MC series

EVAPORATIVE CONDENSER

engineering data and specifications

RECOLD®

EVAPORATOR TON METHOD

Recold MC Series evaporative condenser models may be selected by using one of two different methods. The simplest method is based on evaporator ton load and is intended for **open type reciprocating compressor applications only.**

The second method is based on the total heat of rejection, which provides a more comprehensive and accurate selection. In addition to selecting units for open type reciprocating compressor systems, this method may be applied to selecting condensers for systems with centrifugal, hermetic reciprocating or rotary screw type compressors. The total heat of rejection method can be found on page 3.

SELECTION USING EVAPORATOR TON METHOD:

The MC condenser model numbers in **Table 1** are equal to the unit capacity in evaporator tons at standard conditions for refrigerant 12, 22, 404/507, 134 and 502 at 105°F condensing temperature, 40°F suction temperature and 78°F wet bulb. To select a unit for non-standard conditions, enter **Tables 2** and **Table 3** to select capacity correction factors and multiply times the system evaporator ton load. Select the standard unit model number which is greater than or equal to the result.

Example:

Given:

Evaporator Load, R-22	75 Tons
Entering Air Wet Bulb	72°F
Condensing Temperature	105°F
Suction Temperature	30°F

Selection:

Evaporator Capacity Factor = 0.86

Suction Pressure Capacity Factor = 1.03

75 Tons x 0.86 x 1.03 = 66.4 Corrected Tons

Select Model **MC70** since its model number is greater than the design corrected evaporator load.

TABLE NO. 1: Standard Conditions

MC Model Number and Capacity														
50	60	70	90	100	110	130	150	170	200	220	250	280	300	340

TABLE NO. 2: Evaporator Capacity Factors

Refrigerants R22, R404/507, R134 — Non-Standard Conditions														
Cond. Pressure PSIG		Cond. Temperature °F	Wet Bulb Temperature °F											
R134A	R22		50	55	60	65	68	70	72	75	78	80	85	90
95.2	155.7	85	1.05	1.16	1.33	1.61	1.87	1.98	2.26	2.80				
104.3	168.4	90	.90	.98	1.11	1.28	1.43	1.54	1.72	1.96	2.33	2.70		
113.9	181.8	95	.75	.85	.93	1.04	1.12	1.18	1.28	1.39	1.59	1.75	2.50	
124.1	195.9	100	.70	.75	.81	.88	.93	.97	1.03	1.11	1.22	1.32	1.70	2.53
134.9	210.8	105	.63	.66	.70	.76	.79	.83	.86	.93	1.00	1.05	1.27	1.67
146.3	226.4	110	.57	.60	.63	.67	.70	.72	.75	.80	.85	.89	1.02	1.26
158.4	242.7	115		.54	.57	.60	.63	.64	.66	.69	.73	.75	.84	.99
171.1	259.9	120				.53	.55	.56	.58	.60	.63	.65	.70	.81

Evap Load x Factors = Corrected Tons

TABLE NO. 3: Suction Pressure Capacity Factors

Suction	R-134A	3.6	2.0	6.5	12.0	18.4	26.1	35.0	45.4
Pressure PSIG	R-22	10.2	16.5	24.0	32.8	43.0	54.9	68.5	84.0
Suction Temperature °F		-20	-10	0	+10	+20	+30	+40	+50
Capacity Factor		1.32	1.23	1.17	1.11	1.07	1.03	1.00	.97

HEAT OF REJECTION METHOD

Many times, the specification for an evaporative condenser will be expressed in "Total Heat Rejection" (THR) at the condenser, rather than the net refrigeration effect at the evaporator. Basically, Total Heat Rejection is the sum of the compressor capacity in BTUH and the heat corresponding to the brake horsepower (bhp) in BTUH for open type compressors or to the kilowatt (kW) input in BTUH for hermetic compressors.

SELECTION METHOD:

The first step in the Heat of Rejection method is to determine both the evaporator load and the heat rejected by the compressor in BTUH. These two loads combine to form the total heat load that must be rejected by the condenser.

Evaporator loads in BTUH can readily be determined from data provided by the manufacturer. Compressor loads can be calculated from one of the following two formulas based on compressor type:

Open Type Compressors: THR = Compressor bhp x 2545

Hermetic Compressors: THR = Compressor kW x 3413

Once the total heat of rejection requirements are known, the selection method is similar to the evaporator ton method. For non-standard conditions use the Capacity Factor from **Table 5**. Then multiply the factor times the system total heat of rejection. Select the model from **Table 4** whose heat of rejection is greater than or equal to this product.

Example:

Given:

Compressor Evaporator Capacity	51 Tons
Entering Air Wet Bulb	75°F
Condensing Temperature	105°F
Type of Compressor	Hermetic R-22
Compressor kW Input	49.0 kW

Selection:

1) Calculate Total Heat of Rejection

Evaporator: 51 Tons x 12,000 = 612,000 BTUH

Compressor: 49.0 KW x 3413 = 167,000 BTUH

Total Heat of Rejection = 779,000 BTUH

2) Adjustment for Design Conditions

Capacity Factor for 75°F WB and 105°F Cond. = 0.93

779,000 BTUH x 0.93 = 724,470 BTUH or 724.5 MBH

Select Model **MC50** since its nominal total heat rejection is greater than or equal to the required THR.

Table 4 – Heat Rejection MB

Model	Heat Rejection MBH	Model	Heat Rejection MBH
MC50	735	MC170	2499
MC60	882	MC200	2940
MC70	1029	MC220	3234
MC90	1323	MC250	3675
MC100	1470	MC280	4116
MC110	1617	MC300	4410
MC130	1911	MC340	4998
MC150	2205		

TABLE NO. 5: Heat Rejection Capacity Factors

Refrigerants R22, R134A, R404/507 — Non-Standard Conditions														
Cond. Pressure PSIG		Temperature °F	Wet Bulb Temperature °F											
R34A	R22		50	55	60	65	68	70	72	75	78	80	85	90
78.6	133.5	75	1.46	1.66	1.96	2.51	3.11	3.46	4.26					
86.7	145.0	80	1.26	1.41	1.64	2.03	2.44	2.69	3.19	3.93	4.02			
95.2	155.7	85	1.10	1.22	1.39	1.67	1.94	2.13	2.45	2.94	3.02	3.63		
104.2	168.4	90	.93	1.02	1.14	1.32	1.47	1.59	1.75	2.00	2.38	2.75	3.34	
113.9	181.8	95	.80	.87	.95	1.08	1.16	1.22	1.32	1.45	1.61	1.79	2.56	3.09
124.1	195.9	100	.71	.76	.82	.89	.93	1.00	1.03	1.12	1.23	1.33	1.72	2.50
134.9	210.8	105	.63	.66	.70	.76	.79	.83	.86	.93	1.00	1.05	1.27	1.61
146.3	226.4	110	.56	.59	.62	.66	.70	.71	.75	.79	.84	.88	1.01	1.19
158.4	242.7	115		.52	.55	.58	.60	.62	.64	.67	.70	.73	.81	.92
171.1	259.9	120				.51	.53	.54	.55	.57	.60	.62	.68	.75

The MC Series can be furnished with the condenser coil divided into individual refrigerant circuits, each sized to meet a specified capacity. Each circuit is supplied with a hot gas inlet connection and liquid outlet connection tagged for identification.

The procedure for selecting a multi-circuited condenser coil is described in the "Selection Example" below. For circuit identification purposes it is required that circuits be arranged in sequence. Connections for the individual circuits, will be numbered at the factory, from left to right when facing connection end of unit, with the number 1 circuit being on the extreme left.

Selection Example:

Given:

Condensing Temperature 100°F

Entering Air Wet Bulb Temp. 72°F

Ten individual suction cooled hermetic compressor capacities, as shown in the tabulation below:

1. Tabulate data in Columns 1, 2 and 3, making sure circuits are in correct numerical sequence.
2. From **Table 6** "Hermetic Compressors", select Evaporator Temperature Capacity Factor applicable to each Suction Temperature listed in Column 2 and tabulate in Column 4.
3. From **Table 7**, select "Condenser Capacity Conversion Factor" applicable to the design condensing temperature and the design entering air wet bulb temperature and tabulate in Column 5.
4. Multiply figures in Columns 3, 4 and 5 for each circuit, and tabulate in Column 6.
5. Add all the capacities in Column 6 to arrive at the Total Adj. BTUH to Nominal required and use the total to select the proper size condenser.

Selection:

The adjusted load of 654,840 BTUH should be compared to "Total Unit BTUH" column in **Table 8**. The smallest unit that will meet the requirement is Model **MC50** with a THR of 735,000 BTUH.

To determine the number of tube circuits required for each circuit divide Column 6 by Column 7, and tabulate in Column 8. If the decimal part of the tube circuit requirement is less than .3, drop the decimal and enter the whole number in Column 9. If the decimal part is equal to or greater than .3, round off to the next higher whole number and enter in Column 9.

The "Tabulation Example" shows 26 tube circuits are required and **Table 8** shows that Model **MC50** has 36 tube circuits available, therefore, it is the proper unit selection.

NOTE:

If the summation of the number of tube circuits assigned to the individual circuits is less than the total number of tube circuits available in the unit, add enough tubes to effect a balance.
If the summation of the number of tube circuits assigned to the individual circuits is greater than the total number of tube circuits available in the unit, delete enough tubes to effect a balance. However, if such reduction causes more than a 10 percent reduction in any of the circuits, go to the next larger unit size and reassign tube circuits to give adequate capacity to every circuit.

Tabulation Example

1	2	3	x	4	x	5	=	6	÷	7	=	8	9
Circuit Number	Suction Temperature °F	Comp. Capacity BTUH	x	Evap. Temp. Cap. Conversion Table 6	x	Cond. Cap. Conversion Factor Table 7	=	Adj. BTUH to Nominal	÷	Capacity Per Tube Circuit Table 8	=	Number of Circuits Required	Number of Circuits Used
1	-10	22,500	x	1.69	x	1.03	=	39,165	÷	26,008		1.50	2
2	-5	35,200	x	1.65	x	1.03	=	59,822	÷	26,008		2.30	2
3	+30	72,800	x	1.36	x	1.03	=	101,978	÷	26,008		3.92	4
4	+15	45,400	x	1.48	x	1.03	=	69,208	÷	26,008	÷	2.66	3
5	-20	41,600	x	1.79	x	1.03	=	76,698	÷	26,008		2.95	3
6	+40	70,100	x	1.33	x	1.03	=	96,030	÷	26,008		3.69	4
7	-15	29,700	x	1.74	x	1.03	=	53,228	÷	26,008		2.05	2
8	-20	45,500	x	1.79	x	1.03	=	78,357	÷	26,008		3.01	3
9	-10	19,500	x	1.69	x	1.03	=	33,944	÷	26,008		1.30	1
10	+5	28,700	x	1.57	x	1.03	=	46,410	÷	26,008		1.789	2
								654,840					**26**

Table 6 – Evaporative Temperature Capacity Conversion Factor

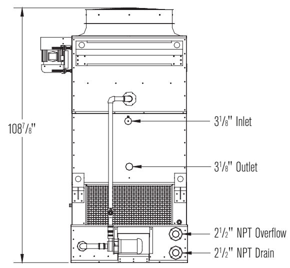
Evaporative Temperature °F	-40	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
Open Compressors	1.75	1.65	1.62	1.59	1.55	1.53	1.50	1.47	1.44	1.40	1.37	1.35	1.32	1.30	1.28	1.26	1.24	1.22
Hermetic Compressors	2.02	1.90	1.852	1.79	1.74	1.69	1.65	1.61	1.57	1.51	1.48	1.45	1.40	1.36	1.34	1.33	1.32	1.31

Table 7 – Condenser Capacity Conversion Factors

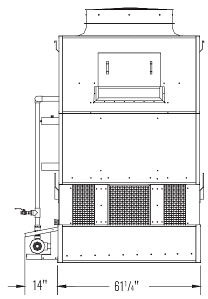
Refrigerants 12, 22, 500 and 502														
Cond. Pressure PSIG		Cond. Temperature °F	Wet Bulb Temperature °F											
R134A	R22		50	55	60	65	68	70	72	75	78	80	85	90
78.6	133.5	75	1.46	1.66	1.96	2.51	3.11	3.46	4.26					
86.7	145.0	80	1.26	1.41	1.64	2.03	2.44	2.69	3.19	3.93	4.02			
95.2	155.7	85	1.10	1.22	1.39	1.67	1.94	2.13	2.45	2.94	3.02	3.63		
104.3	168.4	90	.93	1.02	1.14	1.32	1.47	1.59	1.75	2.00	2.38	2.78	3.34	
113.9	181.8	95	.80	.87	.95	1.08	1.16	1.22	1.32	1.45	1.61	1.79	2.56	3.09
124.1	195.9	100	.71	.76	.82	.89	.93	1.00	1.03	1.12	1.23	1.33	1.72	2.50
134.9	210.8	105	.63	.66	.70	.76	.79	.83	.86	.93	1.00	1.05	1.27	1.61
146.3	226.4	110	.56	.59	.62	.66	.70	.71	.75	.79	.84	.88	1.01	1.19
158.4	242.7	115	.49	.52	.55	.58	.60	.62	.64	.67	.70	.73	.81	.92
171.1	259.9	120	.41	.45	.48	.51	.53	.54	.55	.57	.60	.62	.68	.75

Table 8 – Total Heat Rejection Capacity

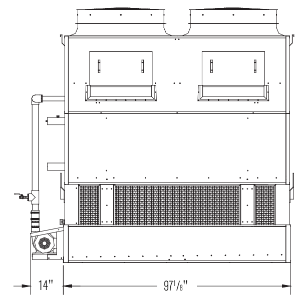
Model Number	Number of Tube Circuits Available	at 105°F Cond. Temperature, 78°F WB Temperature Refrigerants R12, R22 and R502	
		Total Unit BTUH	BTUH per Tube Circuit
MC50	36	735,000	20,417
MC60	36	882,000	24,500
MC70	36	1,029,000	28,584
MC90	36	1,323,000	36,750
MC100	36	1,470,000	40,834
MC110	36	1,671,000	44,917
MC130	36	1,911,000	53,084
MC150	36	2,205,000	61,250
MC170	36	2,449,000	29,417
MC200	72	2,,940,000	40,834
MC220	72	2940,000	44,917
MC250	72	3,234,000	51,041
MC280	72	3,675,000	57,166
MC300	72	4,116,000	61,250
MC340	72	4,410,000	69,417



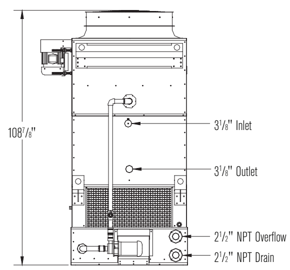
Connection Elevation



Side Elevation MC50-MC70



Side Elevation MC90-MC110



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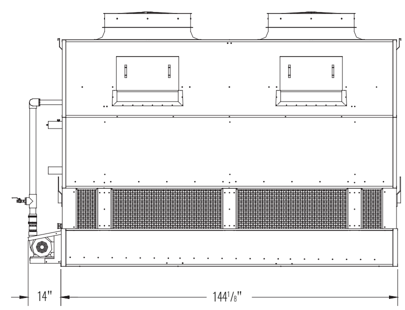


Side Elevation MC130-MC170

TABLE NO. 9: Schematic

Note: Use this bulletin for preliminary layouts only.

Obtain current drawing from your Recold sales representative.

Model	Fan		Pump Motor hp	Dimensions			Weight lb		Remote Sump gallons required
	Motor hp	Air Volume cfm		Height	Length	Width	Shipping	Operating	
MC50	5	12,600	1	108 ⅞"	61 ¼"	49 ¾"	1,540	2,660	105
MC60	5	12,300	1	108 ⅞"	61 ¼"	49 ¾"	1,640	2,830	105
MC70	5	11,800	1	108 ⅞"	61 ¼"	49 ¾"	1,730	3,000	105
MC90	(2) 3	19,500	1	108 ⅞"	97 ⅛"	49 ¾"	2,360	4,150	175
MC100	(2) 3	19,000	1	108 ⅞"	97 ⅛"	49 ¾"	2,510	4,420	175
MC110	(2) 3	18,500	1	108 ⅞"	97 ⅛"	49 ¾"	2,680	4,720	175
MC130	(2) 5	32,400	1 ½	108 ⅞"	144 ⅛"	49 ¾"	3,030	5,700	270
MC150	(2) 5	30,300	1 ½	108 ⅞"	144 ⅛"	49 ¾"	3,270	6,100	270
MC170	(2) 5	29,000	1 ½	108 ⅞"	144 ⅛"	49 ¾"	3,500	6,550	270

AVAILABLE OPTIONS

Stainless Pan and Casing For maximum corrosion protection, Recold can provide a unit with the pan and casing constructed entirely from stainless steel.

Sub-Cooling Coil The sub-cooling coil consists of an additional coil section located below the standard condensing coil. It provides approximately 10°F of sub-cooling at standard conditions for halocarbon refrigerants.Specifying a sub-cooling will slightly increase height and alter certain connection elevations. Please consult Recold sales representative for certified dimensions.

Other Coil Options Additional coil options can be provided including: heavy wall tubing, external headers and multiple circuits.

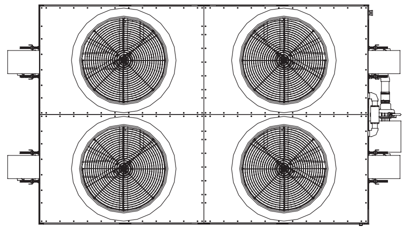
Basin Heaters For freeze protection of the cold water in the basin, electric immersion heaters are available. Heaters are sized to maintain a 40°F minimum basin water temperature at a -10°F ambient temperature.

Control Panel For single point connection, factory wired control panels are available. The U.L. panel includes the fan motor starters, disconnect switch, and submersible bulb thermostat; all inside a NEMA 12 enclosure.

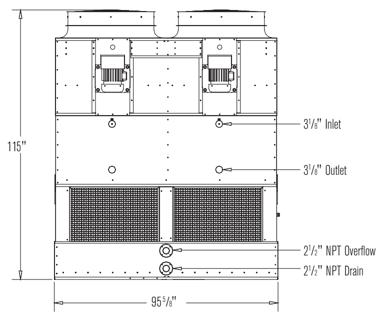
Special Motors A full line of optional motors are available including: high-efficiency, low-speed, special enclosures and special voltages or frequencies.

Vibration Isolation The Recold M Series is designed for smooth and quiet operation. If design conditions require additional vibration isolation, spring type vibration isolator rails can be supplied for field installation.

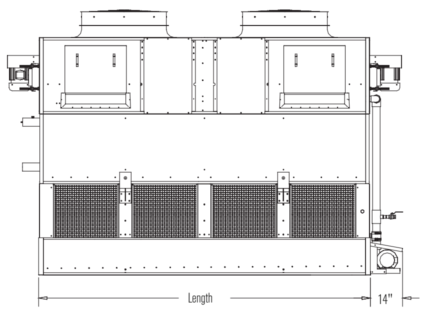
Other options are available. Contact your Recold sales representative for more information.



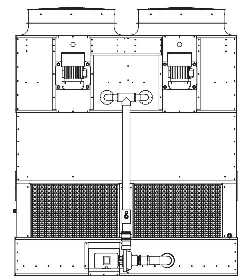
Plan View



Connection Elevation



Side Elevation



Pump Elevation

TABLE NO. 10: Schematic

Note: Use this bulletin for preliminary layouts only.

Obtain current drawing from your Recold sales representative.

Model	Fan		Pump Motor	Dimensions			Weight lb		Remote Sump
	Motor hp	Air Volume cfm	hp	Height	Length	Width	Shipping	Operating	gallons required
MC200	(4) 5	48,000	2	115"	97 ⅛"	95 ⅝"	5,070	8,890	350
MC220	(4) 5	46,500	2	115"	97 ⅛"	95 ⅝"	5,410	9,490	350
MC250	(4) 5	53,400	2	115"	120 ⅝"	95 ⅝"	5,840	10,610	445
MC280	(4) 5	51,900	2	115"	120 ⅝"	95 ⅝"	6,240	11,330	445
MC300	(4) 5	58,800	3	115"	144 ⅛"	95 ⅝"	6,600	12,330	540
MC340	(4) 5	57,200	3	115"	144 ⅛"	95 ⅝"	7,070	13,170	540

GENERAL NOTES

1. Supporting Steel: Purchaser to design, construct and furnish supporting steel complete with 7⁄8" diameter anchor bolt holes to suit. All steel must be framed flush and level at top. Maximum beam deflection to be 1/360 of span, not to exceed 1⁄2" at anchor bolts.
2. Operating Weight and Loads: These loads are based upon normal water level in sump pan at shutdown.
3. Wind Loads: Construction drawings furnished upon request.
4. Anchor Bolts: All anchor bolts are 3⁄4" inch diameter and are to be furnished by others. Wind loads at anchorage points are additive to operating loads.
5. Shipping Weight, Operating Weight, Operating Loads: These weight and loads do not include optional accessory weights. Contact Recold sales representative for accessory weights when applicable.
6. Concrete Slabs: When installed at grade most units are anchored to a flat concrete slab. All applicable piping connections are designed to allow adequate clearance for connecting purchaser's piping to the unit when installed on a concrete slab.
7. Vibration Isolation: If unit is to be supported on vibration isolators, the preferred location for the isolators is beneath steel beams and the unit base rails. If necessary to install isolators between the unit base rails and supporting steel beams, contact Recold sales representative for allowable type and arrangement of isolators for a specific model and for dimensional changes on anchor bolt hole locations.

Furnish _____________ Recold model MC_____________ induced draft evaporative condenser(s). Each unit shall have a condensing capacity of ______________ MBH total heat rejection when operating with ______________ refrigerant at ___________°F condensing temperature and ______________°F design wet bulb temperature.

Heat Transfer Coil: The heat exchange coil tubes shall be constructed of copper to provide maximum corrosion resistance. Coil tubes shall be 5/8" OD copper tubing with type L headers. Tubes shall be supported by stainless steel tube sheets with floating tube design for long life. The completed coil section shall be leak tested under water at 350 psig.

Mechanical Equipment: A high-quality bearing assembly, specifically designed for cooling tower service shall be provided. Bearings will be greased at the factory with extended lubelines provided. The fan shaft shall be stainless steel. Fans shall be low sound, axial propeller type with GRP blades for high-efficiency and long life. V-belt drive shall be designed for 150% of motor horsepower. Belt adjustment shall be accomplished from the exterior of the unit. Each fan section shall have dividers to allow the fans to be cycled individually.

Fan Motor: Fan motors (4) shall be minimum 5 hp 1800 RPM open drip-proof type designed for outdoor service with 1.15 service factor on _____ volts, _____ phase, and _____hertz. All motors shall be mounted outside the tower with a protective rain cover included.

Water Distribution: System shall be designed to evenly and completely distribute the spray water over the coil. Spray nozzles shall be PVC large orifice, non-clogging design, attached to PVC headers with stainless steel clamps. Nozzle spray pattern shall be a full 360° for maximum distribution. Internal piping and fittings shall be made entirely of schedule 40 PVC for maximum corrosion protection.

Recirculation Pump: The water recirculation pump shall be close-coupled, centrifugal type with mechanical seal. A minimum ______ hp open drip proof type pump motor designed for outdoor service with a 1.15 service factor suitable for service on ____volts, _____ phase, and ________hertz shall be provided.

Drift Eliminators: Shall be of cellular type, thermoformed PVC. The eliminator design shall incorporate three changes of air direction with maximum drift rate less than 0.001% of the circulating water rate.

Louvers: Shall be constructed of PVC in a cellular pattern supported in easily removable subassemblies. Shall provide directional changes to the entering air to prevent splashout.

Pan and Casing: The evaporative condenser shall be constructed of stainless steel sump pan and G-235 galvanized steel casing panels. Panels shall be flanged outward for greater rigidity and to eliminate connecting fasteners from penetrating inside the tower wet section. The pan bottom shall be sloped design to allow for easy draining and cleaning. At least one access door to the top section shall be provided for easy inspection and service. The access doors shall be made from stainless steel and operate without any gasket of fasteners.

Safety: The M Series is designed for routine maintenance to be performed from the base of the unit's exterior, eliminating the need for permanent access to the top. The upper horizontal surface is not intended for use as a working platform. Specific reference to the safety of personnel performing maintenance and inspection procedures can be found in the Operation and Maintenance instructions.

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