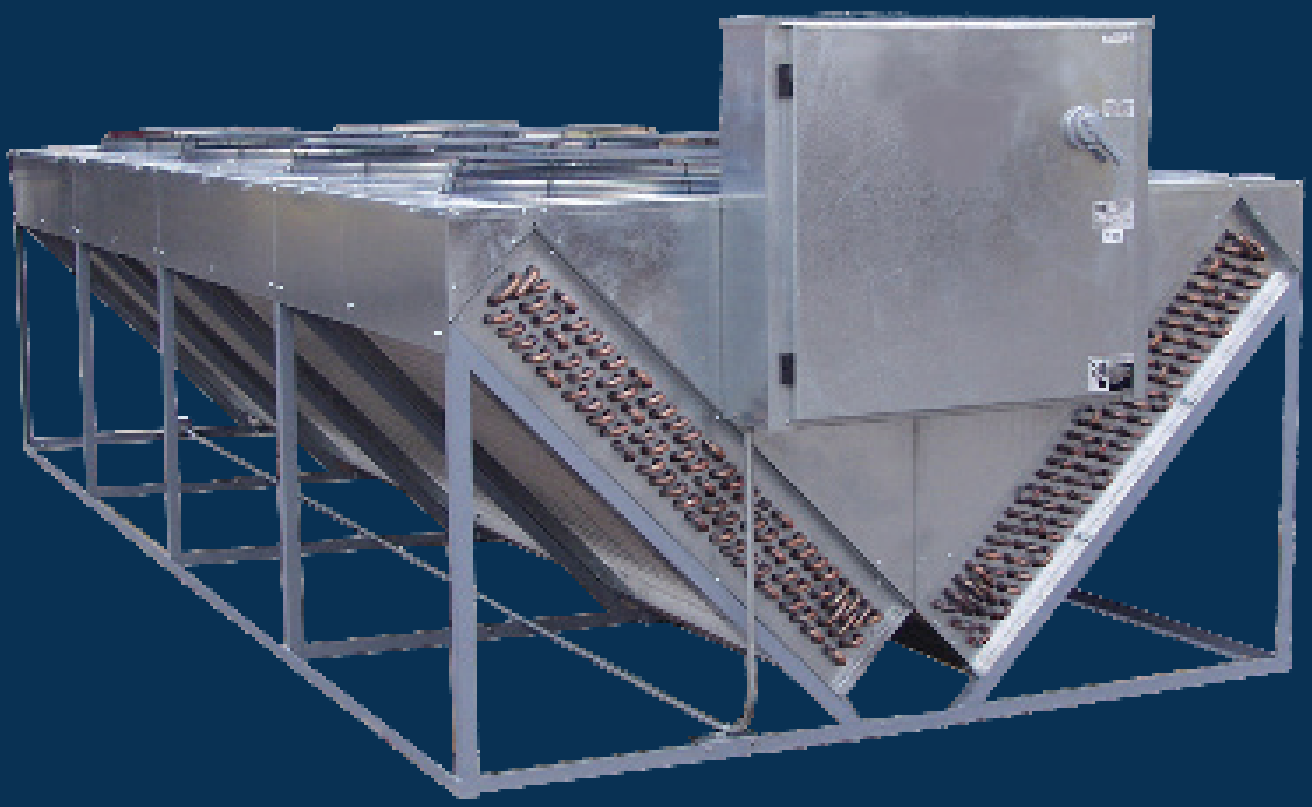
FC SERIES
FLUID COOLERS



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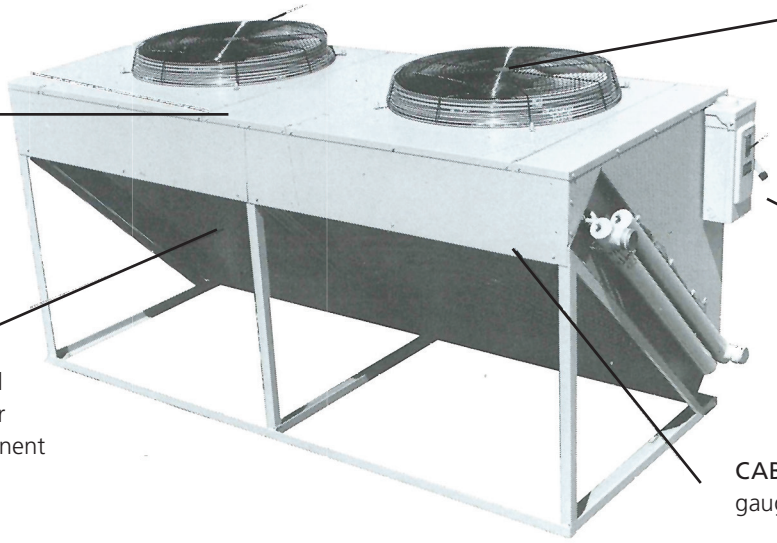

FANS – Efficient, steel blade hub fans use less power.

FAN MOTORS – True three phase ball bearing motors require less energy than typical single-phase motors.

DISCONNECT SWITCH (OPTIONAL)

COILS – All non-ferrous fluid circuit. Staggered 5/8 copper tubes, aluminum fins. Permanent mechanical bond

CABINET – Durable heavy gauge G-90 galvanized steel

Features

1. Cabinets – Cabinets are rigidly constructed of steel members for great strength and durability. All Sheet metal is galvanized per specification ASTM-A-525 Grade G90.
2. Coils – Plate fin coils employ 5/8 in. copper tubes in a staggered configuration for maximum heat transfer. Copper tubes are expanded into and permanently bod with the aluminum fins for maximum conductance through each fin. Each coil is optimally circuited for minimum solution pressure drop.
3. Fans- All fans are sized to provide proper air flow through each coil. They are direct-drive propeller type fans with steel hub and blades. Vertical air discharge through a formed venture minimizes noise generation and air-recirculation.
4. Motors – All motors are three phase 1140 RPM specifically designed for vertical shaft, direct-drive fan application and utilize permanently lubricated ball bearings. Corrosion resistant 3/8 in. diameter steel rod mounting brackets do not restrict air flow and help to eliminate vibration.

Ratings

Table 1 sows unit ratings for three typical sets of design operating conditions.

The first, at 120° entering, 110° leaving solution temperature and 95° ambient air shows the capacities, flow rates, and pressure drops for a 40% Ethylene Glycol solution. This rating represents a typical industrial summer cooling application.

The second rating point, at 115° entering, 108° leaving solution temperature shows the performance data of the unit for a smaller initial temperature difference and a smaller change in solution temperature. A unite designed around these conditions could be used in conjunction with water cooled condensing equipment for air conditioning and refrigeration systems.

The final rating point shows the performance at much lower solution and ambient temperatures. For example, a unit designed for operation at these lower temperature would be used for cooling at low ambient conditions for winter time industrial cooling, requiring no refrigeration. At these low ambient conditions the only mechanical equipment required is a pump to circulate the solution through the system. As can be seen from Table 1, the rating at 60° entering, 50° leaving solution temperature and 40° ambient are considerably lower than those at the higher temperatures. This is due to the change in properties of Ethylene Glycol with respect to temperature; the lower the solutions temperature, the greater the viscosity. This phenomenon reduced the Reynolds number significantly, thereby decreasing turbulent flow and reducing the heat transfer. Because of this effect, it is possible to have flow in the Laminar Region, depending on the pressure drop limitations and the circuiting. The pressure drop limit in this table is 30 ft. of water and the unit ratings which fall into the Laminar Region are denoted in Table 1 by an asterisk. If a pressure drop greater than 30 ft. is acceptable, the unit can be recircuited such that the capacity requirements are met. Write or call your technical Systems Sales Representative or the factory.

NOTE: The values for nominal pressure drop at 3 GPM/Circuit in Table 1 will only be used in conjunction with Table 2 and Figures 3 through 5 when selecting units from this bulletin.

Ratings

Capacities shown are in MBTU/Hr.

Refer to Table 2 for circuiting data. Pressure drop is given in ft. of water head.

TABLE 1

MODEL #		*NOMINAL PRESSURE DROP		120/110/95**				115/108/95**				60/50/40**			
		CIRC. A	CIRC. B	MBH	GPM	P.D	CIRC.	MBH	GPM	P.D.	CIRC.	MBH	GPM	P.D.	CIRC.
FC2	FC2-19	3.2	6.7	19.6	4.5	2.0	B	16.8	5.4	2.8	B	8.5'	2.1	72	B
	FC2-24	3.2	6.7	24.9	5.7	3.0	B	21 3	6.9	4.3	B	9 8'	2.4	.83	B
	FC2-31	5.0	10.2	31.8	7.2	7.0	B	26.8	8 7	9.8	B	14.0'	3.3	1 7	B
	FC2-37	5.0	10.2	37.6	8.7	9.7	B	31.8	10 2	12.9	B	15.5'	3.6	1.9	B
	FC2-42	10.2	20.8	41.9	10.2	3.8	A	35.1	12.0	5.1	A	32.4	7 5	19.4	A
FC4	FC4-41	3.1	4.8	41.3	9.6	1.6	B	39.2	12.6	18.2	B	30.4	7.2	8.8	B
	FC4-52	3.1	4.8	52.7	12.0	2.4	B	50.3	16.2	28.2	B	38.8	9.0	13.0	B
	FC4-66	4.8	7.4	66.9	15.0	5.4	B	56.1	18.6	8.0	A	25.0'	6.0	1.1	A
	FC4-78	4.8	7.4	78.3	18.0	7.4	B	65.7	21.6	10.3	A	27.4'	6.6	1.3	A
	FC4-85	6.6	10.0	85.3	19.8	11.8	B	71.4	23.4	16.0	A	57.5	13.2	7.6	A
	FC4-92	6.6	10.0	92.0	21.6	13.8	B	77.4	25.2	18.2	A	62.5	15.0	9.5	A
	FC4-100	10.0	15.2	100.1	22.8	22.9	B	80.7	26.4	29.9	A	70.2	16.2	16.4	A
FC12	FC12-105	6.5	11.1	105.6	24.0	18.3	B	88.2	28.8	25.5	B	72.3	17.0	21.5	B
	FC12-113	6.5	11.1	113.2	26.0	5.1	A	95.5	31.0	7.0	A	84.9	19.5	27.3	B
	FC12-119	8.8	14.9	119.7	27.0	7.3	A	99.2	33.0	10.5	A	86.8	20.4	23.9	A
	FC12-127	8.8	14.9	127.5	29.0	8.3	A	105.2	35.0	11.7	A	92.9	21.6	26.5	A
	FC12-133	11.1	18.7	133.5	31.0	11.7	A	112.1	36.0	15.4	A	90.6	21.0	7.8	A
FC24	FC24-142	4.5	6.9	142.2	32.0	7.7	B	119.8	39.0	11.1	B	90.1	21.0	4.9	B
	FC24-159	4.5	6.9	159.9	36.0	9.5	B	134.4	44.0	13.7	B	101.2	24.0	6 1	B
	FC24-175	4.5	6.9	175.6	40.0	11.4	B	147.9	48.0	15.9	B	111.0	26.0	7.0	B
	FC24-195	6.9	10.6	195.2	44.0	20.6	B	162.3	53.0	28.8	B	130.8	31.0	14.5	B
	FC24-219	6.9	10.6	219.7	50.0	25.7	B	175.1	57.0	10.6	A	148.2	34.0	17 0	B
	FC24-241	6.9	10.6	241.1	54.0	29.4	B	191.6	61.5	12.1	A	161.7	38.0	20.6	B
	FC24-253	9.4	14.2	253.7	57.0	14.1	A	211 0	67.5	19.2	A	169.1	40.5	10.1	A
	FC24-269	9.4	14.2	269.8	61.5	16.1	A	222.4	73.5	22.2	A	183.1	42.0	10.7	A
	FC24-281	11.8	17.8	281.9	64.5	22.0	A	232.2	76.5	30.0	A	195.3	46.5	16.1	A
FC36	FC36-295	4.6	9.6	295.1	66.0	18.7	B	245.9	79.5	26.2	B	198.2	46.5	13.2	B
	FC36-332	4.6	9.6	332.2	75.0	23.4	B	253.0	84.0	4.2	A	223.7	52.5	16.3	B
	FC36-362	4.6	9.6	362.1	82.5	27.7	B	276.8	90.0	4.7	A	245.1	57.0	18.7	B
	FC36-392	6.3	12.9	392.8	90.0	6.3	A	324.3	108.0	8.8	A	115.9'	27.0	.9	A
	FC36-410	7.9	16.3	410.8	96.0	8.9	A	345.4	111.0	11.6	A	280.1	66.0	6.0	A
	FC36-432	7.9	16.3	432.2	99.0	9.4	A	355.7	117.0	12.7	A	294.5	69.0	6.5	A
FC48	FC48-460	6.0	12.3	460.8	105.0	7.8	A	385.1	126.0	10.9	A	113.0'	27.0	.8	A
	FC48-494	6.0	12.3	494.5	111.0	8.6	A	410.6	135.0	12.3	A	115.6'	27.0	.8	A
	FC48-508	8.1	16.5	508.1	117.0	12.8	A	423.4	138.0	17.2	A	343.2	81.0	8.7	A
	FC48-548	8.1	16.5	548.3	123.0	14.0	A	452.9	147 0	19.3	A	386.6	87.0	9.9	A
	FC48-573	10.2	20.7	573.7	129.0	19.1	A	469.2	153.0	26.0	A	395.0	93.0	14.0	A
	FC48-597	10.2	20.7	597.8	135.0	20.7	A	488.3	159.0	27.9	A	418.2	96.0	14.8	A
FC72	FC72-670	6.3	12.9	670.0	150.0	4.6	A	560.3	180.0	6.4	A	498.0	117.0	26 4	B
	FC72-735	6.3	12.9	735.9	168.0	5.6	A	618.4	198.0	7.5	A	225.1'	54.0	.9	A
	FC72-785	6.3	12.9	785 7	180.0	6.3	A	648.5	216.0	8.8	A	231 8'	54.0	.9	A
	FC72-821	8.0	16.3	821.6	192.0	8.9	A	690.8	222.0	11.6	A	560.1	132.0	6.0	A
	FC72-864	8.0	16.3	864.4	198.0	9.4	A	711.5	234.0	12.7	A	589.0	138.0	6 5	A
FC96	FC96-921	6.0	12.3	921.6	210.0	7.8	A	770.2	252.0	10.9	A	226.0'	54.0	.8	A
	FC96-989	6.0	12.3	989.0	222.0	8.6	A	821 2	270.0	21.3	A	231.2'	54.0	.8	A
	FC96-1016	8.1	16.5	1016.2	234.0	12.8	A	846.9	276.0	17.3	A	686.5	162.0	8.7	A
	FC96-1096	8.1	16.5	1096.6	246.0	14.0	A	905.9	294.0	19.3	A	737.2	174.0	9.9	A
	FC96-1142	8.1	16.5	1142.7	258.0	15.2	A	939.2	306.0	20.7	A	773.7	180.0	10.5	A
	FC96-1195	10.2	20.8	1195.6	270.0	20.7	A	976.6	318.0	27.9	A	836.5	192.0	14.8	A

*Pressure drop at 3 GPM/circuit 115° F fluid temperature, 40% Ethylene Glycol.

** Ent. Sol. Temp/Lvg. Sol. Temp/Ambient -°F.

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Fluid Cooler Selection Procedure

The curves in Figures 3 through 6 show performance for units using 40% Ethylene Glycol at a mean solution temperature of 115° F and at an ambient temperature of 95°F. These curves are plotted for flow rates ranging from 2 to 5 GPM/Circuit versus the capacity (MBH) per degree of initial temperature difference (TD).

Where:
TD = Entering solution temperature (° F)
- Ambient air temperature (° F)
MBH = Thousands of BTUs/Hour

For selections at other conditions the correction factor curves for capacity and pressure drop, shown in Figures 7, 8 and 9 can be used. These factors correct back to the values in the curves.

To select a unit from the curves, the following information must be known.
1. The design air temperature -°F.
2. The total flow rate - GPM.
3. The entering and leaving solution temperatures -°F.
4. The total heat rejection BTUH — If known.
5. The Glycol concentration percentage (by weight).

Example: Cool 30 GPM of a 30% Ethylene Glycol solution from 85° to 65° at an ambient temperature of 60°F.

Step 1. Calculate the desired capacity at the specified conditions using Figures 1 and 2 and the following equation.

Q = 500 x SG x CP x GPM x (Ent. Sol. Temp. - Lvg. Sol. Temp.)
From Fig. 2 @ 30% E.G. (&) 75° Mean Sol. Temp.
SG = 1.037
From Fig. 1 @ 30% E.G. (&) 75° Mean Sol. Temp.
CP = .900
Q = 500 x 1.037 x .900 x 30 x (85-65) = 279,990 BTUH

Step 2. Convert the desired capacity to the equivalent base capacity corresponding to the condition in Figures 3 through 6. The correction factor used to correct for any condition is found in Figure 7.

$$\text{Equivalent Capacity} = \frac{\text{Desired Capacity}}{C1}$$

From Fig. 7 @ 30% E.G. (&) 75° Mean Sol. Temp.
CI = .984

$$Q_E = \frac{279{,}990}{.984} = 284{,}543 \text{ BTUH} = 284.543 \text{ MBH}$$

Step 3. Now find the capacity per degree of initial temperature difference (TD).

TD = (ent. Sol. Temp. - Ambient Temp.) = (85-60) = 25°

$$\frac{Q_E}{TD} = \frac{284.543}{25} = 11.38 \text{ MBH/° TD}$$

Step 4. Obtain from Table 2 a number of circuits which will give a flow rate between 2 and 5 GPM/Circuit by the following calculation.

Assume 15 Circuits

$$\frac{30 \text{ GPM}}{15 \text{ Circ.}} = 2 \text{ GPM/Circuit}$$

Now go to Figure 3 through 6 and select the unit with the same circuiting as that assumed which will meet the capacity requirements.

From Figure 5 @ 2 GPM/Circuit
FC36-432B is the correct selection.

Step 5. From Table 1 the nominal pressure drop for the above unit is found to be 16.3 Ft. H_2O. This value must now be corrected for the desired conditions and corrected for a flow rate other than 3 GPM/Circuit.

The following equation is used to correct the pressure drop for other flow rates and conditions:

$P = C_2 \times C_6 \times P_N$
P = Actual pressure drop.
C_2 = Pressure drop flow rate correction factor (Fig. 9)
C_3 = Pressure drop correction factor for other conditions (Fig. 8)

P_N = Nominal condition pressure drop (Table 1, column 1 or 2)
From Figure 8 @ 30% E.G. (&) 75° Mean Sol. Temp.
C_2= 1.09
From Figure 9 at 2 GPM/Circuit
C_3 = .48
P= 1.09 x .48 x 16.3 Ft. H_2O
P = 8.53 Ft. H_2O

Performance data for special applications such as high altitudes or conditions outside the ranges of the curves may be obtained by writing or calling your Technical Systems Sales Representative or the factory.

Application Engineering Information

1. The leaving fluid temperature can be controlled by different methods, depending on the application and the degree of control required.

   The fan cycle control (air volume) is the least expensive method of controlling the leaving fluid temperature. This method is suitable when exact temperature control is not important. This is accomplished by using a thermostat to sense the leaving fluid temperature and cycling the fans in response to demand. With this type of control, the leaving fluid temperature can approach the ambient temperature when the load requirement decrease, which results in the possibility of overcooling.

   A three way valve control is the most exact method of temperature control and will also prevent overcooling at low load or low ambient conditions. This method consists of a motorized 3-way valve with a sensor in the leaving fluid. The valve will modulate flow through the fluid cooler to blend with the return fluid to give the required temperature. End switches can be installed in the valve motor to cycle the fans off when the entire load can be handled with the static coil.

   The air temperature rise through the fluid cooler should be calculated if the unite is being used for high temperature cooling requirements. The air temperature across the fan motors should not exceed 130°F to prevent excessive motor temperature rise.

2. At low ambient conditions, the percent concentration of ethylene glycol should be sufficient to insure that no damage to the coil from freezing will occur. It should also be noted that excessive ethylene glycol in the system will penalize the performance of the unit. The freeing point curve in Figure 1 can be used to select the percentage concentration of ethylene glycol at the lowest expected ambient temperature.
3. The fluid cooler should be located such that there is no air recirculation back through the coil D not locate a fluid cooler under an overhead obstruction or adjacent to vertical walls unless adequate air flow can be provided. The minimum distance a unit can safely be placed from a wall to insure adequate air flow is one unit width. If multiple units are to be located next to each other, a minimum distance of 1 ½ of the largest unit widths is recommended between them for proper air flow.
4. The fluid to be cooled must be compatible with copper and all other trim in the fluid circuit. The coil tubes and header are all made of copper.
5. The fluid through the coil must be piped for counter flow (into the top header of the coil and out from the bottom header) to achieve the catalog ratings.

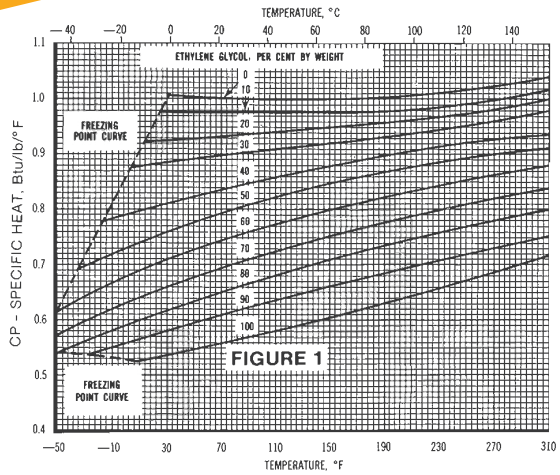

FIGURE 1

TABLE 2

NUMBER OF CIRCUITS PER UNIT (Tubes Fed)

MODEL DESIGNATION	# CIRC. "B"	# CIRC. "A"
FC2 -	3	6
FC4 -	6	9
FC12 -	6	10
FC24 -	10	15
FC36 -	15	30
FC48 -	15	30
FC72 -	30	60
FC96 -	30	60

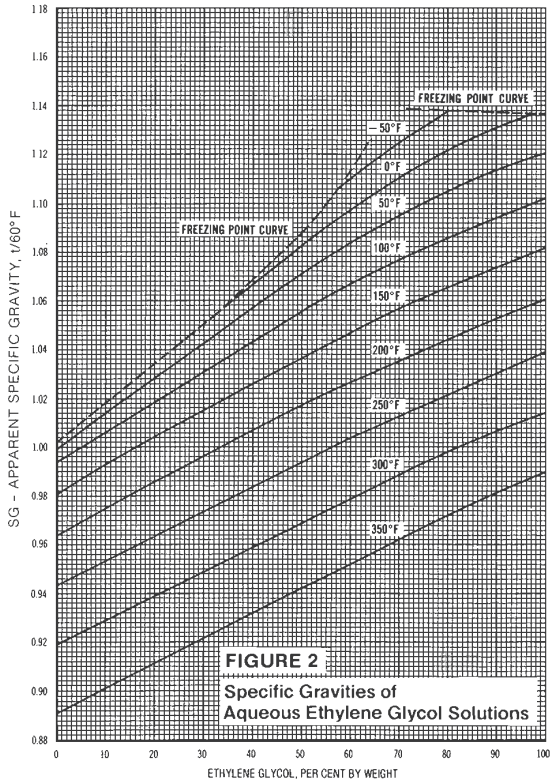

FIGURE 2
Specific Gravities of Aqueous Ethylene Glycol Solutions

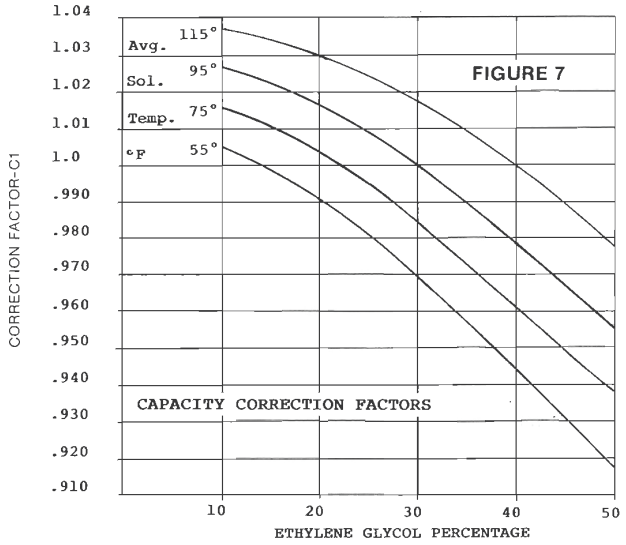

FIGURE 7

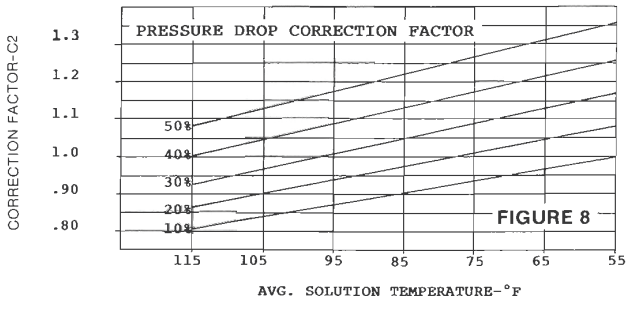

FIGURE 8

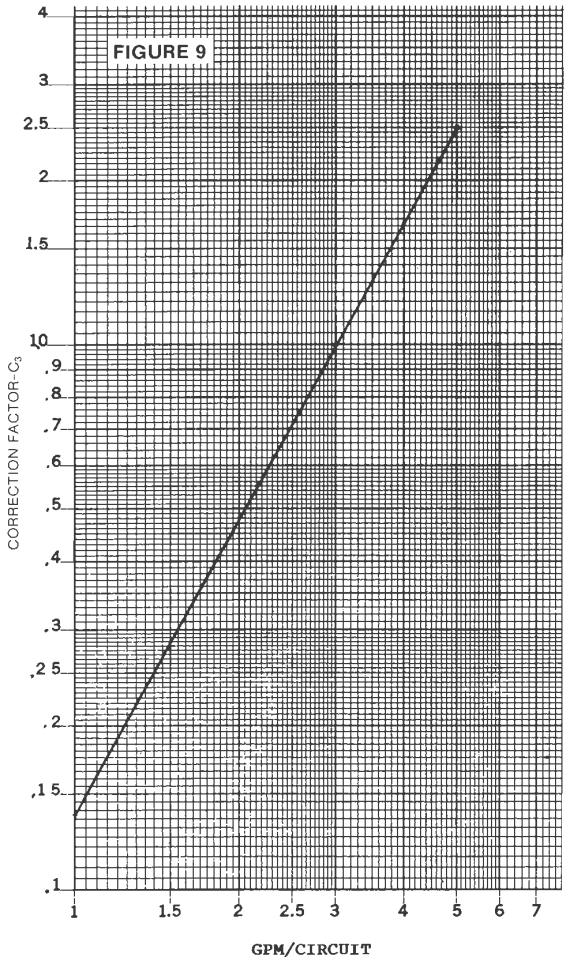

FIGURE 9

Performance Data

Capacity, in MBH, per °F entering temperature difference
(entering fluid minus entering ambient air temperature)

FIGURE 3

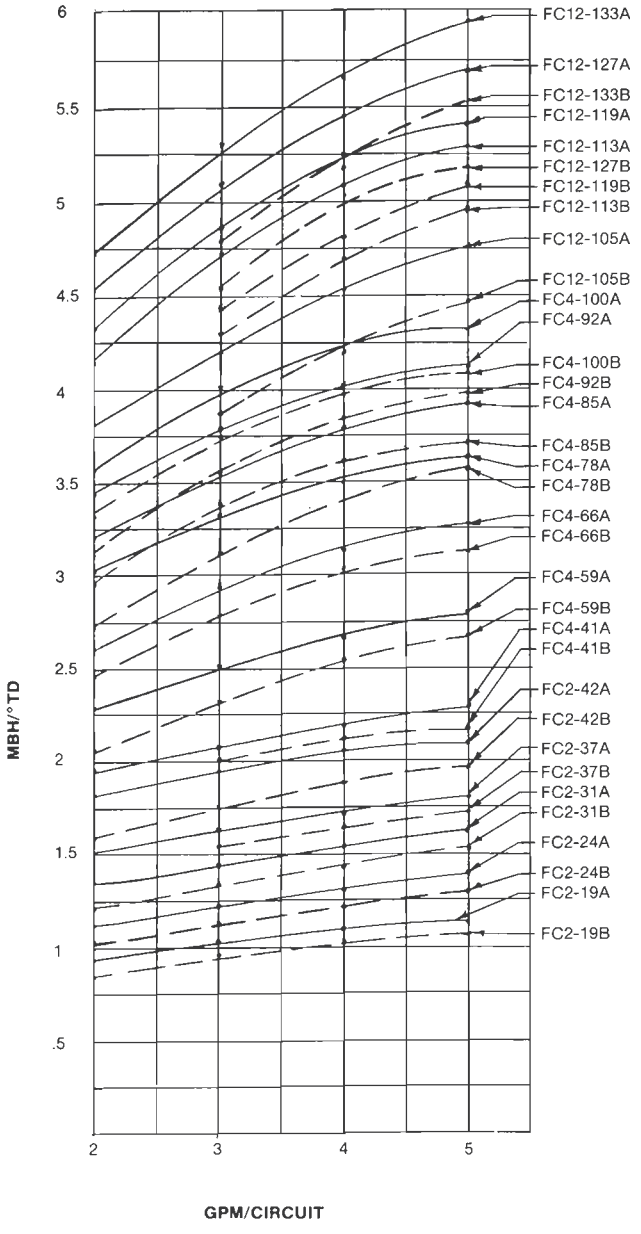

FIGURE 4

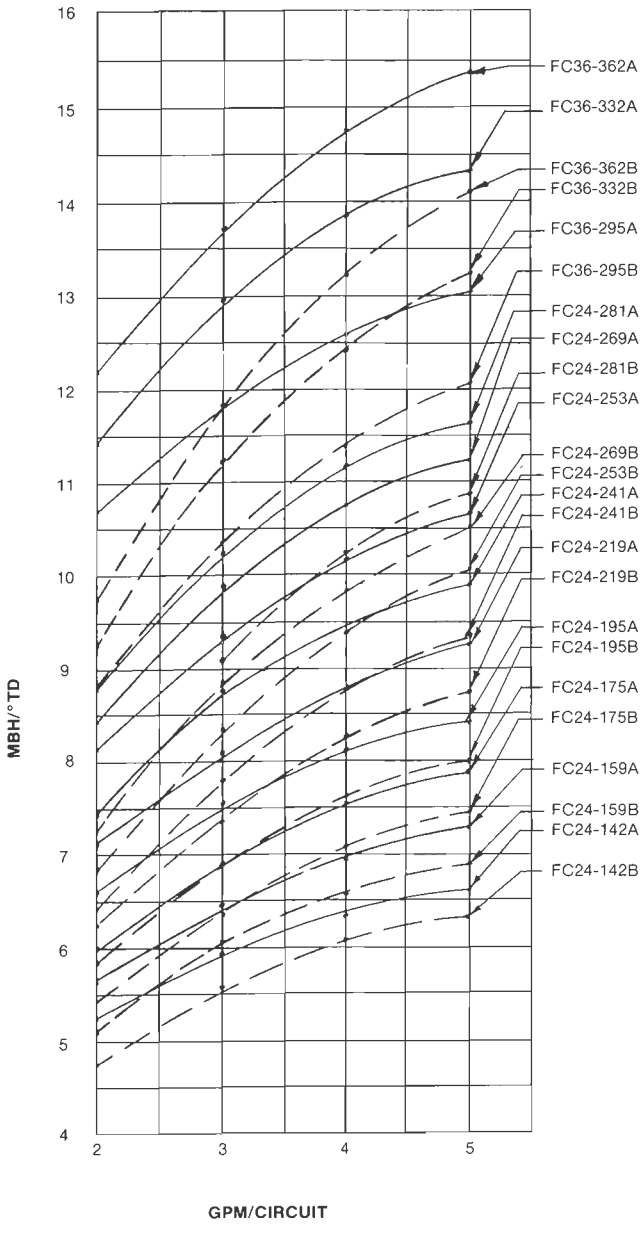

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FIGURE 5

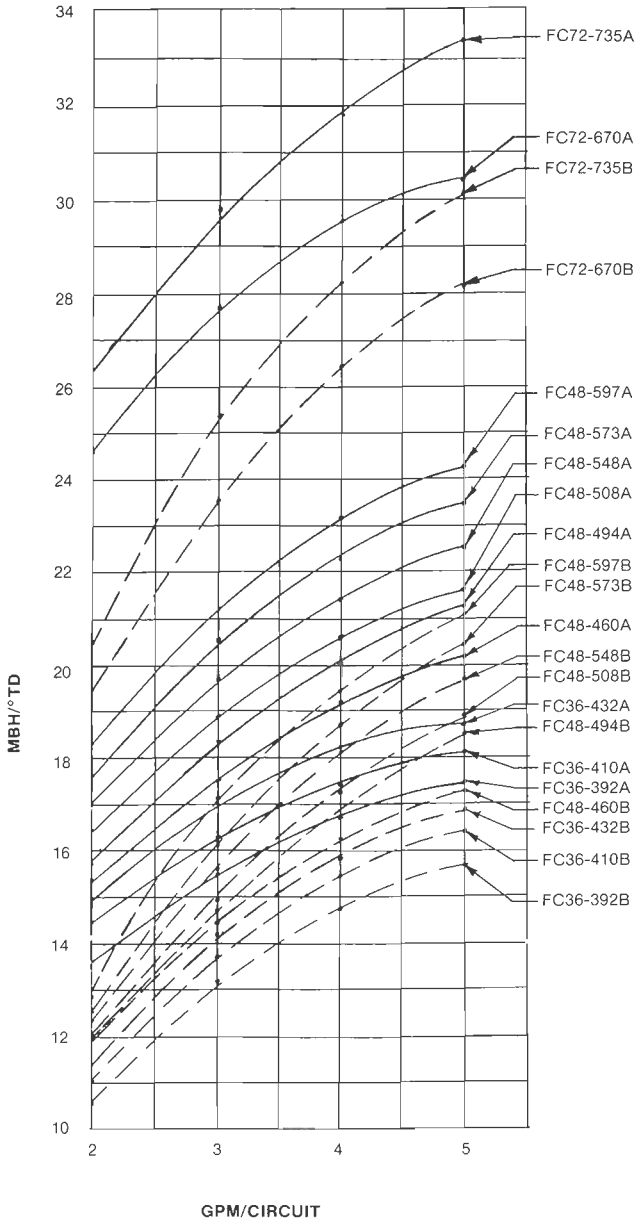
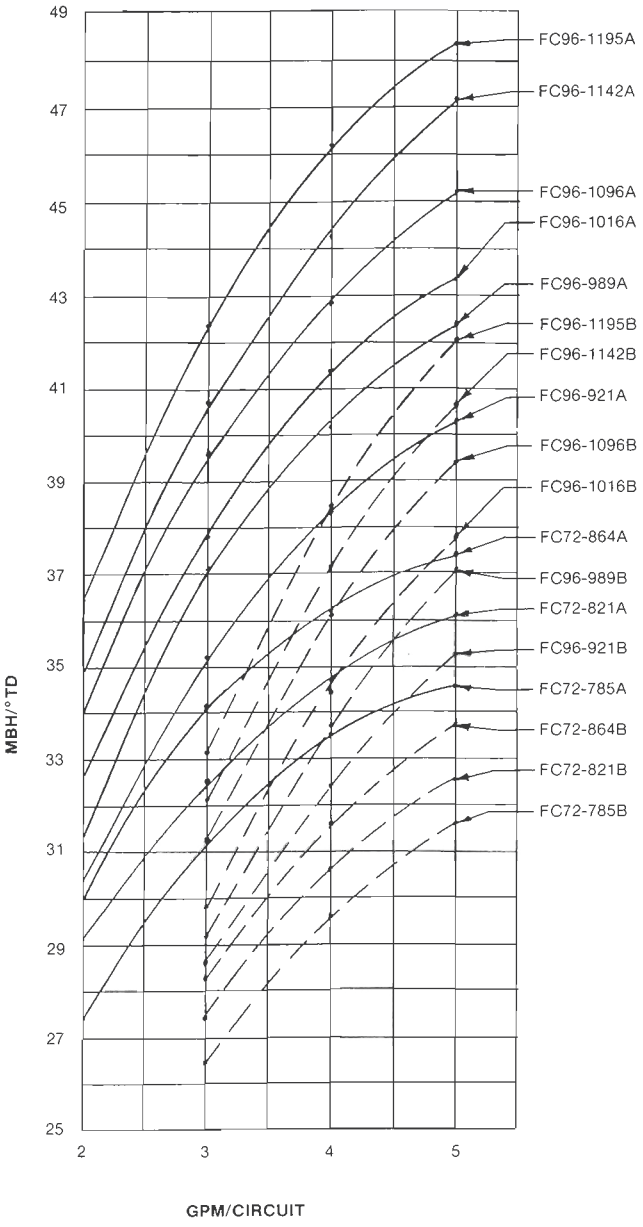


FIGURE 6



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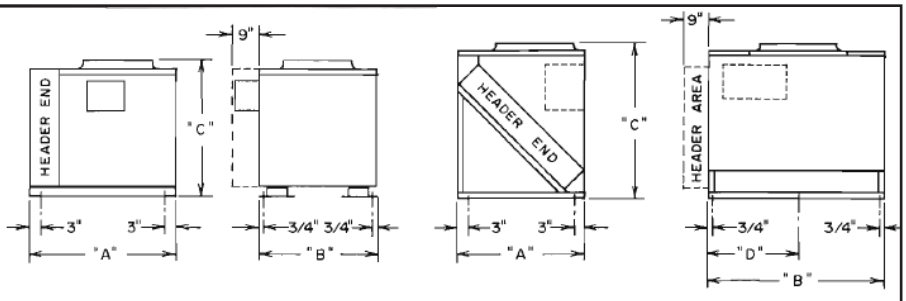
NOMINAL CONNECTION AND 3-WAY VALVE SIZES

ELECTRICAL CONNECTION

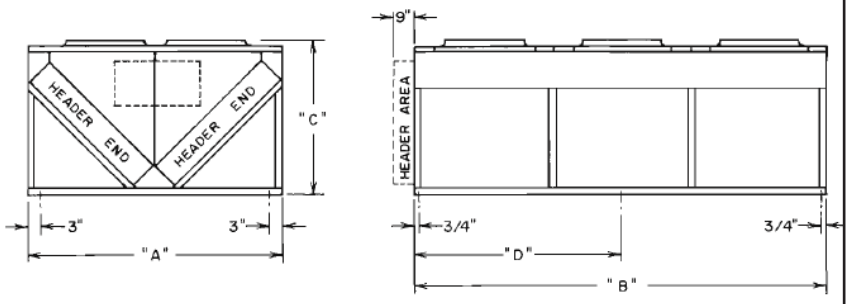


FC2 & FC4 FC12,24,36,48

FLUID COOLERS

MODEL NO.	DIM. "A"	DIM. "B"	DIM. "C"	DIM. "D"
FC2	40"	30"	35"	——
FC4	40"	60"	35"	——
FC12	41-1/4"	49"	50"	——
FC24	41-1/4"	98"	50"	49"
FC36	41-1/4"	147"	50"	73-1/2"
FC48	41-1/4"	196"	50"	98"
FC72	82-1/2"	147"	50"	73-1/2"
FC96	82-1/2"	196"	50"	98"

NOTE: MOUNTING HOLE - 5/8" I.D.
MODELS FC2 — FC48 EACH HAVE 1 INLET & 1 OUTLET.
MODELS FC72 — FC96 EACH HAVE 2 INLETS & 2 OUTLETS, FIELD PIPE IN PARALLEL.



FC72 & 96

ELECTRICAL DATA

GPM SPECIFIED	1-5	5-10	10-15	15-25	25-35	35-75	75-125	125-200	200-300	300-400
CONN. SIZE MPT	½"	¾"	1"	1-¼"	1-½"	2"	2-½"	3"	3-½"	4"
3-WAY VALVE SIZE	½"	1"	1"	1-½"	1-½"	2"	2-½"	3"	4"	4"

ELECTRICAL DATA										OPERATING WEIGHT RANGE MIN-MAX (APPROX. SHIPPING WEIGHTS) -LBS-
MODEL NO.	NO. OF FANS	FAN DIA.	FAN RPM	MOTOR HP (EA.)	PHASE	RUNNING LOAD AMPS 208V (EA.)	230V (EA.)	460V (EA.)	KW (EA.)	
FC2	1	24"	1140	½	3	2.4	2.2	1.1	.55	206-265
FC4	2	24"	1140	½	3	2.4	2.2	1.1	.55	355-490
FC12	1	28"	1140	1	3	4.8	4.6	2.3	1.1	405-491
FC24	2	28"	1140	1	3	4.8	4.6	2.3	1.1	603-851
FC36	3	28"	1140	1	3	4.8	4.6	2.3	1.1	910-1255
FC48	4	28"	1140	1	3	4.8	4.6	2.3	1.1	1300-1650
FC72	6	28"	1140	1	3	4.8	4.6	2.3	1.1	1900-2380
FC96	8	28"	1140	1	3	4.8	4.6	2.3	1.1	2430-3140

MORE: FACTORY WIRED FROM FAN MOTORS TO JUNCTION BOX FOR STANDARD UNITS. FACTORY WIRED TO A CONTROL PANEL SUPPLIED WITH UNITED ORDERED WITH OPTIONAL CONTRACTORS, FUSES, ETC.

ALL DIMENSIONS SUBJECT TO CHANGE.

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