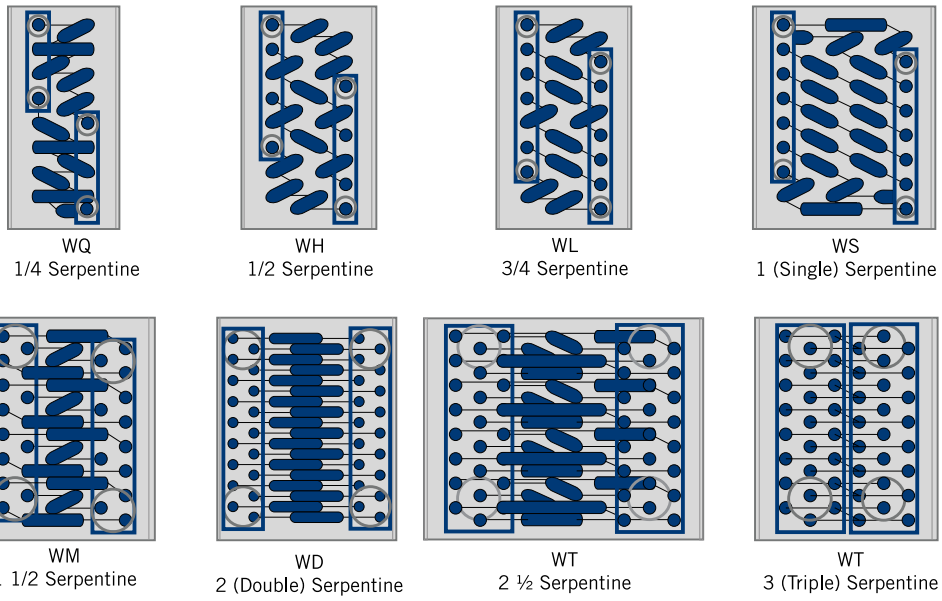
SCHEDULE 80 PIPE DIMENSIONS

Table 15 - Schedule 80

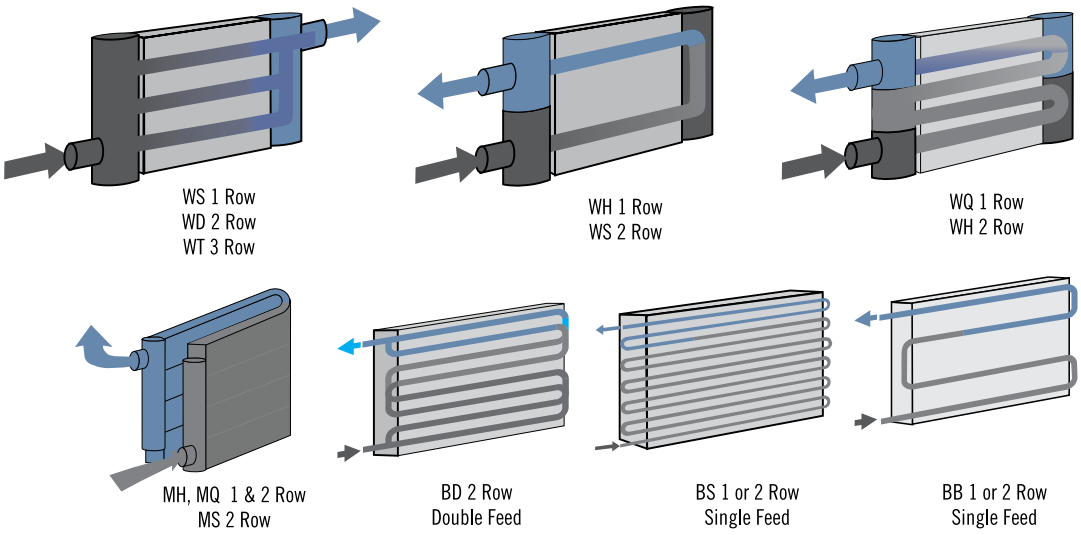
Pipe Size (in.)	External Dia. (in.)	Internal Dia. (in.)	Internal Area (in^2)	Volume ft^3/ft	Weight lbs/ft	Threads per inch
0.250	0.540	0.302	0.072	0.00050	0.535	18
0.375	0.675	0.423	0.141	0.00098	0.738	18
0.500	0.840	0.546	0.234	0.00163	1.000	14
0.750	1.050	0.742	0.433	0.00300	1.470	14
1.000	1.315	0.957	0.719	0.00500	2.170	11.50
1.500	1.900	1.500	1.767	0.01227	3.650	11.50
2.000	2.375	1.939	2.953	0.02051	5.020	11.50
2.500	2.875	2.323	4.238	0.02943	7.660	8
3.000	3.500	2.900	6.605	0.04587	10.300	8
3.500	4.000	3.364	8.888	0.06172	12.500	8
4.000	4.500	3.826	11.497	0.07980	14.900	8
2.500	2.875	2.323	4.238	0.02943	7.660	8
3.000	3.500	2.900	6.605	0.04587	10.300	8
3.500	4.000	3.364	8.888	0.06172	12.500	8
4.000	4.500	3.826	11.497	0.07980	14.900	

Note: Pipe threads listed are N.P.T.

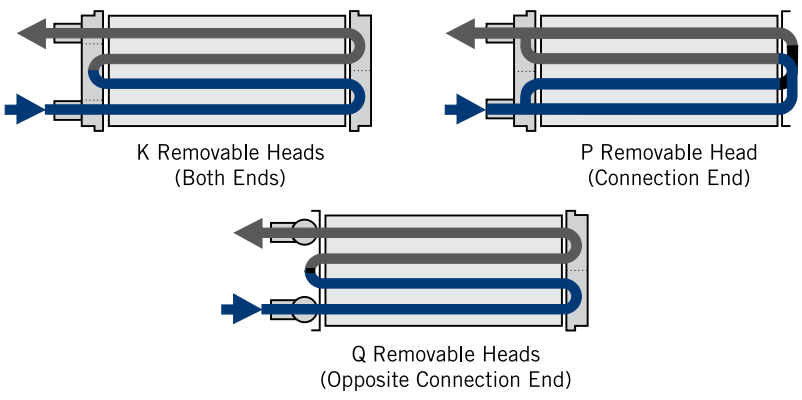
COOLING COILS
Circuiting/Serpentine



HEATING COILS



CLEANABLE COILS



PSYCHROMETRIC CHART

The psychrometric chart provides a graphical representation of the thermodynamic properties of moist air. The chart correlates various properties, which are interrelated. The properties shown on the chart are the following: dry bulb, wet bulb, relative humidity, enthalpy, humidity ratio, dew point and specific volume. If you are given any two of these properties along with barometric pressure it is possible to determine the other properties using the chart once your conditions are correctly plotted.

Example: Given a dry bulb temperature of 80°F, 50% relative humidity at standard atmospheric pressure determine the wet bulb, enthalpy, humidity ratio, and dew point using the psychrometric chart and a straight edged ruler.

The correct answers are wet bulb= 66.7°F, enthalpy= 31.25 Btu/lb. dry air, humidity ratio = .011, dew point = 59.7°F.

By plotting the beginning and ending conditions of a moist air system, you can visually verify the changes, which are occurring between these two points. Draw a straight line between the initial and the ending positions on the chart. Clearly mark which point is beginning and which is ending. Moving from the initial to final condition will give a direction of movement. This direction identifies what type of process has occurred. See the outline of the psychrometric chart below.

Figure 22 - Psychrometric Chart

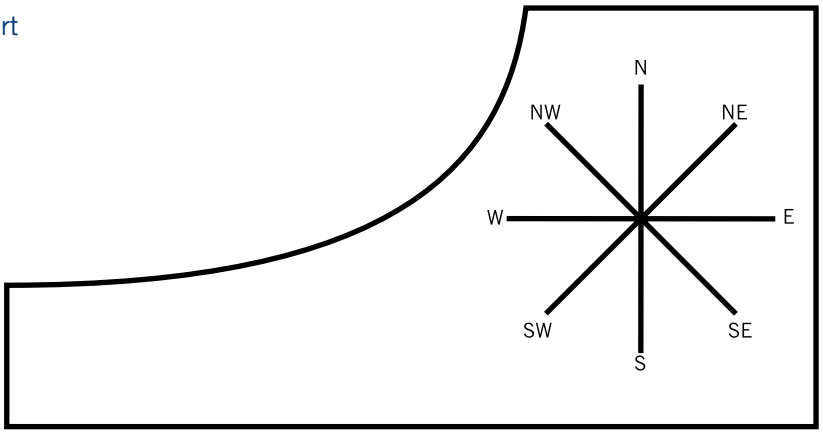


Table 16 - Regional Application

Movement	Process Occurring	Typical Application
East	Sensible Heating Only*	Comfort Heating
Northeast	Heating with Humidification	Comfort Heating & Increasing Moisture
North	Humidification Only	Only Increasing Moisture
Northwest	Evaporative Cooling	Cooling in Very Low Humidity Areas
West	Sensible Cooling Only	Cooling without Moisture Removal
Southwest	Cooling with Dehumidification*	Comfort Cooling & Moisture Removal
South	Demidification Only	Moisture Remova

* Most common processes which occur for comfort heating and cooling.

COMBINING TWO ADIABATIC, EQUAL PRESSURE AIR STREAMS

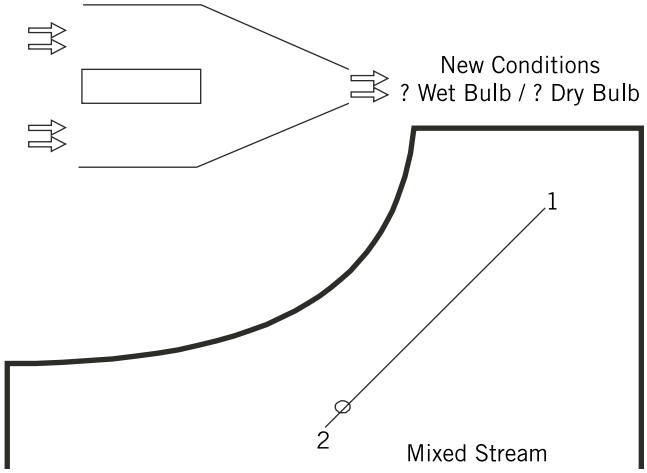
This is a common problem in air duct systems. This situation occurs when outside air is being introduced into the return air ductwork. Here you have two different entering air conditions that combine to form a single state. Using a graphical representation on the psychrometric chart can solve this problem. This process assumes that both airstreams are at approximately the same pressure. Below is an example of how to solve this problem.

Example: Given two airstreams

1. 400 CFM of air at 95/78°F (Dry bulb/Wet bulb)
2. 3600 CFM of air at 80/67°F (Dry bulb/Wet bulb)

Find the resulting combined air stream conditions

Figure 23 - Air Streams



Step 1: Plot both conditions on the psychrometric chart and identify the points.

Step 2: Draw a line between the points. The final mixed air stream's state lies on this line.

Step 3: Calculate the volumetric ratio of the dry air masses. To do this add the airflows together, and then divide the larger airflow by this total.

3600 CFM + 400 CFM = 4000 CFM Total

3600 CFM/4000 CFM = 0.90

Step 4: With a ruler measure the straight-line length between the two points. Multiply this length by the volmetric ratio to get the distance you must travel along this line from the smaller airflow point.

The resulting mixed air stream is 4000 CFM at approx. 82/68°F (dry bulb/wet bulb).

Note: The resulting point plotted on the connecting line will be closest to the point representing the larger of the two airflows. If the airflow were equal the center point on the line would determine the resulting combined entering air conditions.

TOTAL HEAT (ENTHALPY)

Table 17 - Heat Content (BTU) of 1 lb. of Dry Air Saturated with Water Vapor† (Standard atmospheric pressure 29.921" HG)

WET BULB°F*	TENTHS OF DEGREES									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
35	13.01	13.05	13.09	13.14	13.18	13.22	13.27	13.31	13.35	13.39
36	13.44	13.48	13.52	13.57	13.61	13.66	13.70	13.74	13.79	13.83
37	13.87	13.92	13.96	14.01	14.05	14.10	14.14	14.19	14.23	14.27
38	14.32	14.36	14.41	14.45	14.50	14.54	14.59	14.63	14.68	14.73
39	14.77	14.82	14.86	14.91	14.95	15.00	15.05	15.09	15.14	15.18
40	15.23	15.28	15.32	15.37	15.42	15.46	15.51	15.56	15.60	15.65
41	15.70	15.74	15.79	15.84	15.89	15.93	15.98	16.03	16.08	16.12
42	16.17	16.22	16.27	16.32	16.37	16.41	16.46	16.51	16.56	16.61
43	16.66	16.71	16.75	16.80	16.85	16.90	16.95	17.00	17.05	17.10
44	17.15	17.20	17.25	17.30	17.35	17.40	17.45	17.50	17.55	17.60
45	17.65	17.70	17.75	17.80	17.85	17.91	17.96	18.01	18.06	18.11
46	18.16	18.21	18.26	18.32	18.37	18.42	18.48	18.52	18.58	18.63
47	18.68	18.73	18.79	18.84	18.89	18.95	19.00	19.05	19.10	19.16
48	19.21	19.26	19.32	19.37	19.43	19.48	19.53	19.59	19.64	19.70
49	19.75	19.81	19.86	19.92	19.97	20.03	20.08	20.14	20.19	20.25
50	20.30	20.36	20.41	20.47	20.52	20.58	20.64	20.69	20.75	20.81
51	20.86	20.92	20.98	21.03	21.09	21.15	21.21	21.26	21.32	21.38
52	21.44	21.49	21.55	21.61	21.67	21.73	21.79	21.84	21.90	21.96
53	22.02	22.08	22.14	22.20	22.26	22.32	22.38	22.44	22.50	22.56
54	22.61	22.68	22.74	22.80	22.86	22.92	22.98	23.04	23.10	23.16
55	23.22	23.28	23.34	23.41	23.47	23.53	23.59	23.65	23.72	23.78
56	23.84	23.90	23.97	24.03	24.10	24.16	24.22	24.29	24.35	24.42
57	24.48	24.54	24.61	24.67	24.74	24.80	24.86	24.93	24.99	25.06
58	25.12	25.19	25.25	25.32	25.38	25.45	25.52	25.58	25.65	25.71
59	25.78	25.85	25.92	25.98	26.05	26.12	26.19	26.26	26.32	26.39
60	26.46	26.53	26.60	26.67	26.74	26.80	26.87	26.94	27.01	27.08
61	27.15	27.22	27.29	27.36	27.43	27.50	27.57	27.64	27.71	27.78
62	27.85	27.92	27.99	28.07	28.14	28.21	28.28	28.35	28.43	28.50
63	28.57	28.64	28.72	28.79	28.87	28.94	29.01	29.09	29.16	29.24
64	29.31	29.38	29.46	29.53	29.61	29.68	29.76	29.83	29.91	29.98
65	30.06	30.16	30.21	30.29	30.37	30.44	30.52	30.60	30.68	30.75
66	30.83	30.91	30.99	31.07	31.15	31.22	31.30	31.38	31.46	31.54
67	31.62	31.70	31.78	31.86	31.94	32.02	32.10	32.18	32.26	32.34
68	32.42	32.50	32.59	32.67	32.75	32.83	32.92	33.00	33.08	33.17
69	33.25	33.33	33.42	33.50	33.59	33.67	33.75	33.84	33.92	34.00
70	34.09	34.18	34.26	34.35	34.43	34.52	34.61	34.69	34.79	34.86
71	34.95	35.04	35.13	35.21	35.30	35.39	35.48	35.57	35.65	35.74
72	35.83	35.92	36.01	36.10	26.19	36.28	36.38	36.47	36.56	36.65
73	36.74	36.83	36.92	37.02	37.11	37.20	37.29	37.38	37.48	37.57
74	37.66	37.75	37.85	37.94	38.04	38.13	38.23	38.32	38.42	38.51
75	38.61	38.71	38.80	38.90	39.00	39.09	39.19	39.28	39.38	39.47
76	39.57	39.67	39.77	39.87	39.98	40.07	40.17	40.27	40.37	40.47
77	40.57	40.67	40.77	40.87	40.97	41.07	41.18	41.28	41.38	41.48
78	41.58	41.68	41.79	41.89	42.00	42.10	42.20	42.31	42.41	42.52
79	42.62	42.73	42.83	42.94	43.05	43.15	43.26	43.37	43.48	43.58
80	43.69	43.80	43.91	44.02	44.13	44.23	44.34	44.45	44.56	44.67
81	44.78	44.89	45.00	45.12	45.23	45.34	45.45	45.56	45.68	45.79
82	45.90	46.01	46.13	46.24	46.36	36.47	46.58	46.70	46.81	46.93
83	47.04	47.16	47.28	47.39	47.51	47.63	47.75	47.87	47.98	48.10
84	48.22	48.34	48.46	48.58	48.70	48.82	48.95	49.07	49.19	49.31
85	49.43	49.55	49.68	49.80	49.92	50.04	40.17	50.29	50.41	50.54

*Use wet bulb temperature only in determining total heat.

†Compiled from data in ASHRAE Handbook of Fundamentals 1981.

GENERAL FORMULAS

TOTAL BTUH (Air Cooling)

Total BTUH = 4.5 x SCFM x (Total Heat Ent. Air - Total Heat Lvg. Air)
Where 4.5 = Density Std. Air x Min./Hr.
Density Std. Air = 0.075 lbs./cu. ft.
Min./hr. = 60

SENSIBLE BTUH (Air Cooling)

Sensible BTUH = 1.08 x SCFM x (Ent. Air DB - Lvg. Air DB)
Where 1.08 = (Specific heat of air) x (Minutes/Hr.) x Density Std. Air
Specific heat = 0.24 btu/lb.F
Min./hr. = 60
Density Std. Air = .075 Lbs./cu. ft.

TOTAL BTUH (Air Heating)

Total BTUH = 1.08 x SCFM x (Lvg. Air DB - Ent. Air DB)
Where 1.08 = (Specific heat) x (Minutes/Hr.) x Density Std. Air
Specific heat = 0.24 btu/lb.F
Min./hr. = 60
Density Std. Air = 0.075 Lbs./cu. ft.

TOTAL BTUH (Water Side)

Total BTUH = 500 x GPM x (Lvg.Water Temp - Ent. Water Temp) Where 500 = Lbs./Gal. x Min./Hr. x Specific heat water
Lbs./gal. = 8.33
Min./hr.= 60
Specific heat = 1 btu/lb.F

SENSIBLE TOTAL RATIO

S/T Ratio = Sensible BTUH ÷ Total BTUH

LEAVING AIR TEMPERATURE (heating)

Lvg Air Temp. = Ent. Air Temp. + (Sensible BTUH ÷ (1.08 x SCFM))

LEAVING AIR TEMPERATURE (cooling)

Lvg Air Temp. = Ent. Air Temp. - (Sensible BTUH ÷ (1.08 x SCFM))

FACE AREA

FA (Sq. Ft.) = (Fin Height x Finned Length) ÷ 144

FACE VELOCITY (FPM)

FPM = SCFM ÷ Face Area (sq. ft.)

MBH PER SQUARE FOOT OF FACE AREA

MBH/Sq. Ft. = Total BTUH ÷ (Face Area (Sq. Ft.) x 1000)

WATER VELOCITY

FPS = (0.0022 x GPM) / (CS x # of circuits)
CS = 0.785 x $(D\text{-}2t)^2$
(where D = tube outside diameter
t = tube thickness)

NUMBER OF CIRCUITS

for: 5A, 5B, 5C, 4H (FH ÷ 1.5) x Serpentine
for: 4A, 4B, 4C (FH ÷ 1.25) x Serpentine
for: 3A, 3B, 3C, 3D (FH ÷ 1.00) x Serpentine
for: 3H (FH ÷ 1.25) x Serpentine

Standard Conditions:
Temperature = 70°F
Pressure = 14.69 psi
Density = 0.075 lb/ft^3

OTHER APPLICATIONS

Picture 1 - M.A.R.C. Unit

M.A.R.C. (Modular Auxiliary Removable Coil)

- Replaces existing coil section
- Removable coil through access door
- Galvanized or stainless steel casing
- Modular unitary construction
- Insulated (single wall)
- Stainless steel drain pan
- Auxiliary/supplemental heating or cooling
- Add heating or cooling to make-up air unit
- Replaces existing coil section
- Internal (vertical) 2" and 4" filter rack option

Picture 2 - High-Pressure Cleanable Coil

HIGH-PRESSURE CLEANABLE COIL

- For high-pressure fluid applications up to 300 psig operating pressure
- Removable heads on both ends allow for internal tube cleaning without clogging the ends of the coil
- Tube materials: using a combination of copper, cupro-nickel, stainless steel or carbon steel tubes
- Fin material made of stainless steel, carbon steel, copper or aluminum

Picture 3 - Drain Pan

DRAIN PANS

- 304L, 316L stainless steel and 16 gauge galvanized steel
- Lead Time - 10 working days
- Designed per customer's drawing

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