MS Series
Medium Profile Unit Coolers

Operating

and

Installation

Manual

TABLE OF CONTENTS

TABLES

FIGURES

1 RECEIPT OF EQUIPMENT

1.1 *INSPECTION*

All equipment should be carefully checked for damage or shortages as soon as it is received. Each shipment should be carefully checked against the bill of lading. If any damage or shortage is evident, a notation must be made on the delivery receipt before it is signed and a claim should then be filed against the freight carrier.

1.2 *LOSS OF GAS HOLDING CHARGE*

Each unit cooler is leak tested, evacuated to remove moisture and then shipped with a gas holding charge. Absence of this charge may indicate a leak has developed in transit. The system should not be charged with refrigerant until it is verified that there is no leak or the source of the leak is located.

2 ASSEMBLY OF COMPONENTS

2.1 *SHIPPED LOOSE PARTS - LONG THROW ADAPTERS*

Long Throw Adapters are shipped loose. They should be mounted on the unit before the unit is installed. The evaporator fan cabinet contains through-bolts with the threaded end pointing out away from the fan cabinet. The bolts have two ½" nuts, flat washers, and a lock washer on them. Remove the outer most nut, lock washer, and one flat washer on each bolt. Place Long Throw Adapter on the top bolts braced against the remaining flat washer. While holding the adapter with one hand place the flat washers, then the lock washers, and then thread the nuts on the top two bolts to hold the guard and adapter in place. Repeat procedure on the bottom two bolts. Secure with a wrench.

2.2 *REFRIGERANT DISTRIBUTOR NOZZLES*

Direct expansion unit coolers are piped using a refrigerant distributor with a **changeable nozzle** design to equally distribute refrigerant to each circuit of the evaporator coil. Distributor nozzles are installed at the factory.

The nozzles provided with the unit have been selected for design conditions of 9°F to 11°F T.D. and 90°F (85°F electric and hot gas defrost) liquid refrigerant at the expansion valve inlet or the conditions supplied to the factory at the time of order. If the unit will be operated at conditions that are substantially different from these conditions it may be necessary to select a different size nozzle. Contact the factory for advice.

The nozzle must be installed in the distributor or the auxiliary side connector before installing the expansion valve. There are nozzle identification numbers stamped on one side of the nozzle. Be sure to insert the nozzle into the distributor with these numbers visible in case identification is required later. The nozzle is held in place by a retainer ring that is easily inserted or removed with a pair of needle nose pliers.

2.3 *EXPANSION VALVE*

Before mounting the unit, install the expansion valve and connect the equalizer tube. The expansion valve should be installed directly to the distributor body or as close as possible with no elbows or bends. Locate the expansion valve bulb on a horizontal length of suction line as close to the suction header as possible. Position the bulb in a 3, 4 or 8, 9 o'clock position (do not position on the bottom side of the pipe). Clamp the bulb down flush and tight against the pipe and insulate. Never locate the bulb in a trap or downstream from a trap.

Expansion valves are adjusted at the factory prior to shipment. The setting will be correct for many applications, but in other applications adjustments may be needed. It is important that the operation of the expansion valve be checked after the system has balanced out at the desired room temperature. If the coil is being starved it is necessary to reduce the superheat setting of the valve by turning the adjusting stem counter-clockwise. If the superheat is too low it is necessary to increase the superheat setting of the valve by turning the adjusting stem

clockwise. It is recommended that for a 10°F to 12°F T.D. system, the valve should be adjusted to maintain 5°F to 6°F superheat.

2.4 *CHECK VALVE*

Check valves kit brazed to the pipe at the field, refer to Figure 4.

Table 1 CHECK VALVES KITS

Model	Check Valve Kit	Gas Inlet Diam
166, 178, 195, 212, 223, 239, 323, 356, 390, 424	CE269381	0.500
444, 445, 487, 502, 532		0.875
594, 602, 643, 669, 685, 710, 803, 858, 914	CE269382	0.875

3 RIGGING INSTRUCTIONS

3.1 *RIGGING INSTRUCTIONS*

MS units tend to be a long and heavy object. Jobsite requirements will affect the method of moving and lifting the unit into place. Carefully consider the support that is required to lift and move the unit. Under no circumstances should the shipping skid be used for lifting the unit. To ensure that the unit is not bowed or damaged when being lifted into place from above, all leg or hanger points should be used. If the unit is being lifted into place from underneath, a level support directly under all of the shipping legs is required to adequately steady the unit as it is lifted to the hanger rods.

4 UNIT INFORMATION AND DIMENSIONS

4.1 *MODELS COVERED*

MS Series medium profile unit coolers.

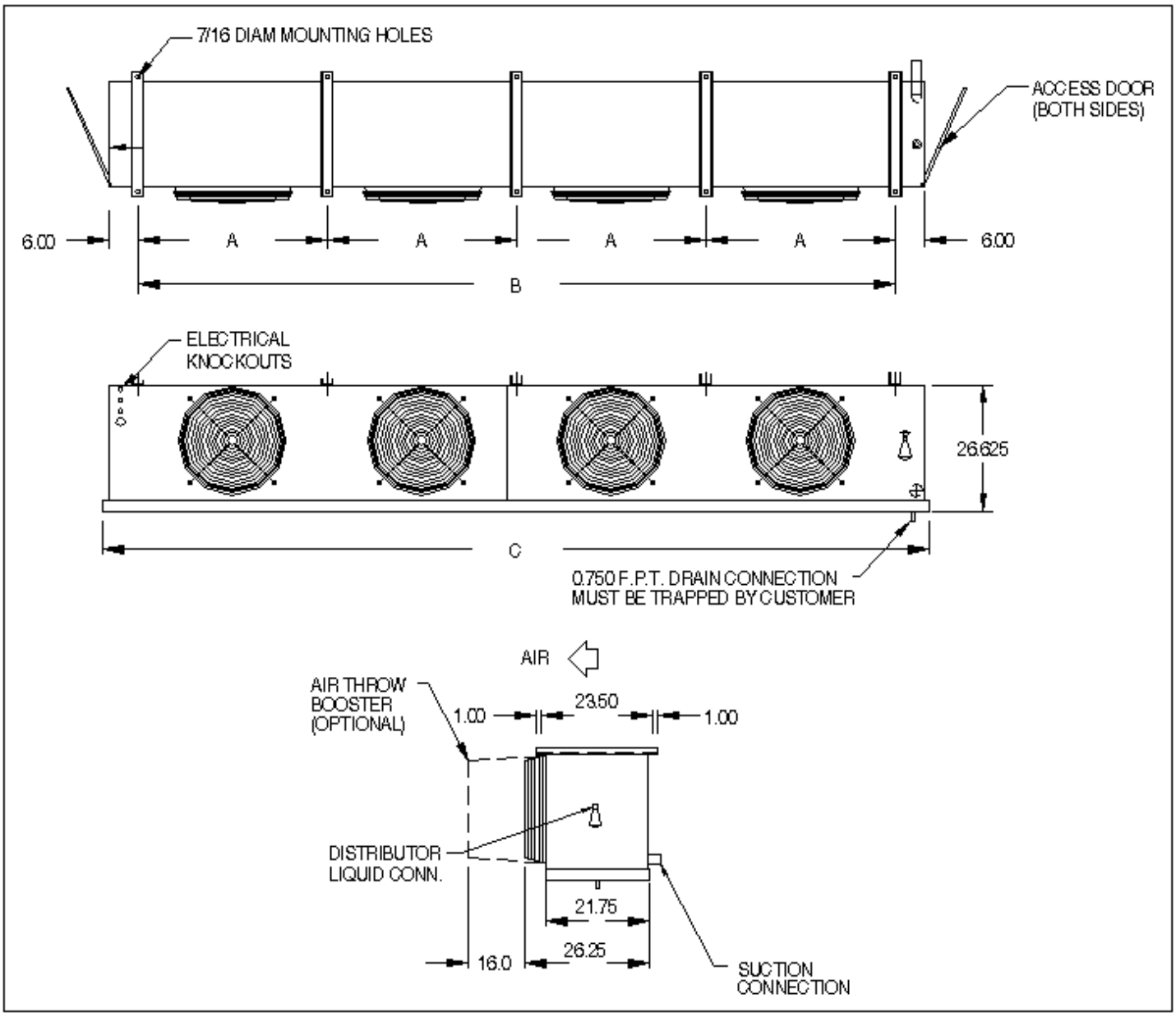
The MS series designed for walk-in coolers with ceiling heights of 10 to 14 feet that require high airflow. The MS series handles medium to low temperature requirements and has three defrost options – air, electric and hot gas. Consult the drawing that was sent with each unit to determine the temperature and defrost type of the unit.

4.2 *UNIT DIMENSIONS*

Table 2 UNIT DIMENSIONS

Fan Q-ty	A	B	C
1	45.00	45.00	57.50
2	45.00	90.00	102.50
3	39.00	117.00	129.50
4	39.00	156.00	168.50

Figure 1 Unit Dimensions



5 UNIT LOCATION AND MOUNTING

5.1 *UNIT LOCATION*

Unit coolers must be located to provide good air circulation to all areas of the cooler. The unit cooler should be positioned to blow away from the wall and directed down an aisle rather than into and through shelves. For best performance it is desirable to arrange the air discharge toward the door of the cooler to minimize the entrance of warm moist air when the door is open. Light fixtures, shelving and product boxes must be located so that they do not block the air intake or air discharge from the unit cooler.

IMPORTANT:
The coil face must be located a minimum of 27" from the wall to assure unrestricted air intake.

5.2 *MOUNTING*

Install the expansion valve and equalizer connection before hanging the unit cooler. See section 2.3.

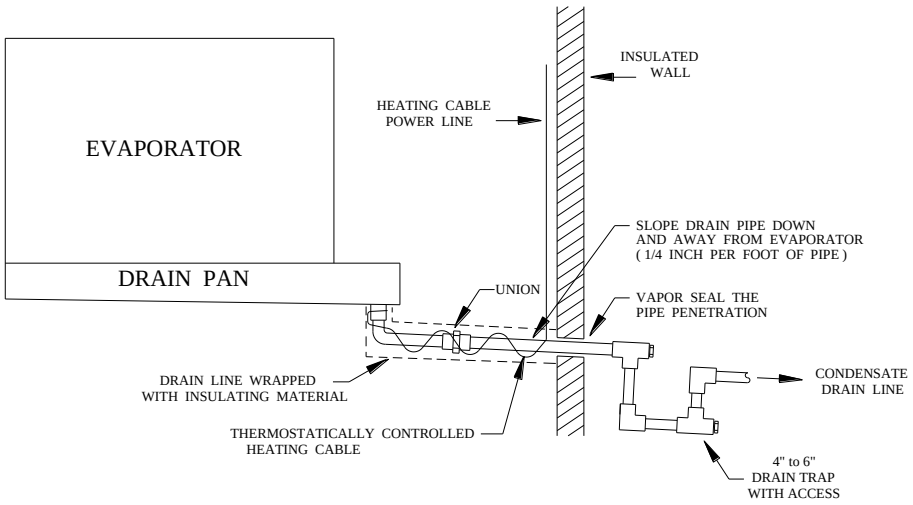
The unit cooler should be suspended with 3/8" diameter rods. Rods should have double nuts on the top and bottom. Adequate support must be provided to hold the weight of the unit.
The unit must be mounted so that the drain pan end is approximately 1" lower then the bottom of the electrical end of the unit. If mounted to a level ceiling the hanging brackets provide the slope. Mount to ceiling with hanging brackets provided. Suspended units must have sufficient clearance above the unit for cleaning the top. Remove shipping legs after installation.

6 PIPING INSTALLATION

6.1 *DRAIN LINE*

The drain line should be as short and as steeply pitched as possible with a minimum of ¼" drop per running foot. A drain line trap should be installed to prevent warm moist air from migrating through the drain line. If the temperature surrounding the drain line and trap is below freezing (32°) it must be wrapped with a drain line heater and insulation. Be sure to also wrap the drain pan coupling. The drain line heater must be energized continuously. Be sure to follow the manufacturer's recommendation when installing the drain line heat tape.

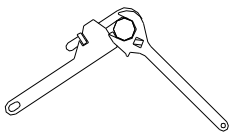
Figure 2 Drain Line



A union at the drain connection in the drain pan is recommended for ease of installation and future servicing. The union should be located as close to the drain pan as possible, but outside the drain pan space. Use two wrenches when tightening to prevent the drain fitting from twisting and damaging the unit.

Use drain line hangers to avoid damage to the drain pan with long runs of drain line, i.e. more than a few feet.

Figure 3 Pipe Joining



6.2 *REFRIGERATION PIPING*

System design must conform to all local and national codes, laws and regulations applying to the site of installation. In addition the safety code for mechanical refrigeration, ASME B31.5, should be followed as a guide to safe installation and operation practice.

Refrigerant line sizes and piping techniques should be obtained from the ASHRAE guide or equivalent reference. Under no circumstances should the refrigerant connection size of the unit be used as the basis for sizing the lines.

The horizontal suction line should slope away from the unit cooler toward the compressor. Vertical suction risers may require a trap at the bottom of the riser for proper oil return.

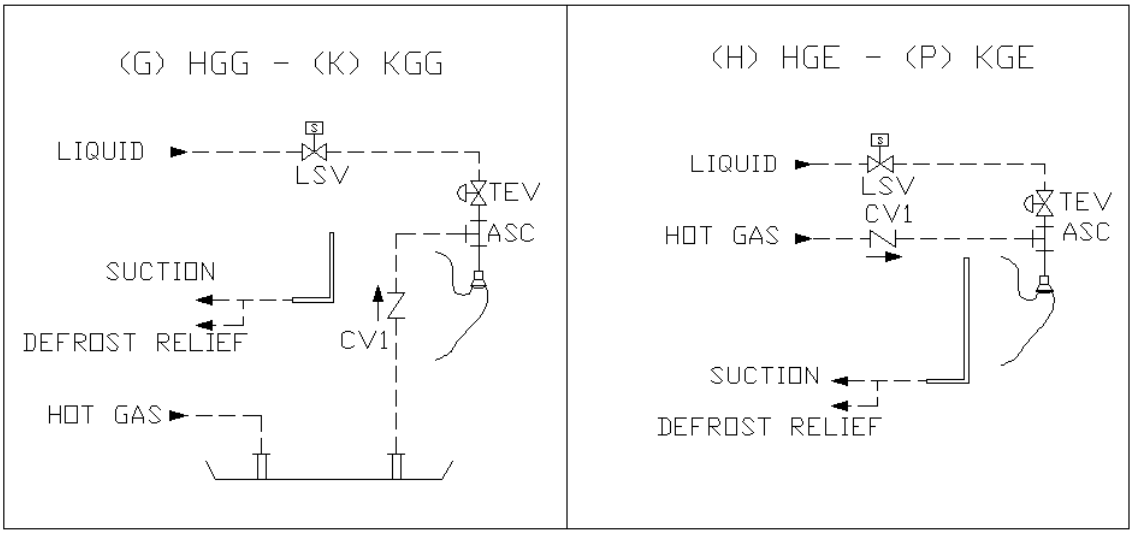
When connecting multiple unit coolers in series using a common suction line, the branch suction lines must enter the top of the common suction line. The branch lines must be sized for the evaporator capacity and the common suction line to be sized for the total system capacity.

6.3 *EVACUATION AND LEAK TEST*

When all refrigeration connections have been completed, the entire system must be tested for leaks and then evacuated. Refer to the instructions provided with your systems condensing unit for information on performing the leak test and evacuation.

6.4 *MS GAS DEFROST PIPING*

Figure 4 Gas Defrost Piping Diagrams



Legend

———	Piping by Manufactory	- - - -	Piping by Others
CV1	Gas Inlet Check Valve	TEV	Expansion Valve
ASC	Aux. Side Connector	LSV	Liquid Solenoid Valve

6.5 *REFRIGERANT DISTRIBUTOR NOZZLES*

Direct expansion unit coolers are piped using a refrigerant distributor with a **changeable nozzle** design to equally distribute refrigerant to each circuit of the evaporator coil. Distributor nozzles are installed at the factory.

The nozzles provided with the unit have been selected for design conditions of 9°F to 11°F T.D. and 90°F (85°F electric and hot gas defrost) liquid refrigerant at the expansion valve inlet. If the unit will be operated at conditions that are substantially different from these conditions it may be necessary to select a different size nozzle. Contact the factory for advice.

The nozzle must be installed in the distributor or the auxiliary side connector before installing the expansion valve. There are nozzle identification numbers stamped on one side of the nozzle. Be sure to insert the nozzle into the distributor with these numbers visible in case identification is required later. The nozzle is held in place by a retainer ring that is easily inserted or removed with a pair of needle nose pliers.

Table 3 DISTRIBUTOR NOZZLE CAPACITIES – TONS OF REFRIGERANT

Distributor nozzle number	R-134A				R-22				
	Evaporator Temperature (F)								
	40	20	0	-20	40	20	0	-20	-40
1/9	0.08	0.06	0.05	0.04	0.14	0.11	0.09	0.07	0.06
1/6	0.12	0.09	0.07	0.06	0.21	0.16	0.13	0.11	0.09
1/4	0.2	0.15	0.12	0.1	0.34	0.26	0.21	0.18	0.15
1/3	0.26	0.2	0.15	0.13	0.44	0.34	0.28	0.23	0.2
1/2	0.36	0.27	0.21	0.17	0.61	0.48	0.38	0.32	0.27
3/4	0.54	0.41	0.32	0.26	0.92	0.72	0.58	0.48	0.41
1	0.72	0.54	0.43	0.35	1.23	0.96	0.78	0.64	0.55
1-1/2	1.05	0.79	0.63	0.51	1.79	1.4	1.13	0.94	0.8
2	1.44	1.09	0.86	0.7	2.46	1.92	1.55	1.29	1.1
2-1/2	1.79	1.35	1.07	0.88	3.07	2.39	1.93	1.6	1.37
3	2.15	1.63	1.28	1.05	3.68	2.87	2.32	1.93	1.65
4	288	2.18	1.72	1.41	4.92	3.84	3.1	2.58	2.2
5	3.55	2.68	2.12	1.74	6.07	4.74	3.83	3.18	2.72
6	4.26	3.22	2.54	2.08	7.28	5.68	4.59	3.81	3.26
8	5.13	3.88	3.06	2.51	8.77	6.84	5.52	4.59	3.93
10	5.75	4.35	3.43	2.81	9.83	7.67	6.19	5.15	4.4
12	7	5.37	4.24	3.47	12.1	9.47	7.65	6.36	5.43
15	8.81	6.65	5.25	4.3	15.1	11.7	9.48	7.88	6.74
17	9.85	7.44	5.87	4.81	16.8	13.1	10.8	8.81	7.54
20	11.9	8.97	7.08	5.8	20.3	15.8	12.8	10.6	9.08
25	14.9	11.3	8.91	7.3	25.5	19.9	16.1	13.4	11.4

Distributor nozzle number	R-404A					R-507				
	Evaporator Temperature (F)									
	40	20	0	-20	-40	40	20	0	-20	-40
1/9	0.09	0.07	0.05	0.04	0.04	0.09	0.07	0.05	0.04	0.03
1/6	0.14	0.11	0.08	0.07	0.05	0.14	0.11	0.08	0.07	0.05
1/4	0.23	0.17	0.13	0.11	0.09	0.23	0.17	0.13	0.11	0.09
1/3	0.3	0.23	0.18	0.14	0.11	0.29	0.22	0.17	0.14	0.11
1/2	0.41	0.31	0.24	0.19	0.16	0.41	0.31	0.24	0.19	0.16
3/4	0.62	0.47	0.37	0.29	0.24	0.61	0.47	0.36	0.29	0.23
1	0.83	0.63	0.49	0.39	0.32	0.82	0.62	0.49	0.39	0.31
1-1/2	1.2	0.92	0.71	0.57	0.46	1.2	0.91	0.71	0.56	0.46
2	1.65	1.26	0.98	0.78	0.64	1.64	1.25	0.97	0.77	0.62
2-1/2	2.06	1.57	1.22	0.97	0.79	2.05	1.56	1.21	0.96	0.78
3	2.47	1.88	1.47	1.17	0.95	2.46	1.87	1.45	1.15	0.93
4	3.31	2.52	1.96	1.56	1.27	3.29	2.5	1.94	1.54	1.25
5	4.08	3.11	2.42	1.93	1.57	4.06	3.08	2.4	1.9	1.54
6	4.89	3.72	2.91	2.31	1.88	4.86	3.69	2.87	2.28	1.85
8	5.89	4.49	3.5	2.79	2.27	5.86	4.45	3.46	2.75	2.23
10	6.6	5.03	3.92	3.12	2.54	6.57	4.99	3.88	3.08	2.5
12	8.16	6.21	4.84	3.86	3.14	8.11	6.16	4.79	3.8	3.08
15	10.1	7.7	6.01	4.78	3.89	10.1	7.64	5.94	4.72	3.83
17	11.3	8.61	6.72	5.35	4.35	11.2	8.54	6.64	5.27	4.28
20	13.6	10.4	8.1	6.45	5.24	13.6	10.3	8.01	6.38	5.16
25	17.1	13.1	10.2	8.11	6.6	17.1	12.9	10.1	8	6.48

6.6 EXPANSION VALVE

Before mounting the unit, install the expansion valve and connect the equalizer tube. The expansion valve should be installed directly to the distributor body or as close as possible with no elbows or bends. Locate the expansion valve bulb on a horizontal length of suction line as close to the suction header as possible. Position the bulb in a 3, 4 or 8, 9 o'clock position (do not position on the bottom side of the pipe). Clamp the bulb down flush and tight against the pipe and insulate. Never locate the bulb in a trap or downstream from a trap.

Expansion valves are adjusted at the factory prior to shipment. The setting will be correct for many applications, but in other applications adjustments may be needed. It is important that the operation of the expansion valve be checked after the system has balanced out at the desired room temperature. If the coil is being starved it is necessary to reduce the superheat setting of the valve by turning the adjusting stem counter-clockwise. If the superheat is too low it is necessary to increase the superheat setting of the valve by turning the adjusting stem clockwise. It is recommended that for a 10°F to 12°F T.D. system, the valve should be adjusted to maintain 5°F to 6°F superheat.

7 ELECTRICAL

7.1 *FIELD WIRING*

Field wiring should comply with NEC and local codes. The power supply voltage, phase and frequency must match what is shown on the unit cooler data plate.
The field-wiring compartment is constructed as part of the unit cooler enclosure. The wiring diagram for each unit is located on the inside of the electrical panel door. Wiring connections are made at the terminal block(s) provided inside the unit on the end opposite the refrigerant connections. The unit must be grounded. Refer to tables 3, 4, 5, 6 for motor and heater electrical information.

Special consideration must be taken when wiring single-phase fan motors and defrost heaters. If the total amp draw of the motors or heaters exceed the amp rating of the fan delay or heater safety switch then a contactor must be installed.

7.2 *ELECTRICAL DATA*

Table 4 MS MOTOR ELECTRICAL DATA (AMPS)

Fans Q-ty	230/1/60	230/3/60	460/3/60	575/3/60
1	3.9	2.24	1.12	0.76
2	7.8	4.48	2.24	1.52
3	11.7	6.72	3.36	2.28
4	15.6	8.96	4.48	3.04

Table 5 (E) EDL HEATERS ELECTRICAL DATA

Model	No. of Fans	Coil Heaters Q-ty	Drain Pan Heaters Q-ty	230/3/60		460/3/60		575/3/60	
				kW	Amps	kW	Amps	kW	Amps
MS-162,178,195	1	8	2	5.05	15.21	5.05	8.30	9.60	6.60
MS-212,223,239	1	10	2	6.60	15.21	6.60	8.30	11.50	6.63
MS-323,356,390	2	8	2	10.10	30.42	10.10	15.20	19.10	13.60
MS-424,444,478	2	10	2	12.12	30.42	12.12	15.20	13.20	13.25
MS-445,502,532	3	8	2	12.85	38.71	12.85	19.35	24.30	16.90
MS-602,643,685	3	10	2	15.42	38.71	15.42	19.35	16.80	16.87
MS-594,669,710	4	8	2	17.44	46.12	17.44	26.23	33.00	22.90
MS-803,858,914	4	10	2	20.92	52.51	20.90	26.23	39.60	22.89

Table 6 (D) ED HEATERS ELECTRICAL DATA

Model	No. of Fans	Coil Heaters Q-ty	230/3/60		460/3/60		575/3/60	
			kW	Amps	kW	Amps	kW	Amps
MS-162,178,195	1	8	4.04	11.61	4.04	5.08	4.40	5.06
MS-212,223,239	1	10	5.05	15.21	5.05	7.60	5.50	6.63
MS-323,356,390	2	8	8.08	23.23	8.08	11.60	8.80	10.12
MS-424,444,478	2	10	10.10	30.42	10.10	15.21	11.10	13.25
MS-445,502,532	3	8	10.28	29.56	10.28	14.78	11.20	12.83
MS-602,643,685	3	10	12.85	38.71	12.85	19.35	14.00	16.87
MS-594,669,710	4	8	13.95	40.12	13.95	20.06	15.20	16.82
MS-803,858,914	4	10	17.44	52.52	17.44	26.26	19.00	21.68

Table 7 (P) KGE & (H) HGE HEATERS ELECTRICAL DATA

Model	No. of Fans	Coil Heaters Q-ty	230/3/60		460/3/60		575/3/60	
			kW	Amps	kW	Amps	kW	Amps
MS-162,178,195	1	2	1.01	4.39	1.01	2.19	1.10	1.91
MS-212,223,239	1	2	1.01	4.39	1.01	2.19	1.10	1.91
MS-323,356,390	2	2	2.02	8.78	2.02	4.39	2.20	3.82
MS-424,444,478	2	2	2.02	8.78	2.02	4.39	2.20	3.82
MS-445,502,532	3	2	2.57	11.73	2.57	5.58	2.80	4.86
MS-602,643,685	3	2	2.57	11.73	2.57	5.58	2.80	4.86
MS-594,669,710	4	2	3.49	15.16	3.49	7.58	3.80	6.60
MS-803,858,914	4	2	3.49	15.16	3.49	7.58	3.80	6.60

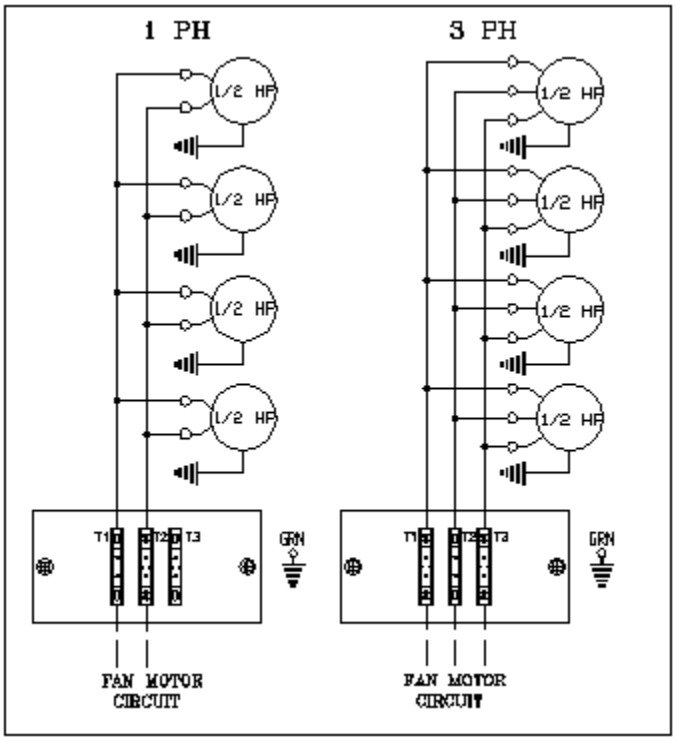
7.3 *AIR DEFROST SEQUENCE OF OPERATION*

SEQUENCE OF OPERATION

1. The unit cooler fan motors are energized and the fans operate continually.
2. The room thermostat calls for cooling. The liquid solenoid valve opens allowing liquid to flow to the unit cooler. The suction pressures rises and starts the compressor.
3. When the room temperature is satisfied the thermostat opens and closes the liquid solenoid. The compressor continues to run until the suction pressure reaches the low-pressure cutout setting and shuts off the compressor.
4. The fan circulates air over the coil and frost melts.

For air defrost to work properly the compressor run time should not exceed 40 minutes per hour.

Figure 5 (A) Air Defrost Wiring



7.4 *ELECTRIC DEFROST SEQUENCE OF OPERATION*

The electric defrost cycle is time clock initiated and temperature terminated with a timer and or high temperature over-ride. For systems with multiple unit coolers and a single defrost time clock the defrost termination thermostat must be wired in series. Reference figures 6, 7, and 8 for electric defrost wiring diagrams.

SEQUENCE OF OPERATION

STEP A: Normal Refrigeration Cycle

1. Power is supplied to terminals "N' and "4" on the defrost timer.
2. The heater safety and fan delay thermostat are closed, the defrost termination thermostat is off and the defrost heaters are off.
3. The unit cooler fan motors are energized and the fans operate continually.
4. The systems compressor operates in accordance with the demand of the room thermostat.
5. Frost slowly builds up on the evaporator fins.

STEP B: Defrost Cycle

The timer starts defrosting of the evaporator coil at a predetermined interval. A typical setting would be two defrost periods per 24-hour day.

1. Upon initiation of the defrost cycle, the timer mechanically disconnects power to terminal "4" thus closing the liquid line solenoid valve and shutting off the fan motors. Simultaneously power is connected to terminal "3" which allows current to flow to the defrost heaters.
2. The heaters, embedded in slots in the coil face, give up heat directly to the evaporator fins. This heat raises the coil temperature to 32°F causing the frost to melt.
3. As the frost melts it drops into the drain pan and flows down the drain.
4. When the frost has completely melted from the coil the temperature of the coil will start to rise above 32°F.
5. When the coil reaches the temperature setting of the defrost termination thermostat (75°F for fixed Klixon), the thermostat closes which allows current to flow to terminal "X" on the timer which energizes the switching solenoid in the timer. The timer disconnects power to terminal "3" thus turning off the defrost heaters. At the same, instant power is connected to terminal "4" of the timer.
6. Because there is power at terminal "4" the liquid line solenoid opens and the compressor restarts.
7. The evaporator fan motor(s) remain off because the fan delay thermostat is still open. This prevents warm air from being blown into the refrigerated area.
8. The evaporator coil cools down approaching operating temperature.
9. When the coil temperature reaches 25°F (approximately 2 to 3 minutes after defrost termination) the fan delay thermostat closes, thus allowing the fan motors to restart. The unit is now back in operation.
10. The heater safety thermostat will only open if the defrost termination thermostat fails to close at it's set temperature. The heater safety thermostat is set to open at 80°F. The timer also has a fail-safe (inner dial) timeout; the recommended setting is for 30 minutes.

NOTE: On systems where the room temperature is above +25°F the fan delay thermostat may not close for an extended period of time. If the fan delay time is too long, it is permissible to install a jumper wire between terminals "F" and "B" at the unit cooler. This allows the fans to turn on immediately after the defrost period.

Figure 6 Electric Defrost Wiring with Defrost Timer

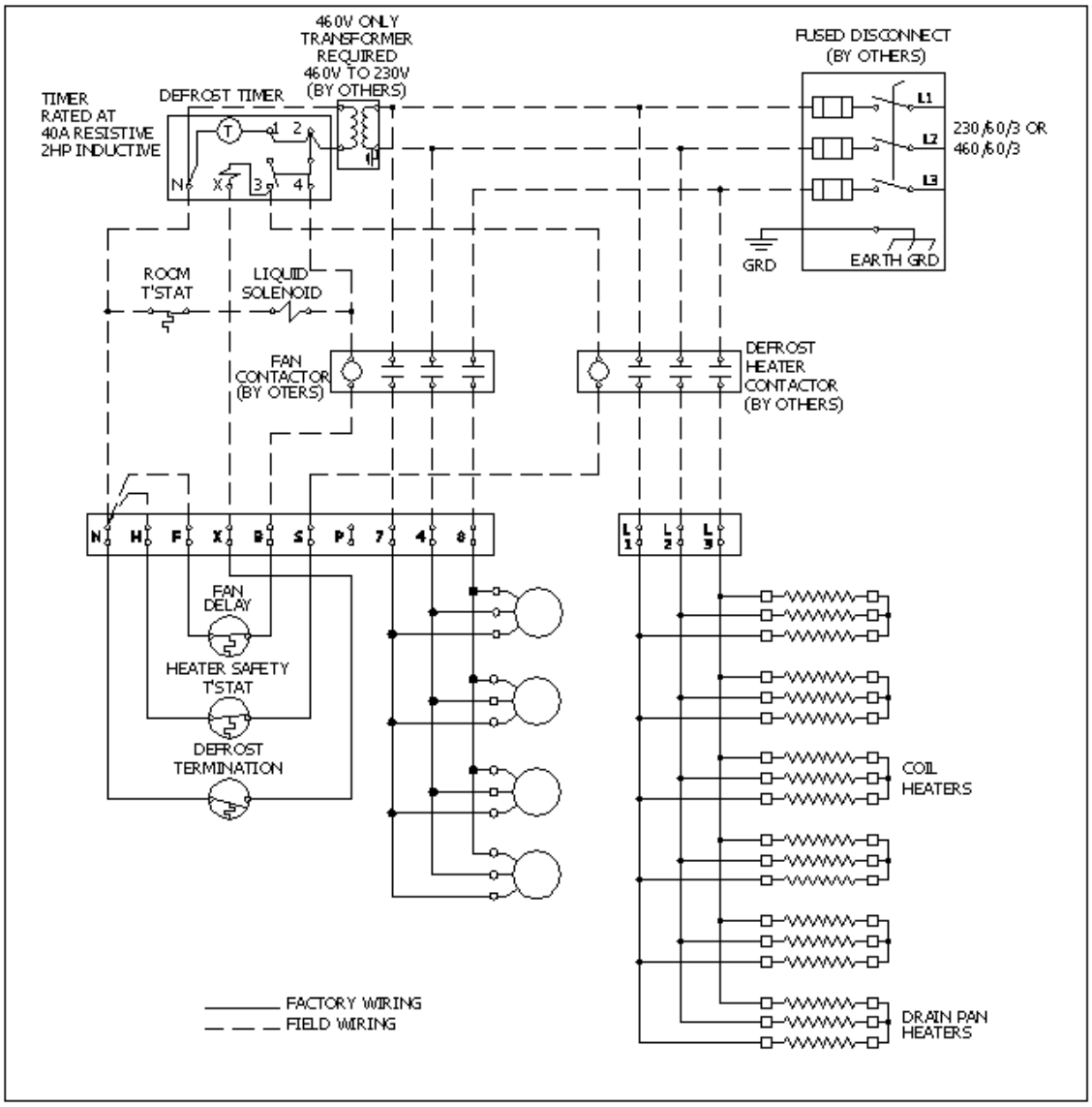


Figure 7 (E) EDL Electric Defrost Wiring 1 PH

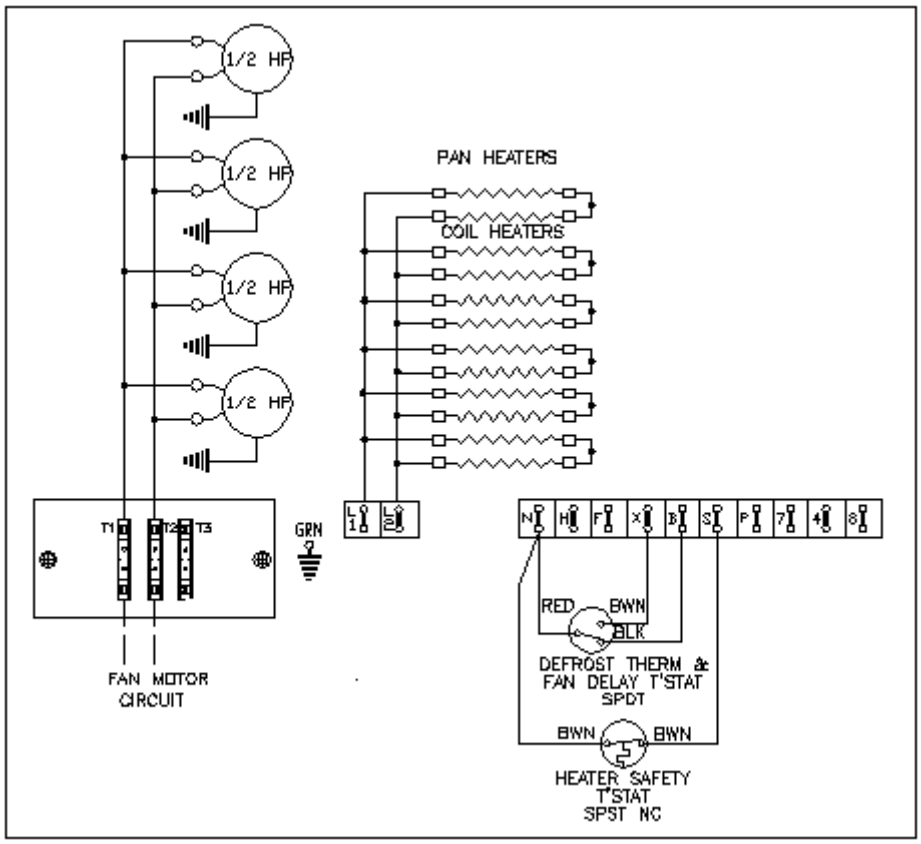
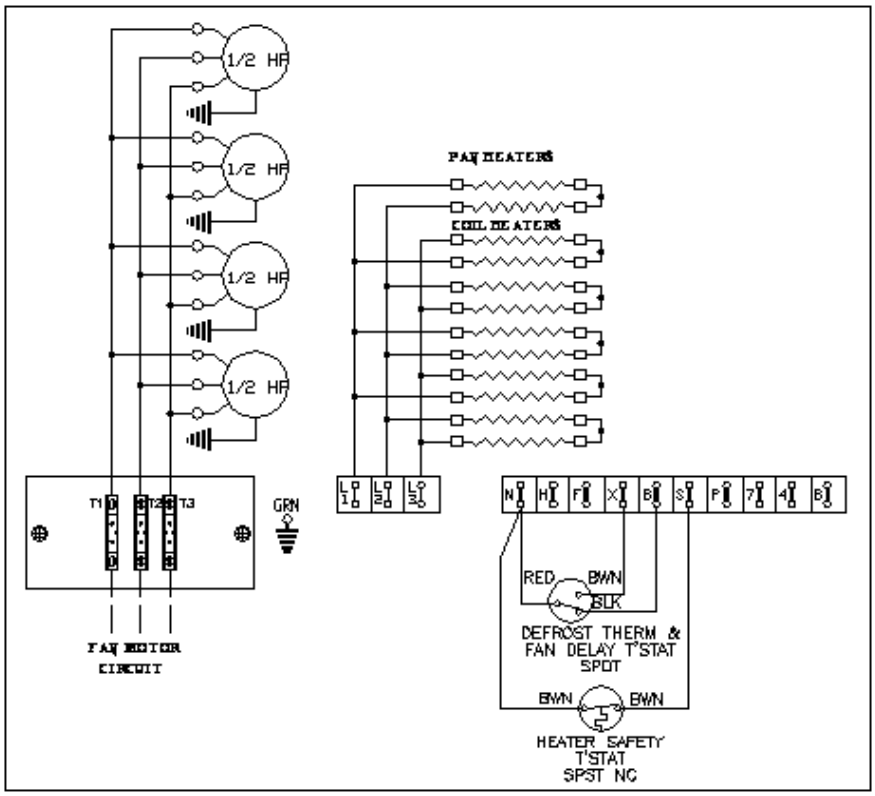


Figure 8 (E) EDL Electric Defrost Wiring 3 PH



7.5 *HOT GAS DEFROST SEQUENCE OF OPERATION*

The hot gas defrost cycle is time clock initiated and terminated.

(H) HGE/(G) HGG THREE PIPE HOT GAS DEFROST

Three pipe hot gas defrost systems distribute compressor discharge gas through a separate hot gas line, controlled by a solenoid valve, through a check valve to the refrigerant distributor auxiliary side connection. Defrost condensate and gas vapor is evaporated in a re-evaporator outside the MS unit prior to returning to the compressor through the suction line.

SEQUENCE OF OPERATION

1. Upon initiation of the cycle, the timer contacts "1" and "4" opens thus de-energizing the liquid solenoid valve and the fan motors. If the unit has electric drain pan heater, contacts "4" and "5" close, thus energizing the drain pan heater. The compressor pumps the refrigerant out of the coil.
2. The timer contacts "4" and "2" closes, thus energizing the hot gas solenoid valve and allows hot gas to flow into the coil through a check valve and the refrigerant distributor auxiliary side connection.
3. After the timer timeouts contacts "4" and "2" open, thus de-energizing the hot gas solenoid valve. During this period the coil pressure will vent down to the compressor suction pressure.
4. Upon termination of the vent down cycle the contacts between "4" and "
   1" close, thus de-energizing the drain pan heater if the unit is equipped with one. The contacts between "4" and "1" close, thus opening the liquid line solenoid valve and starts the fan motors.

Figure 9 (H) HGE (3 PIPE) Hot Gas Coil and Electric Drain Pan Wiring

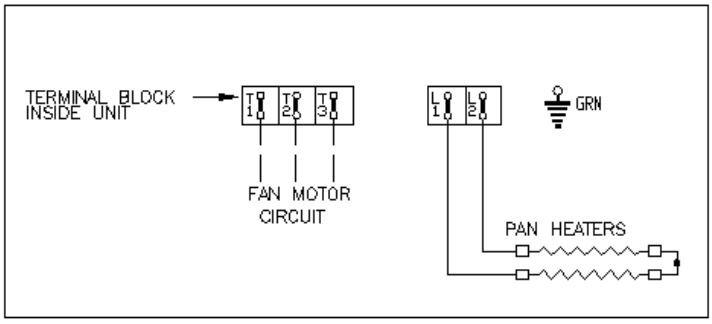
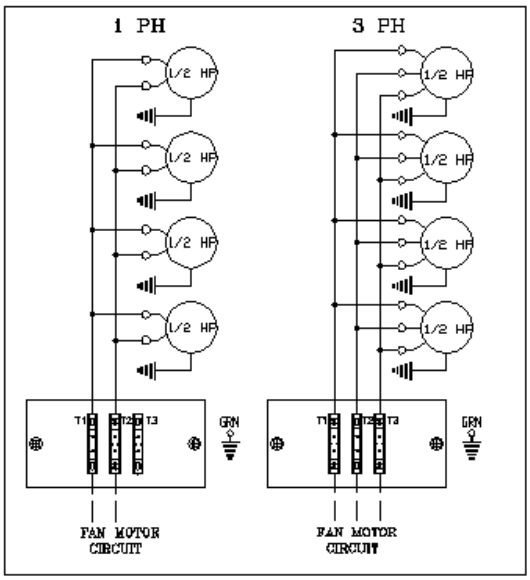


Figure 10 (G) HGG (3 PIPE)/(K) KGG (2 PIPE) Gas Coil and Gas Drain Pan Wiring



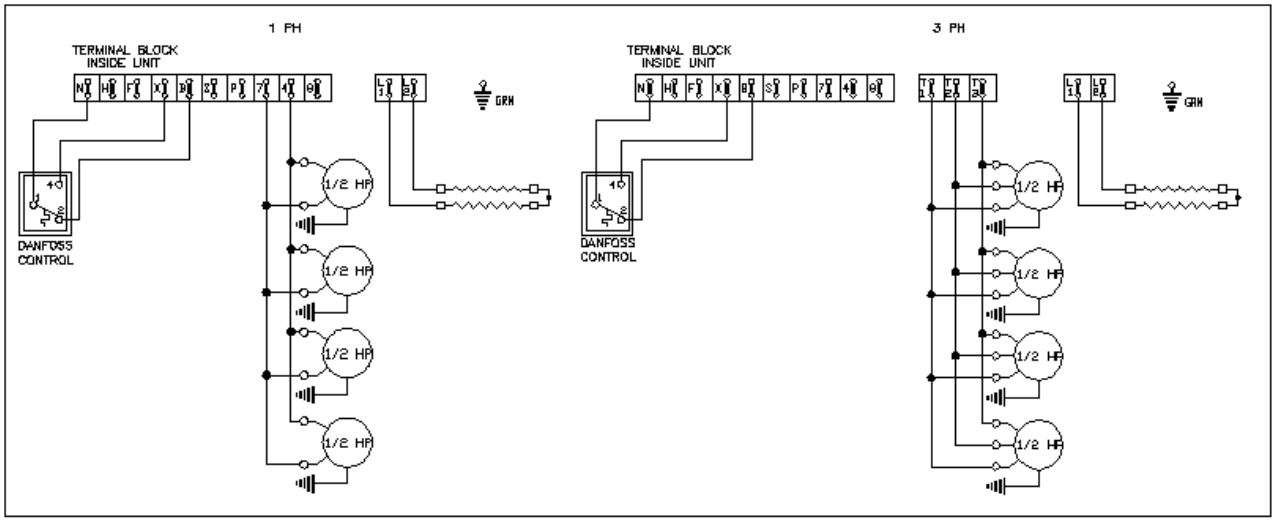
(P) KGE/(K) KGG REVERSE CYCLE (2 PIPE) HOT GAS DEFROST

Reverse cycle (2 pipe) defrost systems distribute compressor discharge gas through the suction line during defrost. Defrost condensate flows through the refrigerant distributor auxiliary side connection and a check valve, bypassing the expansion valve and the liquid line solenoid valve into the liquid line, which is reduced in pressure.

SEQUENCE OF OPERATION

1. Power is supplied to the unit cooler continuously.
2. Hot gas is supplied to the unit via the suction line. A factory-mounted thermostat senses a rise in coil temperature. The SPDT control turns off the fan motors. If the unit has a drain pan heater, the other portion of the SPDT control is now closed and the drain pan heater is energized.
3. When the defrost is complete the hot gas supply is stopped. The liquid line solenoid is energized and the coil temperature begins to fall.
4. The factory-mounted thermostat senses the drop in coil temperature. The SPDT thermostat opens the circuit to the drain pan heater (when supplied) and close the circuit to the fan motors.

Figure 11 (P) KGE (2 PIPE) Cool Gas Coil and Electric Drain Pan Wiring



8 START UP

8.1 *PRE-STARTUP*

After the installation is complete, a review of the following items should be preformed before the system is placed into operation:

Check electrical connections, fan blade set screws, fan motors, guards and all other fasteners for tightness. Be sure the thermostatic expansion valve bulb is properly located, strapped and insulated.

With the system operating, check the supply voltage. It must be within +/- 10% of the voltage marked on the unit nameplate.

For electric defrost systems check the defrost timer to see that is set for the correct time of day and the starting pins have been installed (normally two per day). The defrost should be scheduled for times when the freezer doors are not likely to be open.

When the system is first started up, the box temperature is typically above the opening temperature of the fan delay thermostat. The fans may remain off for a lengthy period of time. To prevent this it is permissible to install a temporary jumper wire between terminals “F” and “B” or “N” and “B” depending on the unit wiring arrangement. Once the box temperature is below +25°F the jumper wire should be removed.

8.2 *OPERATION CHECKOUT*

With the system operating, check the supply voltage. The voltage must be within +/- 10% of the voltage marked on the unit nameplate and the phase to phase unbalance should be 2% or less.

LISTEN CAREFULLY to the unit to make sure there are no unusual sounds. Sounds such as a noisy motor, the fan(s) scraping on the housing, or loose fasteners allowing parts to rattle need to be addressed immediately before continued unit operation.

Check the room THERMOSTAT setting. Be sure it functions properly.

For DIRECT EXPANSION systems let the system balance out at the desired room temperature and check the operation of the expansion valve by properly measuring the superheat at the sensing bulb. As much as thirty minutes may be required for the new balance to take place after an adjustment is made.

For BRINE or GLYCOL COOLING systems keep the closest vent to the coil open while the fluid fills the coil to allow trapped air to escape. Close the vent valve once fluid flows out of the valve and check for water hammer in the coil.

With HOT GAS DEFROST systems allow the coil to frost, then manually advance the defrost timer to initiate a defrost cycle. Observe the defrost cycle to see if all controls are functioning properly and that the coil is clear of all frost before the system returns to refrigeration. Adjust the time clock pins if necessary. Reset the defrost timer to the correct time of day. A defrost cycle is only needed when the frost build up is such that it impedes the airflow through the coil. The defrost requirements will vary on each installation and may change depending on the time of the year and other conditions.

With ELECTRIC DEFROST systems allow the coil to frost then manually advance the defrost timer to initiate a defrost cycle. Observe the defrost cycle to see if all controls are functioning properly and that the coil is clear of all frost before the system returns to refrigeration. Adjust the time clock pins if necessary. Reset the defrost timer to the correct time of day. A defrost cycle is only needed when the frost build up is such that it impedes the airflow through the coil. The defrost requirements will vary on each installation and may change depending on the time of the year and other conditions.

9 PREVENTATIVE MAINTENANCE

A preventive maintenance schedule should be established as soon as the MS Series unit is installed. The unit should be inspected periodically for proper operation and build up of frost and debris.

WARNING: All power supply to the unit must be shut off before opening any compartments, cleaning or performing maintenance.

9.1 *DRAIN PAN*

Inspect and clean the drain pan to insure free drainage of condensate. The drain pan should be cleaned regularly with warm water and soap.

If the drain pan needs to be removed, support the long dimension of the pan from underneath, so the outer sheet metal skin does not buckle and become damaged. **Do not point load the center of the support beam.** For

longer pans more than one lifting device may be needed to keep the pan balanced when lifting. If the drain pan uses hot gas defrost make sure the coil is completely pumped out and isolated with hand valves to prevent refrigerant from escaping to the atmosphere. Remove electric wires if the unit has an electric defrost drain pan. Remove the drain line so that it is out of the way of the pan when it is being lowered. Remove the drain pan attachment bolts from the bottom of the evaporator unit and slowly lower the pan from the unit. Assemble pan in reverse order.

9.2 *COIL AND CABINET*

Clean the coil, fan cabinet, fans, and fan guards with warm water and soap. A low-pressure water hose is recommended to avoid water entering into electrical components and causing equipment failure.

The evaporator coil should be checked once a month for proper defrosting. Many variables affect coil frosting such as room temperature, type of product being stored or processed, how often new product is brought in, and the length of time the door to the room remains open. Summer conditions of high humidity can cause heavier frost loads and it may be necessary to change the number of defrost cycles seasonally.

9.3 *FAN GUARD OR LONG THROW ADAPTER REPLACEMENT*

To remove a fan guard or long throw adapter for fan-motor maintenance, or for guard or adapter replacement, make sure all electrical power to the unit has been turned off before any work is performed. Remove the two nuts on the lowest part of the guard or adapter first. While supporting the guard or adapter to the unit remove the top two nuts. Remove the guard or adapter. Reassemble in the reverse order.

9.4 *FAN REPLACEMENT*

If a fan is out of balance, damaged, or needs to be replaced, the unit does not need to be at floor level for maintenance. Make sure all electrical power to the unit has been turned off before any work is performed. Remove the fan guard as described in Section 10.3. Mark the location of the fan on the motor shaft. Loosen the fan hub set screws that hold the fan onto the motor shaft. Remove the fan. Clean and deburr the motor shaft if necessary.

Place the new fan onto the motor shaft, tighten fan hub set screws. Reattach the fan guard.

9.5 *UNIT MOTOR REPLACEMENT*

Make sure all electrical power to the unit has been turned off before any work is performed. The motor weight about 30 lbs so caution when lifting is required. Remove the fan guard and fan as described in Sections 10.3 and 10.4. Remove the motor electrical cover and disconnect the motor leads and wire conduit from the motor.

Mark the belly band location on the motor, then loosen the belly band bolts holding the motor. Remove motor. Transfer mark from old motor to new motor and reassemble in to the belly band.

Connect the wires to the motor following the wiring schematic for the motor. Make certain the motor is wired for the correct supply voltage. Replace the motor electrical cover. Attach fan and guard as described in section 10.3 and 10.4.

When starting the motor make sure the fan is rotating in the proper counter clockwise direction. If the fan rotates clockwise, stop the motor, shut off all power to the unit, and change the motor wiring for counter clockwise rotation.

9.6 *ELECTRIC DEFROST HEATERS*

Electric defrost heater replacement on face of coil.

Make sure all electrical power to the unit is off and locked out before performing any work.

Open the hinged access door on each end of the MS unit. Disconnect the heater wiring at the each end of the unit. Using pliers remove heater retaining clips on the face of the coil for the heater being replaced. Pull the heater out from the end of the unit with the bent end of the heater. Move identification tag from old to new heater. Install new heater in the same location as the old heater, straight end first. Install retainer clips then attach wires to terminal blocks. Run defrost cycle to make sure heaters work.

Electric defrost heater replacement on bottom of coil.

Disconnect drain pan line then open the hinged doors on the end of the unit. Lower the drain pan. Follow the same procedure as the coil face heaters.

Electric defrost drain pan heater replacement.

Disconnect drain line then open the hinged doors on the ends of the unit. Lower the drain pan. Disconnect heater wiring on both ends. Remove each retainer bracket individually starting on one end. Slightly lift the heater to be replaced and replace the retainer bracket to hold the other heaters in place. Do the same procedure along the length of the pan. Install new heater in reverse order.

10 TROUBLESHOOTING CHART

Table 8 TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Fans will not operate.	Unit not wired properly. Defective motor. Defective defrost timer, termination thermostat or fan delay switch. Room temperature too high for use of fan delay switch.	Check wiring. Replace motor. Replace defective component. Jumper fan delay switch. Terminals F to B.
Ice forming on ceiling. Steaming during defrost.	Too many defrosts per day. Defective termination Thermostat or defrost timer.	Observe frost build up on coil, change to fewer defrost per day. Replace defective component.
Excessive buildup of frost on coil.	Too few defrost times. Defrost cycle too short. Too high humidity in cooler.	Add more defrost cycles to timer. Extend defrost time on timer. Limit access to cooler, do not prop doors open during stocking.
Accumulation of ice in drain pan.	Drain line plugged. Defective heater.	Clean drain line. Make sure drain line is insulated properly. Replace heater.

11 REPLACEMENT PARTS LIST

Listed below are the major replacement parts. When ordering parts it is imperative that you obtain the complete model and serial number of the unit.

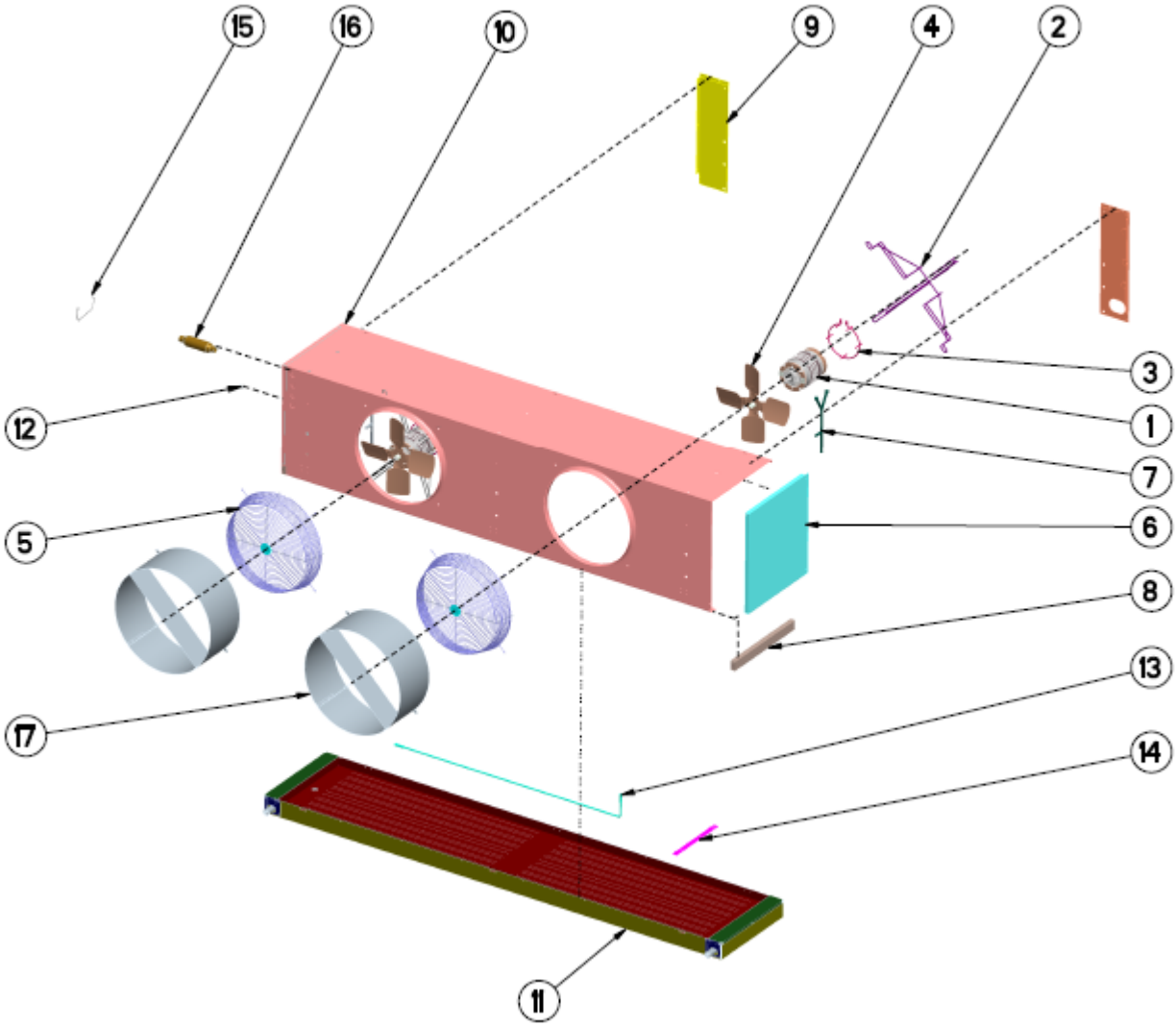


Table 9 REPLACEMENT PARTS LIST

Item	General Description	Options Description	Krack BOM Part Number	Hussmann Aftermarket Part Number
1	MOTOR	1/2HP 208/230/460/50/60/3/11440	11096	MO.4410170
		1/2HP 575/60/3/1140	11506	MO.4410173
		1/2 HP 115/208/230/50/60/1/1075	E316796	MO.4410723
2	MOTOR MOUNT		BF0302000	TP.4967700
3	MOTOR RING	1 PH MTR 48 FRAME	B1135300	TP.4914983
		3 PH MTR 56 FRAME	80034	BR.4910148
4	FAN BLADE	20" 17 DEG CW 5/8"BORE	BF0102800	FB.4780659
5	FAN GUARD		BF0202200	FG.4914788
6	ACCESS DOOR	ALUM	1112700	DO.4994622
		GALV	1112700G	DO.4994623
7	WIRE HARNESS	1 FAN	80576	EP.4441235
		2 FAN	80577	EP.4441234
		3 FAN	80579	EP.4482886
		4 FAN	80581	EP.4482887
8	ACCESS DOOR PART	1-4 FAN	E270054	DO.4994624
9	CORNER PANEL	1-4 FAN ALUM BACK SIDE LEFT	E270033	TP.4994637
		1-4 FAN ALUM BACK SIDE RIGHT	E270032	TP.4994638
		1-4 FAN GALV BACK SIDE LEFT	E270033G	TP.4994639
		1-4 FAN GALV BACK SIDE RIGHT	E270032G	TP.4994640
10	FRONT AND TOP PANEL	1 FAN ALUM FRONT AND TOP PANEL	E270112	TP.4994647
		2 FAN ALUM FRONT & TOP PANEL	E270023	TP.4994648
		3 FAN ALUM FRONT & TOP PANEL	E270073	TP.4994649
		4 FAN ALUM FRONT PANEL	E270076	TP.4994650
		4 FAN ALUM FRONT PANEL PART B	E270077	TP.4994651
		4 FAN ALUM TOP PART A	E270074	TP.4994652
		4 FAN ALUM TOP PART B	E270075	TP.4994653
		1 FAN GALV FRONT AND TOP PANEL	E270112G	TP.4994654
		2 FAN GALV FRONT & TOP PANEL	E270023G	TP.4994655
		3 FAN GALV FRONT & TOP PANEL	E270073G	TP.4994656
		4 FAN GALV FRONT PANEL	E270076G	TP.4994657
		4 FAN GALV FRONT PANEL PART B	E270077G	TP.4994658
		4 FAN GALV TOP PART A	E270074G	TP.4994659
		4 FAN GALV TOP PART B	E270075G	TP.4994660
11	DRAIN PAN	2 FAN ALUM NON-INSULATED	CE270024	DP.4918685
		3 FAN ALUM NON-INSULATED	CE270025	DP.4918686
		4 FAN ALUM NON-INSULATED	CE270026	DP.4918687
		2 FAN GALV NON-INSULATED	CE270024G	DP.4918688
		3 FAN GALV NON-INSULATED	CE270025G	DP.4918689
		4 FAN GALV NON-INSULATED	CE270026G	DP.4918690
		2 FAN ALUM INSULATED	CE270009	DP.4918691
		3 FAN ALUM INSULATED	CE270012	DP.4918692
		4 FAN ALUM INSULATED	CE270015	DP.4918693
		2 FAN GALV INSULATED	CE270009G	DP.4915601
		3 FAN GALV INSULATED	CE270012G	DP.4915182
		4 FAN GALV INSULATED	CE270015G	DP.4918694
		1 FAN ALUM 575/3 V	CE270113	DP.4918695
		2 FAN ALUM 230/3 V	CE270000	EV.4671349
		2 FAN ALUM 460/3 V	CE270046	DP.4918696
		2 FAN ALUM 575/3 V	CE270047	DP.4918697
		3 FAN ALUM 230/3 V	CE270003	DP.4918707
		3 FAN ALUM 460/3 V	CE270049	DP.4918698

		3 FAN AMUM 575/3 V	CE270050	DP.4918699
		4 FAN ALUM 230/3 V	CE270006	DP.4918700
		4 FAN ALUM 460/3 V	CE270052	DP.4918701
		4 FAM ALUM 575/3 V	CE270053	DP.4918702
		1 FAN GALV 575/3 V	CE270113G	DP.4918703
		2 FAN GALV 230/3 V	CE270000G	DP.4918704
		2 FAN GALV 460/3 V	CE270046G	DP.4918705
		2 FAN GALV 575/3 V	CE270047G	DP.4918706
		3 FAN GALV 230/3 V	CE270003G	DP.4918707
		3 FAN GALV 460/3 V	CE270049G	DP.4915069
		3 FAN GALV 575/3 V	CE270050G	DP.4918708
		4 FAN GALV 230/3 V	CE270006G	DP.4918709
		4 FAN GALV 460/3 V	CE270052G	DP.4915070
		4 FAM GALV 575/3 V	CE270053G	DP.4918710
12	THERMOSTATS	DEFROST TERM (14T32)	E206100	CT.4480288
		HEATER SAFETY (14T21)	10956	CT.4480289
		FAN DELAY (14T31)	E201818	CT.4480287
		KP-73	E205004	CT.4480147
13	COIL/PAN HEATERS	1 FAN 230V	BR01091	HE.4850804
		1 FAN 460V	BR01110	HE.4851162
		1 FAN 575V	BR01090	HE.4850803
		2 FAN 230V	BR01095	HE.4850759
		2 FAN 460V	BR01112	HE.4850810
		2 FAN 575V	BR01094	HE.4850758
		3 FAN 230V	BR01097	HE.4850761
		3 FAN 460V	BR01113	HE.4850811
		3 FAN 575V	BR01096	HE.4850760
		4 FAN 230V	BR01101	HE.4850809
		4 FAN 460V	BR01115	HE.4850812
		4 FAN 575V	BR01100	HE.4850762
14	DRAIN PAN HEATER BRACKET		E269334	BR.4915180
15	SUPPORT BRACKET	FACE	66317	HH.4914775
		BOTTOM	66318	HH.4914776
16	CHECK VALVE	1/2”	11852	VR.4612280
		5/8”	11853	VR.4612281
		7/8”	10930	VR.4613706
17	AIR BOOSTER		CE207243	TP.4967699