APPLICATION MANUAL

WATERSIDE ECONOMIZER

ISO 9001:2000 Certified

ENERGY WISE HVAC EQUIPMENT

FHP MANUFACTURING COMPANY
601 N.W. 65th Court
Fort Lauderdale, FL 33309
Phone: 954/776-5471 • Fax: 800/776-5529
http://www.fhp-mfg.com

TABLE OF CONTENTS

SAFETY APPROVALS:

This factory installed option is Underwriter Laboratories (UL) and The City of New York Materials Equipment Acceptance Division (MEA) safety listed on all EM, and GT models.

COMMON WATERSIDE ECONOMIZER APPLICATIONS:

Commercial application where perimeter heating is being done while core cooling is required. Perimeter heat pumps operation in the heating mode extract heat from the building loop thus dropping the building loop fluid temperature. Internal core cooling requirements are usually high even in the winter months due to people, lighting, and equipment loads. The moderate temperature loop water circulated through a core heat pump's waterside economizer coil can provide free-cooling without the use of mechanical cooling (Compressors). Also, in many areas code requires some type of economizer cycle. Waterside Economizers in lieu of air side economizers are an inexpensive way to satisfy code requirements in commercial applications.

Tenant build out commercial applications where the central chilled water fluid loop serves as a individual zoned heat pump condenser water. In this application low temperature fluid is always available for free-cooling.

Residential applications where moderate temperature ground water is utilized, mainly in the midwest and northern regions. In these areas the cooling loads are relatively low compared to the heating requirements. Summer months are relatively mild so often the free-cooling coil can handle total summer cooling requirements without the use of mechanical cooling. Some mechanical cooling may be required during peak loads.

SEQUENCE OF OPERATION (SINGLE COMPRESSOR MODELS)

(Utilizing 2 Stage Cool, 2 Stage Heat Thermostat)

COOLING MODE:

On a call for cooling from the space sensor the following sequence is initiated:

The "G" terminal energizes the blower relay, powering the blower motor.

The "O" terminal energizes the reversing valve coil, setting the heat pump in the cooling mode and energizing the pre cooling relay "PC". The normally closed contacts of PC open and the normally open contacts of PC close. The motorized ball valve will be energized in the bypass mode, routing water directly to the water to refrigerant heat exchanger, until the "Y1" terminal closes.

On a rise in space temperature Y1 will close. If the temperature of the water is below the aquastat set point the motorized ball valve relay "MBVR" will be energized. This will energize the motorized ball valve in the economizer mode, diverting water first through the economizer coil then the water to refrigerant heat exchanger in series. Should the space temperature continue to rise Y2 will be energized allowing mechanical cooling. If at any time the water temperature rises above the aquastat set point the motorized ball valve will be energized in the bypass mode and fluid will bypass the economizer coil.

HEATING MODE:

On a call for heating from the space sensor the sequence of operation is identical to the above with the exception that the reversing valve and pre-cooling relay are not energized so locking the motorized ball valve in the bypass mode.

SEQUENCE OF OPERATION (DUAL COMPRESSOR MODELS)

The sequence of operation is exactly the same as above. The second compressor circuit is in parallel with the first compressor across "Y2". A delay on make timer is located in the second stage compressor contactor circuit to avoid dual compressor in-rush starting current. Both compressors are energized thru "Y2" in heating and "Y2" in cooling.

SPECIAL APPLICATIONS UTILIZING WATERSIDE ECONOMIZER COILS AS PREHEATING COIL:

Waterside Economizer coils can also be applied as pre-heating coils in outside air pre-heating application. When utilizing high temperature condenser water a pre-heating coil can elevate the entering outside air temperature to a minimum entering air temperature of 40° F into the heat pump during the heating mode.

CAUTION: When introducing outside air below 32° F anti-freeze solution is required. Coil damage due to freezing is not covered under FHP warranty. Usually some means of heating outside air to above 40° F is field provided.

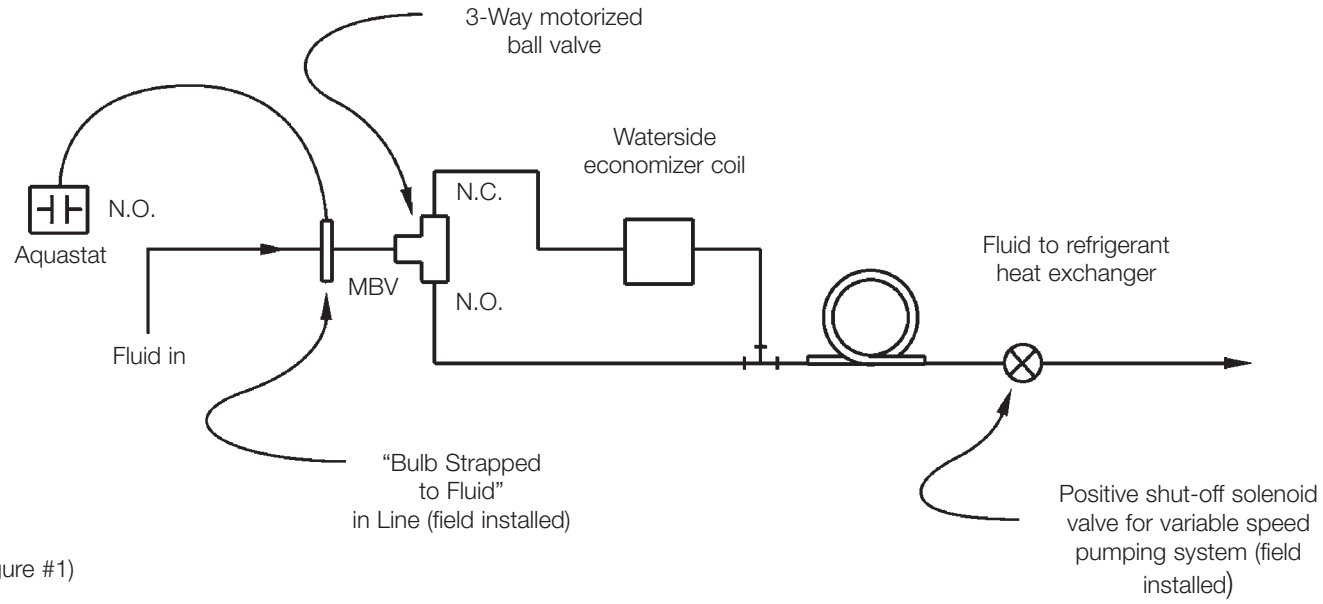
Pre-heating coils can also be supplied by a hydronic boiler loop or a dedicated water to water heat pump for pre-heating outside air. In this application the coil only is utilized without the valve package and associated controls. Field installed pumping means, piping systems, and associated controls are required. (Consult factory for heating coil capacity data).

FLUID FLOW:

Fluid flow through heat pumps equipped with waterside economizer coils is directed by the use of a single three way motorized ball valve. Flow is either through the waterside economizer coil and then through the condenser or through the condenser only. When applying these units to a variable speed pumping system a field provided means of positive flow shut-off is required. (Re: A positive shut-off solenoid valve located downstream of the heat pump). (See Figure #1)

CONDENSATE DRAIN:

A drain line must be connected to the Waterside Economizer drain pan and pitched away from the unit a minimum of 1/8" per foot to allow the condensate to flow away from the unit. A trap must be installed in the condensate line to insure free condensate flow. A vertical air vent tube is sometimes required to avoid air pockets. The depth of the trap depends on the amount of positive or negative pressure on the on the drain pan. A second trap must not be installed. This connection should be in conformance to local plumbing codes. (See Figure #2)



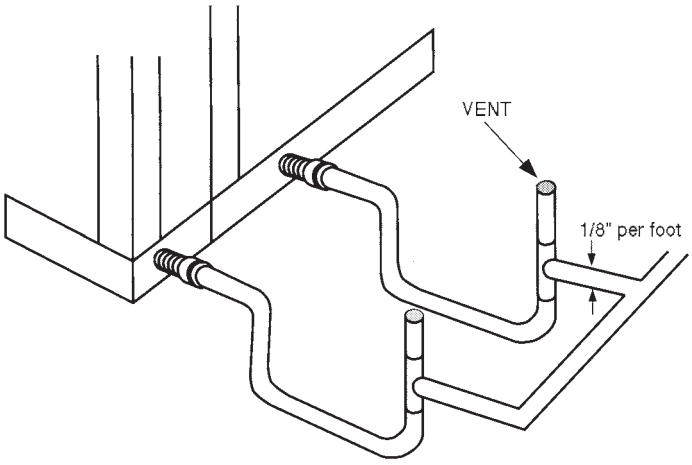
(Figure #1)

The Waterside economizer coil and the heat pump must be trapped independently per Figure #2.

AQUASTAT:

The aquastat controller is mounted to the heat pump electrical control box. All electrical control wiring is factory installed. The controller is supplied with an external range adjustment and screwdriver slot. Actual range is -30° to 100°F and requires field setting. The remote bulb stored inside the heat pump for shipping requires field mounting. (Figure #1) Care should be taken not to dent or deform this sensitive remote bulb. A dent or deformation will change the calibration and cause the control to cycle at a temperature lower than the selected setting.

(Figure #2)



MAXIMUM DESIGN WORKING (OPERATING) PRESSURES:

The maximum design fluid side working pressure is 400 PSIG. This applies to waterside economizer coils, water to refrigerant heat exchangers, and motorized ball valves. In multi-story high rise applications care needs to be taken with regards to high static pressures generated by elevation.

AIR SIDE PRESSURE DROP:

The air side pressure drops shown on the waterside economizer performance tables is considered as additional heat pump external static pressure. Refer to the individual heat pump specification sheets to determine if the CFM delivered versus the total external static pressure (including waterside economizer coil drop) is adequate to meet specified air flow requirements. In certain instances oversized drive packages may be required. Please consult factory for oversized drive specifications.

COOLING CAPACITY DATA

Heat Pump Model		Waterside			Air		Cooling Capacity	
EM	GT	Flow GPM	Press. PSI	Press. Ft.HD	NOM. CFM	Press. Drop in H_2O (avg.)	Total	Sensible
007	---	2 4	.68 1.7	1.6 3.9	300	.03	5600 6500	3920 4290
009	010	3 5	.04 2.0	1.7 4.6	350	.05	7700 8700	5360 5720
012	---	3 5	.04 2.0	1.7 4.6	400	.07	8800 9900	6100 6500
015	018	4.5 7.5	.08 2.2	1.8 5.1	550	.07	11500 13100	8180 8710
018	022	4.5 7.5	.08 2.2	1.8 5.1	650	.08	13600 15500	9670 10300
024	026	4.5 7.5	0.8 2.2	1.8 5.1	850	.10	16800 19200	11950 12730
028	---	4.5 7.5	.98 2.7	2.3 6.2	950	.10	18100 21100	13300 14300
031	030	6 10	1.2 3.1	2.8 7.2	1000	.11	21700 24200	16100 17800
036	036	6 10	.95 2.4	2.2 5.5	1200	.12	24400 28300	17600 19000
041	042	8 12	.99 2.8	2.3 6.5	1200	.13	25100 29200	17900 19200
042	048	8 12	.99 2.8	2.3 6.5	1500	.14	26500 31300	20000 21600
048	054	9 15	.82 2.0	1.9 4.6	1700	.15	33400 38700	24300 26100
060	062	9 15	.82 2.0	1.9 4.6	2000	.17	35500 41600	26600 28600
070	070	9 15	.82 2.0	2.0 4.8	2200	.18	37300 44800	29000 32400

NOTES:

1. For total system waterside pressure drop add heat pump pressure drop and waterside economizer coil pressure drop.
2. Air side pressure drop based on 1" thick clean filter and wet coil.
3. Capacities shown are based on 45° E.F.T. and 80° DB/67° WB E.A.T.
4. See correction tables for other conditions.

FLUID TEMPERATURE CORRECTION TABLE

Ent. Fluid Temp. Deg. F	Total Capacity BTUH	Sensible Capacity BTUH
45	1.000	1.000
50	.790	.890
55	.610	.780
60	.470	.470
65	.350	.350
70	.240	.240

COOLING CAPACITY DATA

Heat Pump Model	Waterside			Air		Cooling Capacity	
EM	Flow GPM	Press.		NOM. CFM	Press. Drop in H_2O (avg.)	Total	Sensible
		PSI	Ft. HD				
072	10 18	1.3 6.0	3.0 8.3	2300	.22	56000 67200	46200 50400
096	10 22	1.3 6.0	3.0 13.9	2800	.25	61400 79800	52000 59400
120	16 32	2.5 9.2	5.7 21.4	4000	.30	91900 113400	75300 84200
140	18 38	2.7 9.4	6.2 21.8	5000	.25	94700 113500	77800 84300
144	20 45	1.2 4.2	2.8 9.7	5000	.25	97600 113600	81300 84400
168	20 45	1.2 4.2	2.8 9.7	6000	.28	106000 125200	92100 97300
210	24 52	1.4 6.2	3.3 14.4	7000	.28	155400 203600	131000 151600
240	32 64	2.5 9.2	5.7 21.4	8000	.30	183800 226800	150600 168400
300	38 75	3.0 11.3	7.3 27.3	10000	.33	213000 256000	174600 190300
360	45 90	4.1 7.8	9.4 18.0	12000	.37	307900 370000	251500 275000

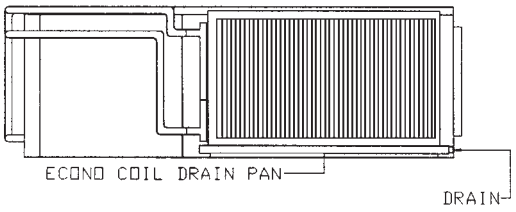
NOTES:

1. For total system waterside pressure drop add heat pump pressure drop and waterside economizer coil pressure drop.
2. Air side pressure drop based on 1" thick clean filter and wet coil.
3. Capacities shown are based on 45º E.F.T. and 80º DB/67º WB E.A.T.
4. See correction tables for other conditions.

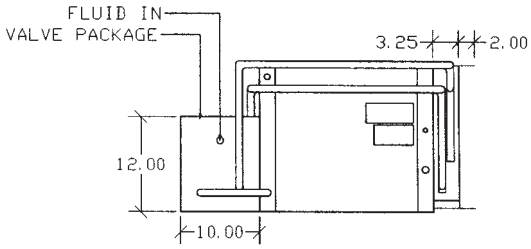
AIR TEMPERATURE CORRECTION

Ent. WB Deg. F	Total Capacity Correction	Sensible Capacity Correction for Ent. DB				
		70	75	80	85	95
57	.851	.961	---	---	---	---
61	.910	.763	1.030	---	---	---
64	.955	.615	.881	1.148	---	---
67	1.000	---	.733	1.000	1.267	---
73	1.090	---	---	.703	.970	---
78	1.164	---	---	---	.723	1.257

MODELS: EM007 thru EM042 and EM070
GT009 thru GT070

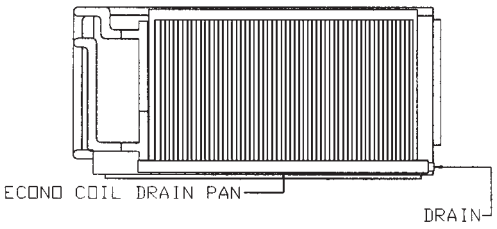


RETURN AIR VIEW

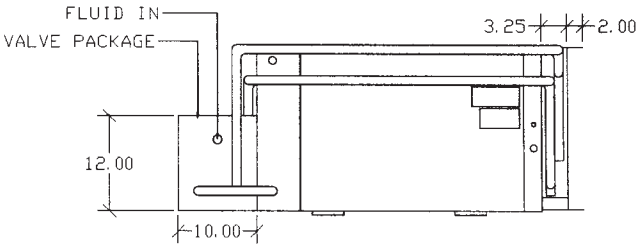


FRONT VIEW

MODELS: EM048 thru EM060

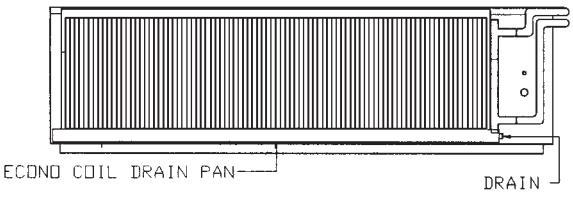


RETURN AIR VIEW

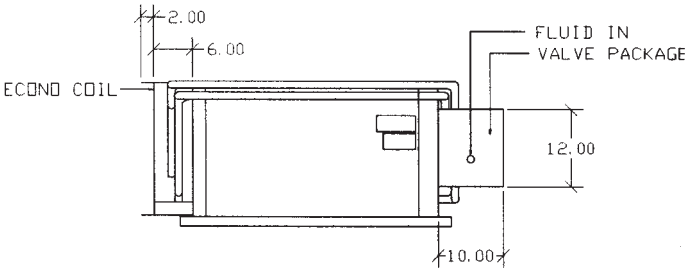


FRONT VIEW

MODELS: EM072, EM096,
EM120, EM140



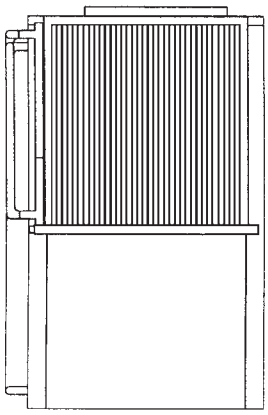
RETURN AIR VIEW



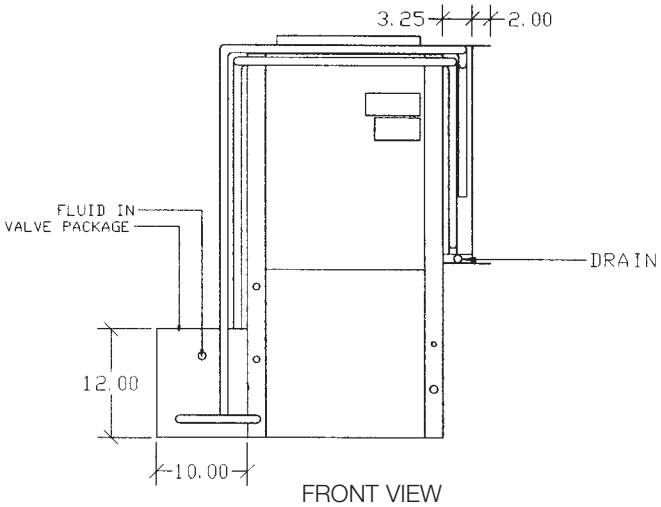
FRONT VIEW

NOTES:
1. All drain connections 3/4"
2. Not all cabinet configurations are shown

MODELS: EM009 thru EM070
GT009 thru GT070

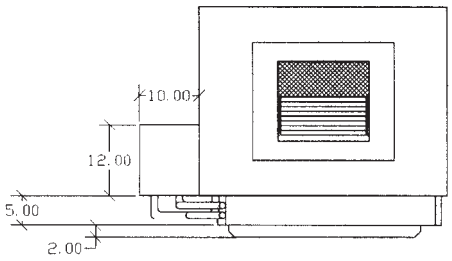


RETURN AIR VIEW

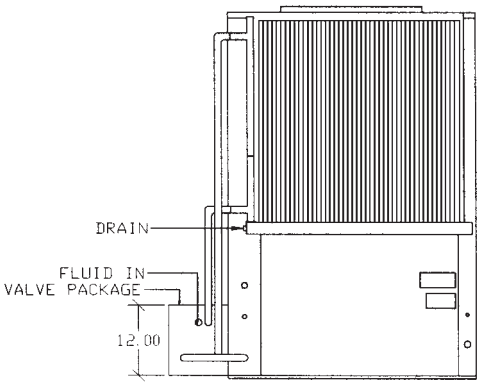


FRONT VIEW

MODELS: EM072, EM096, EM120

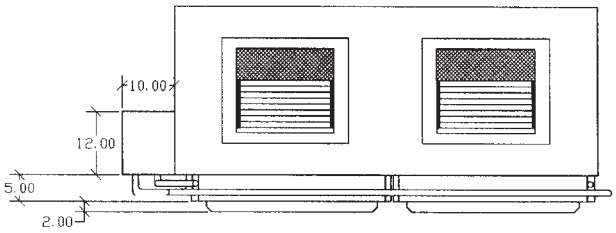


TOP VIEW

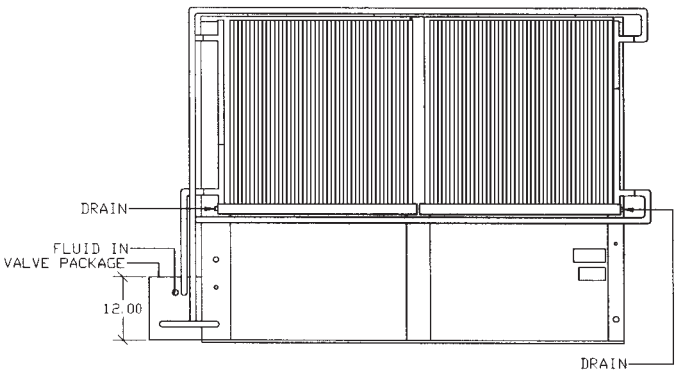


FRONT VIEW

MODELS: EM144, EM168, EM210, EM240, EM300, EM360

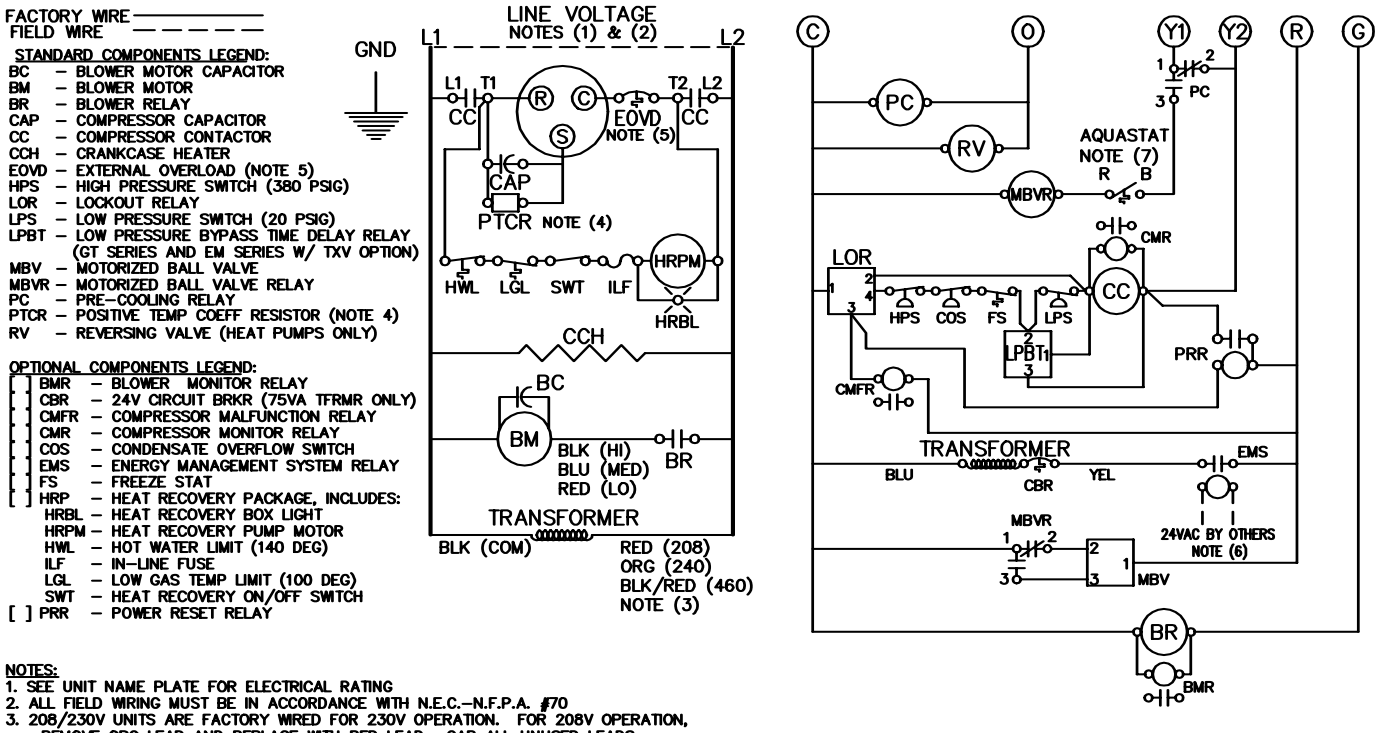


TOP VIEW

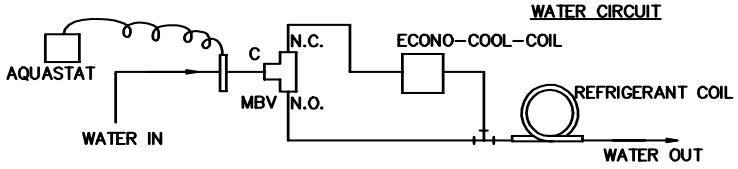


FRONT VIEW

NOTES:
1. All drain connections 3/4”
2. Not all cabinet configurations are shown



NOTES:
1. SEE UNIT NAME PLATE FOR ELECTRICAL RATING
2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH N.E.C.–N.F.P.A. #70
3. 208/230V UNITS ARE FACTORY WIRED FOR 230V OPERATION. FOR 208V OPERATION, REMOVE ORG LEAD AND REPLACE WITH RED LEAD. CAP ALL UNUSED LEADS
4. PTCR IS STANDARD ON ALL UNITS EQUIPPED WITH BRISTOL INERTIA COMPRESSORS OR SCROLL COMPRESSORS.
5. EXTERNAL OVERLOAD STANDARD ON ALL UNITS EQUIPPED WITH ROTARY COMPRESSORS.
6. FOR ALTERNATE EMS COIL VOLTAGES CONSULT FACTORY.
7. CLOSES ON DROP IN TEMPERATURE BELOW SET POINT



CAUTION:
FHP Manufacturing will not warranty waterside economizer coil failures or assume any associated liabilities resulting there of caused by the following mis-applications:

1. Freezing of waterside economizer coils due to low temperature outside air entering the coil
2. Freezing of waterside economizer coils caused by heat pump fan failure, belt failure, or restricted airflow caused by any outside circumstances including acts of God. Convection from the DX evaporator during this situation may cause coil freezing. (Field installed sail switches may be utilized to confirm air flow.)
3. High pressure hydraulic hammer due to pumping system start-ups and shutdowns splitting tubes seam wise.
4. High velocity water caused by excessive flow rates which erode and thin the inner wall of the coils copper tubing and resulting in a pressure burst situation.
5. Particulate matter or foreign debris contained in the systems water loop which may cause erosion of the inner tube walls resulting in a pressure burst.