

Maintenance Manual



CSR *Power Saver* and CSR *Power Saver Plus* Hermetic Systems

TK 50825-4-MM (Rev. 3/00)

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Recover Refrigerant

At Thermo King we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

In addition, service personnel must be aware of Federal regulations concerning the use of refrigerants and the certification of technicians. For additional information on regulations and technician certification programs, contact your local THERMO KING dealer.

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Introduction

About This Manual

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. This manual includes maintenance and diagnosis information for both standard and optional unit features. Some optional features may not apply to your unit. The maintenance information in this manual covers unit models:

CSR PS Hermetic Models	System Number
CSR40SL-148 Power Saver	917148

Other Reference Manuals

For detailed descriptions of our refrigeration systems or micro-processor controllers, see the appropriate manual. For further information refer to:

Parts Manuals

CSR40SL-148 PS Parts List	TK 50896
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Operation, Diagnosis and Refrigeration Maintenance Manuals

Diagnosing Thermo King Container Refrigeration Systems	TK 41166
Electrostatic Discharge (ESD) Training Guide	TK 40282
Evacuation Station Operation and Field Application	TK 40612
Tool Catalog	TK 5955

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Safety Precautions

General Practices

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid and battery acid can permanently damage the eyes (see First Aid under Refrigerant Oil).
2. Never close the compressor discharge valve with the unit in operation. Never operate the unit with the discharge valve closed.
3. Keep your hands, clothing and tools clear of the fans when the refrigeration unit is running. If it is necessary to run the refrigeration unit with covers removed, be very careful with tools or meters being used in the area.
4. Be sure the gauge manifold hoses are in good condition. Never let them come in contact with a fan motor blade or any hot surface.
5. Never apply heat to a sealed refrigeration system or container.
6. Fluorocarbon refrigerants, in the presence of an open flame or electrical arc, produce toxic gases that are severe respiratory irritants capable of causing death.
7. Be sure all mounting bolts are tight and are the correct length for their particular application.
8. Use extreme caution when drilling holes in the unit. The holes may weaken structural components. Holes drilled into electrical wiring can cause fire or explosion. Holes drilled into the refrigeration system may release refrigerant.
9. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
10. Use caution when working with a refrigerant or refrigeration system in any closed or confined area with a limited air supply (for example, a trailer, container or in the hold of a ship). Refrigerant tends to displace air and can cause oxygen depletion, resulting in suffocation and possible death.
11. Use caution and follow the manufacturer's suggested practices when using ladders or scaffolds.

Refrigerant

When removing any refrigerant from a unit, use a recovery process that prevents or absolutely minimizes the refrigerant that can escape to the atmosphere. Although fluorocarbon refrigerants are classified as safe refrigerants when proper tools and procedures are used, certain precautions must be observed when handling them or servicing a unit in which they are used. When exposed to the atmosphere in the liquid state, fluorocarbon refrigerants evaporate rapidly, freezing anything they contact.

First Aid

In the event of frost bite, the objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly, and to maintain respiration.

- **EYES:** For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- **SKIN:** Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- **INHALATION:** Move victim to fresh air and use CPR or mouth-to-mouth ventilation, if necessary. Stay with victim until arrival of emergency medical personnel.

Refrigerant Oil

Observe the following precautions when working with or around refrigerant oil:

- Do not allow refrigerant oil to contact your eyes.
- Do not allow prolonged or repeated contact with skin or clothing.
- To prevent irritation, you should wash thoroughly immediately after handling refrigerant oil. Rubber gloves are recommended when handling Polyol Ester based refrigerant oil.

First Aid

- **EYES:** Immediately flush eyes with large amounts of water for at least 15 minutes while holding the eyelids open. Get prompt medical attention.
- **SKIN:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **INHALATION:** Move victim to fresh air and restore breathing if necessary. Stay with victim until arrival of emergency personnel.
- **INGESTION:** Do not induce vomiting. Contact a local poison control center or physician immediately.

Electrical

High Voltage

When servicing or repairing a refrigeration unit, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with a refrigeration unit that is connected to a source of operating power, even if the unit is not running. Lethal voltage potentials can exist at the unit power cord, inside the control box, inside any high voltage junction box, at the motors and within the wiring harnesses.

Precautions

1. Be certain the unit On/Off switch is turned OFF before connecting or disconnecting the unit power plug. Never attempt to stop the unit by disconnecting the power plug.
2. Be certain the unit power plug is clean and dry before connecting it to a power source.
3. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.

4. Do not make any rapid moves when working on high voltage circuits. If a tool or other object falls, do not attempt to grab it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
5. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
6. Never work alone on high voltage circuits on the refrigeration unit. Another person should always be standing by in the event of an accident to shut off the refrigeration unit and to aid a victim.
7. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

IMMEDIATE action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance if available.

The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or by a rescuer wearing electrically insulated gloves and safety glasses. Whichever method is used, do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim has to be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. **DO NOT TOUCH** the victim. You can receive a shock from current flowing through the victim's body.

After separating the victim from power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardio Pulmonary Resuscitation) and call for emergency medical assistance. If a pulse is present, respiration may be restored by using mouth-to-mouth resuscitation, but call for emergency medical assistance.

Low Voltage

Control circuits are low voltage (24 Vac and 12 Vdc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amperes) can cause severe burns if shorted to ground.

Do not wear jewelry, watch or rings. These items can short out electrical circuits and cause severe burns to the wearer.

General Safety Precautions for Servicing Units (or Containers) Equipped with a Microprocessor Controller

Precautions must be taken to prevent electrostatic discharge when servicing the MP-3000 microprocessor and related components. If these precautionary measures are not followed, the risk of significant damage to the electronic components of the unit is possible.

The primary risk potential results from the failure to wear adequate electrostatic discharge preventive equipment when handling and servicing the controller. The second cause results from electric welding on the unit and container chassis without taking precautionary steps.

Controller Repair

When servicing the controller, it is necessary to ensure that electrostatic discharges are avoided. Potential differences considerably lower than those which produce a small spark from a finger to a door knob can severely damage or destroy solid-state integrated circuit components. The following procedures must be rigidly adhered to when servicing these units to avoid controller damage or destruction.

1. Disconnect all power to the unit.
2. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
3. Do wear a static discharge wrist strap (TK P/N 204-622) with the lead end connected to the controller's ground terminal. These straps are available at most electronic equipment distributors. DO NOT wear these straps with power applied to the unit.
4. Avoid contacting the electronic components on the circuit boards of the unit being serviced.
5. Leave the circuit boards in their static proof packing materials until ready for installation.
6. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
7. After servicing the circuit board and any other circuits, the wiring should be checked for possible errors before restoring power.

Welding of Units or Containers

Whenever electric welding is to be performed on any portion of the refrigeration unit, container or container chassis with the refrigeration unit attached, it is necessary to ensure that welding currents are NOT allowed to flow through the electronic circuits of the unit. These procedures must be rigidly adhered to when servicing these units to avoid damage or destruction.

1. Disconnect all power to the refrigeration unit.
2. Disconnect all quick-disconnect wire harnesses from the back of the controller.
3. If the unit is equipped with an Remote Monitor Modem (RMM), disconnect all wire harnesses from the RMM.
4. Switch all of the electrical circuit breakers in the control box to the OFF position.
5. Weld unit and/or container per normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
6. When the welding operation is completed, the unit power cables, wiring and circuit breakers must be restored to their normal condition.

Unit Decals

Serial number decals, refrigerant type decals and warning decals appear on all Thermo King equipment. These decals provide information that may be needed to service or repair the unit. Service technicians should read and follow the instructions on all warning decals.

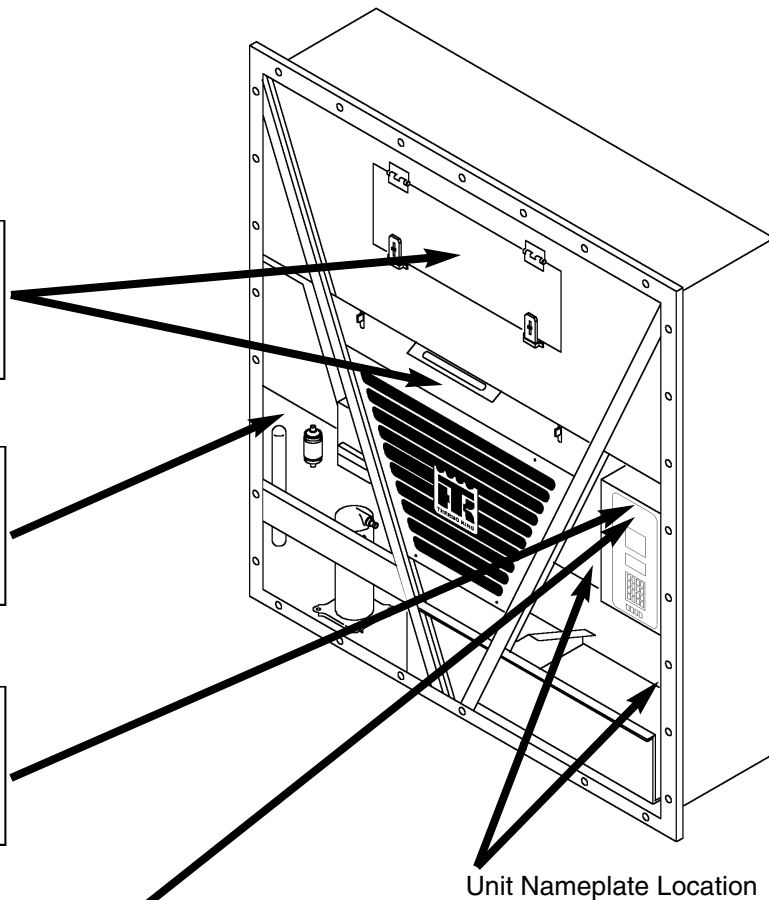
Serial Number Locations

Electric Motors: Nameplate attached to the motor housing.

Compressor: Nameplate on front of the compressor.

Unit: Nameplate on unit frame in power cord storage compartment.

MP-3000 Controller: Nameplate on back of controller.



Service Guide

Pretrip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Refrigeration
•			Perform a controller Full Pretrip Test to check the refrigeration and electrical systems.
	•	•	Perform a controller Extended Pretrip Test.
			Electrical
•	•	•	Visually inspect condenser fan and evaporator fan rotation.
•	•	•	Visually inspect electrical contacts for damage or loose connections.
•	•	•	Visually inspect wire harnesses for damaged wires or connections.
	•	•	Download the data logger and check data for correct logging.
		•	Check operation of protection shutdown circuits.
			Structural
•	•	•	Visually inspect unit for damaged, loose or broken parts.
•	•	•	Tighten unit, compressor and fan motor mounting bolts.
	•	•	Clean entire unit including condenser and evaporator coils and defrost drains.
			Humidify System (Option)
•			Check water level in water tank.
•	•	•	Check humidify system operation.
	•	•	Clean water supply filter on water tank.

System Net Cooling Capacity — Full Cool
CSR20 PS Models — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW @460V	Watts	Kcal/hr	BTU/hr	kW @380V
21.1 C (70 F)	12,510	10,760	42,695	9.6	10,010	8,610	34,160	7.5
1.7 C (35 F)	8,010	6,890	27,340	8.5	6,410	5,515	21,875	6.9
-17.8 C (0 F)	4,435	3,815	15,135	5.2	3,550	3,055	12,115	4.2
-28.9 C (-20 F)	2,810	2,415	9,590	4.6	2,250	1,935	7,680	3.7

*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-404A.

CSR40SL PS Models — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW @460V	Watts	Kcal/hr	BTU/hr	kW @380V
21.1 C (70 F)	12,660	10,890	43,200	9.8	10,130	8,715	34,575	7.6
1.7 C (35 F)	9,100	7,825	31,050	8.9	7,280	6,260	24,845	6.9
-17.8 C (0 F)	5,300	4,555	18,075	6.1	4,240	3,645	14,470	4.9
-28.9 C (-20 F)	3,470	2,980	11,830	5.8	2,775	2,385	9,470	4.1

*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-404A.

CSR40 PS Models — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW @460V	Watts	Kcal/hr	BTU/hr	kW @380V
21.1 C (70 F)	13,660	11,750	46,620	9.7	10,930	9,400	37,300	7.6
1.7 C (35 F)	10,090	8,680	34,440	8.9	8,070	6,940	27,545	6.9
-17.8 C (0 F)	5,945	5,115	20,290	6.0	4,755	4,090	16,230	5.4
-28.9 C (-20 F)	4,000	3,440	13,650	5.6	3,200	2,750	10,920	4.1

*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-404A.

System Net Heating Capacity*

Heater Type	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
	Heating Capacity			Heating Capacity		
	Watts	Kcal/hr	BTU/hr	Watts	Kcal/hr	BTU/hr
CSR20 PS	5,880	5,060	20,070	4,900	4,215	16,720
CSR40SL PS	5,880	5,060	20,070	4,900	4,215	16,720
CSR40 PS	5,800	4,990	19,800	4,200	3,610	14,335

*System net heating capacity includes electric resistance rods and fan heat.

Evaporator Airflow**CSR20 PS Models**

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min
0 mm (0 in.)	4,000	2,350	2,000	1,180	3,300	1,940	1,650	970
10 mm (0.4 in.)	3,500	2,060	1,450	850	2,600	1,530	900	530
20 mm (0.8 in.)	2,900	1,710	—	—	1,800	1,060	—	—
30 mm (1.2 in.)	2,200	1,300	—	—	1,100	650	—	—
40 mm (1.6 in.)	1,400	820	—	—	—	—	—	—

CSR40SL PS Models

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min
0 mm (0 in.)	5,820	3,430	2,800	1,650	4,860	2,860	2,590	1,525
10 mm (0.4 in.)	5,055	2,975	1,400	825	3,940	2,320	510	300
20 mm (0.8 in.)	4,365	2,570	—	—	3,040	1,790	—	—
30 mm (1.2 in.)	3,440	2,025	—	—	2,140	1,260	—	—
40 mm (1.6 in.)	2,615	1,540	—	—	—	—	—	—

CSR40 PS Models

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min
0 mm (0 in.)	6,560	3,860	3,170	1,865	5,480	3,225	2,710	1,595
10 mm (0.4 in.)	5,820	3,425	1,770	1,040	4,530	2,665	930	545
20 mm (0.8 in.)	5,000	2,940	—	—	3,750	2,205	—	—
30 mm (1.2 in.)	4,430	2,610	—	—	2,930	1,725	—	—
40 mm (1.6 in.)	3,520	2,070	—	—	1,870	1,100	—	—

Electrical System

Compressor Motor:	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	4.48 kW @ 460V, 60 Hz
	Horsepower	6.0 hp @ 460V, 60 Hz
	RPM	3550 rpm @ 460V, 60 Hz
	Locked Rotor Amps	70 amps @ 460V, 60 Hz
Condenser Fan Motor:	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	0.37 kW @ 460V, 60 Hz
	Horsepower	0.50 hp @ 460V, 60 Hz
	RPM	1145 rpm @ 460V, 60 Hz
	Full Load Amps	0.9 amps @ 460V, 60 Hz; 1.0 amps @ 380V, 50 Hz
	Locked Rotor Amps	4.0 amps @ 460V, 60 Hz; 4.0 amps @ 380V, 50 Hz
Evaporator Fan Motors:	Type	460/380V, 60/50 Hz, 3 Phase
	Number: CSR20 PS	3
	CSR40SL PS	3
	CSR40 PS	2
	Kilowatts	0.75 kW @ 460V, 60 Hz
	Horsepower	1.0 hp @ 460V, 60 Hz
	RPM (Each): High Speed	3450 rpm @ 460V, 60 Hz
	Low Speed	1725 rpm @ 460V, 60 Hz
	Full Load Amps (Each): High Speed	1.2 amps @ 460V, 60 Hz
	Low Speed	0.5 amps @ 460V, 60 Hz
	Locked Rotor Amps: High Speed	10.3 amps @ 460V, 60 Hz
	Low Speed	2.9 amps @ 460V, 60 Hz
Electric Resistance Heater Rods:	Type	460/380V, 60/50 Hz, 3 Phase
	Number	6
	Watts (Each)	680 Watts @ 460V, 60 Hz
	Current Draw (Amps)	5 amps total @ 460V across each phase at heater contactor
Control Circuit Voltage:		29 Vac @ 60 Hz 24 Vac @ 50 Hz
Evaporator Overheat Switch:	Opens	54 +/- 3 C (130 +/- 5 F)
	Closes	38 +/- 4.5 C (100 +/- 8 F)

Refrigeration System

Compressor Model No.:		ZM18K4E-TFD-279, Hermetic Scroll
Refrigerant Charge:	CSR40SL PS	3.6 Kg (8.0 lb) R-404A
Compressor Oil Capacity		1.77 liter (60 oz.)*
Compressor Oil Type		Polyol Ester Based Type (required), TK Part No. 203-433**
High Pressure Cutout Switch:	Cutout Cutin	3243 +/- 48 kPa, 32.43 +/- 0.48 bar, 470 +/- 7 psig 2588 +/- 262 kPa, 25.88 +/- 2.62 bar, 375 +/- 38 psig
Low Pressure Cutout Switch:	Cutout Cutin	+21 to -20 kPa, +0.21 to -0.20 bar, 3 psig to 6" Hg vacuum 48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig
High Pressure Relief Valve:	Relief Pressure Reset	3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig 2758 kPa, 27.58 bar, 400 psig
Liquid Injection Control:	Compressor Start Power Limit or Modulation Cool Compressor Discharge Temperature Control	Liquid injection valve opens for 5 minutes on each compressor start Liquid injection valve opens continuously during Power Limit and Modulation Cool modes Energizes (Opens) Liquid Injection Valve at 138 C (280 F) De-energizes (Closes) Liquid Injection Valve at 132 C (270 F) Compressor Shutdown (Auto Reset) at 148 C (298 F)
Liquid Injection Valve (Compressor):	Voltage Current Cold Resistance	24 Vac 0.85 amps 5.6 ohms
Warm Gas Bypass Solenoid Valve:	Voltage Current Cold Resistance	24 Vac 0.85 amps 5.6 ohms
Stepper Valve Regulating Motor:	Voltage Current Draw Resistance	12 Vdc 0.13 to 0.21 amperes per winding 0.26 to 0.44 amperes with 2 windings energized 75 +/- 7.5 ohms across each winding at 24 C (75 F) ambient

*When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be maintained in the replacement compressor.

**DO NOT use or add standard synthetic or mineral oils to the refrigeration system. If Ester based oil becomes contaminated with moisture or with standard oils, dispose of properly — DO NOT USE!

MP-3000 Controller

Temperature Controller:	Type	MP-3000 microprocessor with thermostat, digital thermometer, programming keypad, mode indicators, LED display and LCD display for displaying unit operating and cargo information
Setpoint Range		-29.0 to +29.0 C (-20.2 to +84.2 F)
Digital Temperature Display		-60.0 to +80.0 C (-76.0 to +176.0 F)
Controller Software (Original Equipment):	Version	See controller identification decal
Defrost Initiation	Evaporator Coil Sensor	<ul style="list-style-type: none"> - Manual Switch or Demand Defrost Initiation: Coil must be below 18 C (65 F). Defrost cycle starts when technician or controller request defrost initiation. - Timed Defrost Initiation: Coil must be below 10 C (50 F). Defrost cycle starts 1 minute after the hour immediately following a defrost timer request for defrost initiation. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. Datalogger will record a Defrost event for each interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs).
	Demand Defrost	<p>Demand defrost function initiates defrost when:</p> <ul style="list-style-type: none"> - Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large - Temperature difference between the left hand and right hand supply air sensors is too large and unit has operated for more than 90 minutes since last defrost - Temperature difference between the supply air sensors and return air sensor is too large
	Defrost Timer: Chilled mode	<ul style="list-style-type: none"> - Supply Temperature at 5.1 C (41.2 F) or Above: Every 8 hours of compressor operation. - Supply Temperature at 5.0 C (41.0 F) or Below: Every 2.5 hours of compressor operation. Defrost interval increases 0.5 hours each timed defrost interval. Defrost synchronization creates step intervals of 3, 4, 4, 5, 5, 6, 6 and 7 hours. Maximum time interval in chilled mode is 7 hours.
	Defrost Timer: Frozen mode	Every 8 hours of compressor operation. Defrost interval increases 2 hours each timed defrost interval. Maximum time interval in frozen mode is 24 hours.
	Defrost Timer Reset	Defrost timer resets if the unit is Off more than 12 hours, setpoint is changed more than 5 C (9 F) or PTI Pretrip test occurs.

MP-3000 Controller (Continued)

Defrost Termination:	Defrost (Coil) Sensor	Chilled mode: Terminates defrost when coil sensor temperature rises to 30 C (86 F); or exceeds 18 C (65 F) for 15 minutes
	Termination Timer	Frozen mode: Terminates defrost when coil sensor temperature rises to 18 C (65 F); or exceeds 8 C (46 F) for 15 minutes
	Power Off	Terminates defrost after 90 minutes at 60 HZ operation if coil sensor has not terminated defrost (120 minutes at 50 Hz operation)
Compressor Shutdown Protection (Auto Reset):		Turning unit On/Off switch OFF terminates defrost
	Stops Compressor	130 C (266 F)
	Allows Compressor Start	90 C (194 F)

Dehumidify and Humidify Systems (Options)

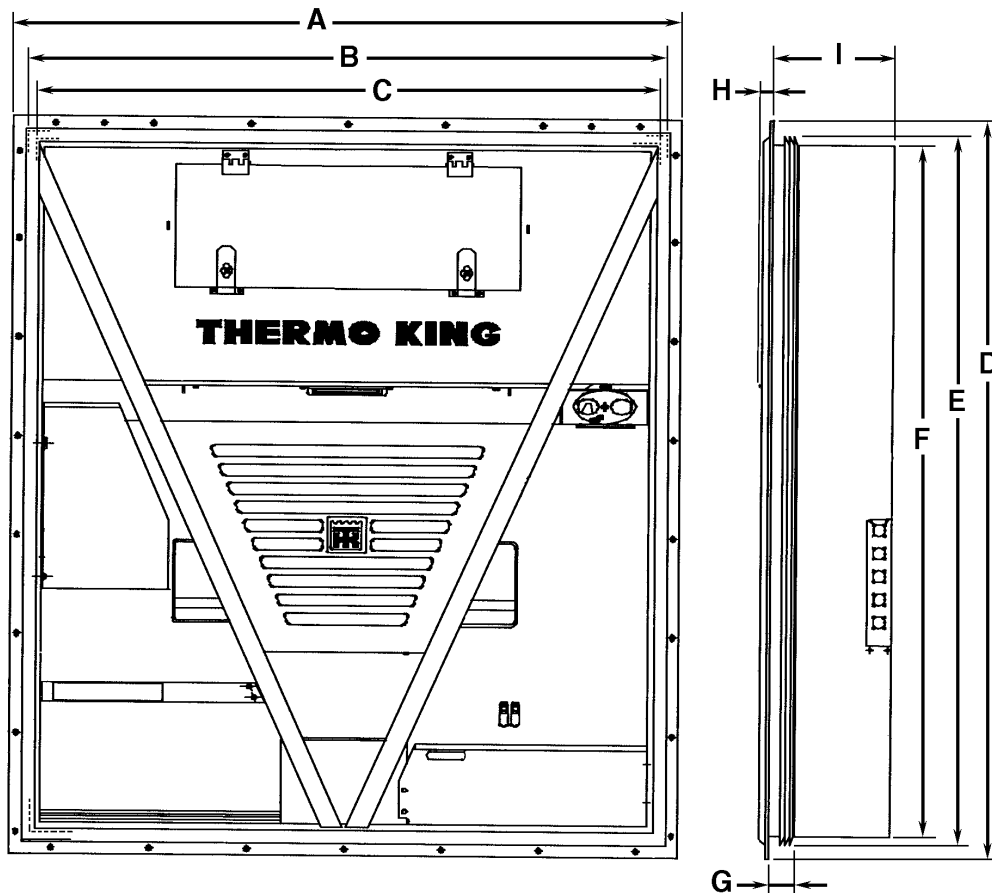
Dehumidify System (Option):	Turn Mode ON and OFF	Set from CONTROL line of the Setpoint menu of the controller
	Control Range (HUMSP) Setting	50% to 99% Relative Humidity
Humidify System (Option):	Turn Mode ON and OFF	Set from CONTROL line of the Setpoint menu of the controller
	Operating Temperature Range	0 to 60 C (32 to 140 F)
	Control Range (HUMSP) Setting	50% to 99% Relative Humidity
	Air Compressor Output	2.5 m ³ /hr @ 0 kPa (1.5 CFM @ 0 psig)
	Humidity Tank Heater:	240-600 Vac; 55 to 70 Watts at -17.8 C (0 F) Water Temperature
Humidity Sensor:	Accuracy:	+/- 1.5% between 55% and 75% Relative Humidity
		+/- 3.0% between 75% and 95% Relative Humidity
	Output Range:	4 to 20 milliamps
		1% Relative Humidity = 0.2 milliamp

Physical Specifications

<p>Fresh Air Exchange Venting System (Adjustable):</p> <p>CSR20 PS</p> <p>CSR40SL PS and CSR40 PS</p>	<p>0 to 160 m³/hr (0 to 94 ft³/min.) @ 60 Hz</p> <p>0 to 134 m³/hr (0 to 79 ft³/min.) @ 50 Hz</p> <p>0 to 285 m³/hr (0 to 168 ft³/min.) @ 60 Hz</p> <p>0 to 236 m³/hr (0 to 139 ft³/min.) @ 50 Hz</p>
<p>Evaporator Fan Blade Specifications:</p> <p>CSR20 PS: Diameter</p> <p>Pitch</p> <p>Number</p> <p>CSR40SL PS: Diameter</p> <p>Pitch</p> <p>Number</p> <p>CSR40 PS: Diameter</p> <p>Pitch</p> <p>Number</p>	<p>280 mm (11.02 in.)</p> <p>19°</p> <p>3</p> <p>312 mm (12.25 in.)</p> <p>25°</p> <p>3</p> <p>355 mm (14.0 in.)</p> <p>25°</p> <p>2</p>
<p>Weight (net):</p> <p>CSR20 PS Base Unit</p> <p>CSR40SL PS Base Unit</p> <p>CSR40 PS Base Unit</p> <p>Full TRANSFRESH® Option</p>	<p>392 Kg (865 lb)</p> <p>402 Kg (885 lb)</p> <p>413 Kg (910 lb)</p> <p>13 Kg (28 lb)</p>

Physical Specifications (Continued)

Unit Dimensions:	A = Flange Width	2025.5 mm (79.74 in.)
	B = Gasket Width	1935 mm (76.18 in.)
	C = Unit Width	1894 mm (74.57 in.)
	D = Flange Height	2235.2 mm (88.00 in.)
	E = Gasket Height	2140 mm (84.25 in.)
	F = Unit Height	2094 mm (82.44 in.)
	G = Gasket Depth	72 mm (2.83 in.) from back of flange
	H = Maximum Protrusion	37 mm (1.46 in.) from back of flange
	I = Unit Depth: CSR20 PS	335.0 mm (13.18 in.) from back of flange
	CSR40SL PS	378.0 mm (14.88 in.) from back of flange
	CSR40 PS	420.0 mm (16.54 in.) from back of flange



Metric Hardware Torque Charts

Bolt Type and Class*	Bolt Size			
	M6	M8	M10	M12
	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)
HH – CL 5.8	6-9 (4-7)	12-16 (9-12)	27-34 (20-25)	48-61 (35-40)
HH – CL 8.8	10-13 (7-10)	20-27 (15-20)	41-47 (30-35)	75-88 (55-65)
HH – CL 10.9	14-17 (10-13)	27-34 (20-25)	54-68 (40-50)	102-122 (75-90)
HH – CL 12.9	17-21 (12-16)	41-47 (30-35)	68-81 (50-60)	122-149 (90-110)
HH – SS (2)	10-13 (7-10)	20-27 (15-20)	41-47 (30-35)	75-88 (55-65)

Bolt Type and Class*	Bolt Size			
	M14	M16	M18	M22
	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)
HH – CL 5.8	75-88 (55-65)	115-135 (85-100)	177-216 (130-160)	339-406 (250-300)
HH – CL 8.8	115-135 (85-100)	177-216 (130-160)	271-339 (200-250)	475-610 (350-450)
HH – CL 10.9	136-176 (100-130)	224-298 (180-220)	393-474 (290-350)	678- 813 (500-600)
HH – CL 12.9	177-216 (130-160)	285-352 (210-260)	448-542 (330-400)	881-1016 (650-750)
HH – SS (2)	115-135 (85-100)	177-216 (130-160)	271-339 (200-250)	475-610 (350-450)

*HH = Hex Head, CL = Class.

Unit Features

Model CSR20 PS, CSR40SL PS and CSR40 PS units are all-electric, single-piece, refrigeration units with bottom air supply. Each unit is designed to cool and heat containers for ship-board or overland transit. Each unit mounts in the front wall of the container. CSR20 PS and CSR40SL PS units feature a slimline frame (see “Physical Specifications” on page 1-8). Fork lift pockets are provided for installation and removal of the unit.

The frame and bulkhead panels are constructed of aluminum and are treated to resist corrosion. A hinged, removable evaporator compartment door provides easy service access. All operating components except the evaporator coil can be replaced from the front of the unit. A totally sealed, hermetic refrigeration system minimizes maintenance and service.

Each unit is equipped with an 18.3 m (60 ft) power cable for operation on 460-380V/3 Ph/60-50 Hz power. For operation on 460-380V/3 Ph/60-50 Hz power, plug the 460-380V power cable into the proper power supply. The unit power cable is stored below the control box in the condenser section.

Each unit is equipped with 460-380V/3 Ph/60-50 Hz electric motors. An automatic phase correction system provides the proper electrical phase sequence for condenser fan, evaporator fan and compressor operation.

Unit features include a hermetic scroll compressor with a liquid injection system; 2-speed evaporator fans; a fresh air exchange system; and a MP-3000 controller with integral data logger. For additional unit feature information, see “CSR PS Hermetic Model Features” on page vi of the Introduction.

Hermetic Scroll Compressor with Liquid Injection Cooling System

The refrigeration unit includes a hermetic scroll compressor (one stationary and one orbiting member) with ambient compensated internal overload and high temperature protectors, and a refrigerant injection system.

Dual Speed Evaporator Fans

CSR PS models are equipped with either 2 or 3 evaporator fans. All models feature 2-speed motors. The evaporator fans operate continuously to circulate air inside the container. The fans operate on high speed for perishable cargo at setpoints of -9.9 C (14.1 F) and above. At setpoints of -10 C (14 F) and below, the evaporator fans operate on low speed for frozen cargo.

NOTE: If Economy Mode is ON:

- **Fresh Loads: Evaporator fans operate on low speed when container temperature is in-range.**
- **Frozen Loads: Evaporator fans stop during the Null mode; controller operates fans on low speed for 5 minutes every 45 minutes.**

Fresh Air Exchange System

The fresh air exchange system removes harmful gases from containers carrying sensitive perishable commodities. The fresh air vent is located above the control box. The fresh air vent is adjustable to accommodate a variety of cargo and chilled load operating conditions. The fresh air vent should be tightly closed when carrying frozen cargo.

MP-3000 Controller

The MP-3000 controller incorporates refrigeration system component control, thermostat, digital thermometer, fault indication and data recording capabilities into one self-contained package.

The controller mounts in a weather tight, corrosion resistance enclosure. A large-character LED display (top) provides easy viewing of the control sensor temperature (return or supply air temperature). A 4-line, 20-character LCD display (bottom) display shows important data including the setpoint temperature, controller Main Menu tree and important unit operating data.

Sixteen general purpose keys are used to enter and scroll through the controller menu tree and message text; initiate Pretrip and Function tests; enter new setpoint temperature; and enter trip information. The keyboard supports both numerical and text input. Four special keys provide quick access to setpoint temperature change, manual defrost initiation, alternate return/supply air temperature display, and alternate temperature scale (C/F) display.

Status indicator LEDs in the controller display signal Compressor, Heat, Defrost, In-range, Alarm, Humidity, Supply Temperature display and Return Temperature display.

A datalogger incorporated in the MP-3000 controller records sensor temperatures as well as loss of power, alarms, unit operating modes, sensor failure, setpoint change and unit shutdown indications. All data recordings are stored in a RAM memory that is backed by battery.

Logging intervals are selectable from 1 minute and 1/2, 1, 2 or 4 hours. When a 1 hour logging interval is selected, the datalogger memory can store approximately 512 days of information. The logging of USDA sensors is fixed at 1 hour intervals to comply with USDA requirements.

The datalogger clock is factory set at UTC time. All data logs include the time and date; setpoint temperature; and supply, return, USDA1, USDA2 and USDA3 sensor temperatures. All temperature logs can be viewed from the controller's LCD message display.

A high speed serial communication port provides data retrieval using a DRU-II hand-held data retriever or laptop computer with SmartSponge software, or a REFCON power line remote monitoring system.

Unit Options

USDA Cold Treatment Temperature Recording

The datalogger includes provisions for the use of up to four USDA sensors. These sensors allow temperatures in various areas of the load to be monitored and recorded for United States Department of Agriculture use in monitoring Cold Treatment shipments.

Dehumidification Control System

A dehumidification system lowers the relative humidity in the container to the humidity setpoint. The control range setpoint is adjustable between 50% and 99%.

Humidification Control System

An optional humidification system increases the relative humidity in the container to the humidity setpoint. The control range setpoint is adjustable between 50% and 99%.

Dual Voltage

A dual voltage system includes a 15 KVA auto transformer and an 18.3 m (60 ft) power cable for operation on 230-190V/3 Ph/60-50 Hz power. The power cable is stored below the control box in the condenser section.

The 15 KVA auto transformer steps 230/190V power up to 460/380V. The auto transformer includes a 460-380V/3 Ph/60-50 Hz power receptacle.

For operation on 230/190V power, plug the 460-380V unit power cable into the receptacle on the auto transformer. Then plug the 230/190V power cable into a 230-190V power supply.

REFCON Remote Monitoring Modem (RMM)

A REFCON remote monitoring modem is provided to permit remote monitoring via the power cable. High speed transmission reads all controller information. Data can also be retrieved from the datalogger via high speed transmission.

TRANSFRESH® Atmosphere Control System Options

Several TRANSFRESH options are available to meet individual customer needs. The TRANSFRESH system provides a controlled atmosphere within the container. By controlling the container temperature and atmosphere, the respiration rate of fruit and vegetables can be lowered. This allows the product quality to be maintained for longer periods of time.

- **TRANSFRESH Ready:** Provisions for the future installation and use of a TRANSFRESH atmosphere control system are incorporated in the unit. TRANSFRESH compatible A2 (power/defrost) and A3 (communications) cables (without connectors) are factory installed.
- **Full TRANSFRESH Option:** TRANSFRESH system components are installed for use of a TRANSFRESH atmosphere control system. In addition to A2 and A3 cables (with connectors), the security frame, security enclosure with insulation block, TRANSFRESH supplied single purge port, air hose and scrubber cable (A5, with connectors) are factory installed. Purge port includes a removable plug for charging the container with a modified atmosphere.

Controlled Atmosphere Option

An optional port injection kit includes two charging ports and a pressure relief valve to provide a modified atmosphere within the container. By controlling the container temperature and atmosphere, the respiration rate of fruit and vegetables can be lowered. This allows the product quality to be maintained for longer periods of time.

Remote Monitoring Receptacle (4-Pin) Option

An optional 4-pin remote monitor connector provides 24 Vac signals for bridge lights that monitor Cool (Compressor On), Defrost and In-range conditions.

Recording Thermometer Options

Several models of temperature recorders are available for mounting on the unit. Each temperature recorder is designed to withstand widely varying environments including low and high ambient temperatures, salt water, humidity, fungus, industrial pollutants, dynamic loading, rain, sand and dust.

- The 31-day Saginomiya Recorder is electric motor driven by a dry cell type battery with a 1 year life expectancy.
- The 31-day Partlow Recorder is mechanically driven by a spring mechanism.

Operating Modes

NOTE: See MP-3000 Controller chapter for complete sequence of operation.

A sequence start of the required loads occurs during initial start-up of the unit and when a control mode shift requires the compressors to start. As the controller relays and unit loads energize, the controller LCD display shows the setpoint temperature. The controller LED display shows the controlling air sensor temperature. The controlling sensor is determined by the setpoint temperature:

Setpoint	Controlling Sensor
-9.9 C (14.1 F) and above	Supply Air Temperature
-10 C (14 F) and below	Return Air Temperature

The MP-3000 controller uses a proportional-integral derivative (PID) algorithm to provide accurate temperature control in direct response to load demand. Therefore it is difficult to predict which operating mode the unit should be in by comparing the setpoint to the return or supply air temperature. The unit operates in either the Fresh (Chill) or Frozen mode. Chill to Frozen mode transition point is -10 C (14 F).

Chill Loads: Controller Setpoint at -9.9 C (14.1 F) or Above

Temperature control by the controller is based on the supply air sensor temperature, the setpoint, the modulation temperature range and the pull-down rate. The evaporator fans operate in high speed (except during defrost).

- Cool with Modulation (down to setpoint)
- Null (compressor and condenser fan stops, evaporator fans operate)
- Heat (resistance heaters on, evaporator fans operate)
- Defrost (resistance heaters on, evaporator fans stop)

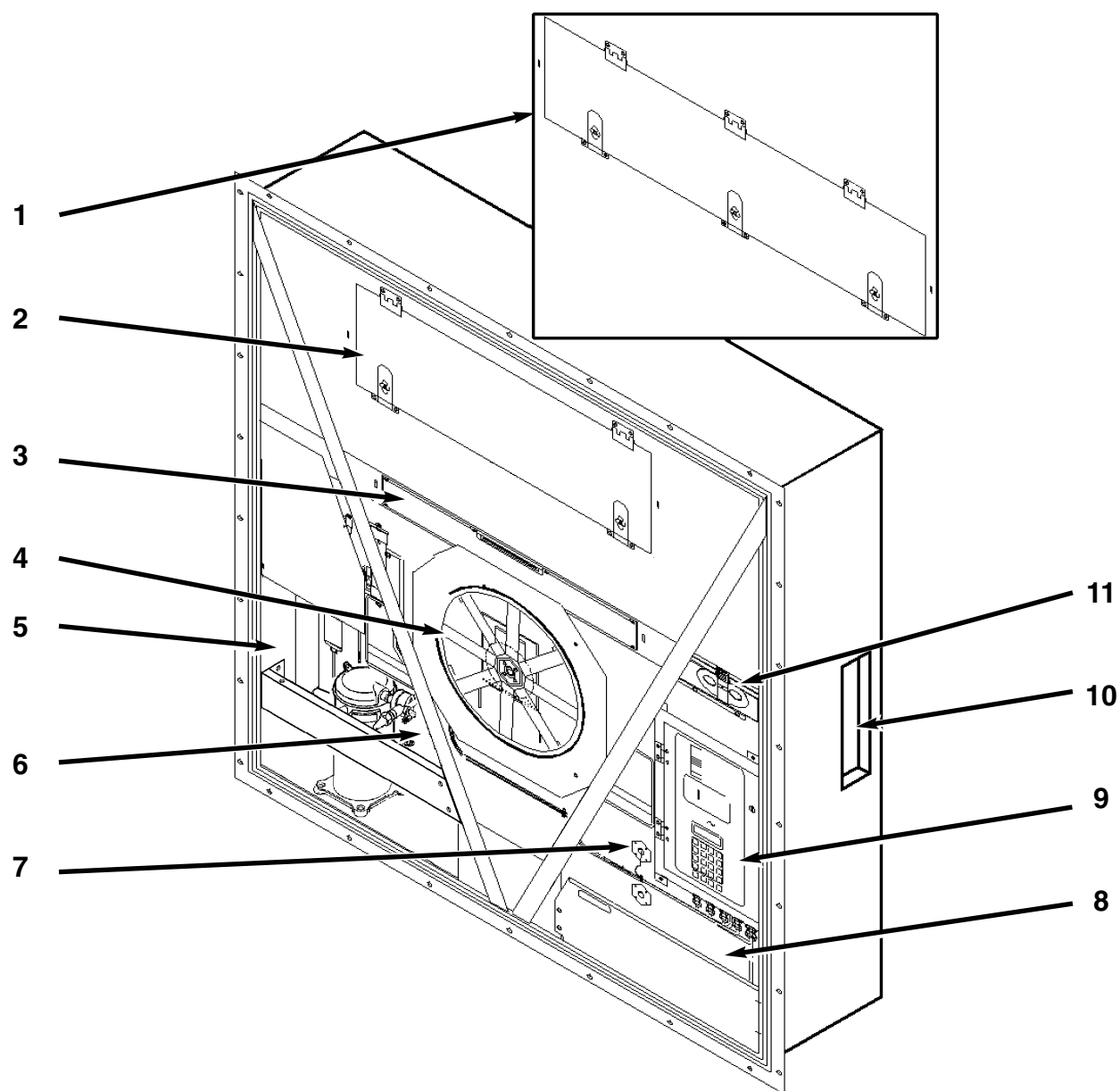
NOTE: If the Economy Mode is set to ON, the evaporator fans operate on low speed at setpoints of -9.9 C (14.1 F) and above whenever the container temperature is In-range.

Frozen Loads: Controller Setpoint at -10 C (14 F) or Below

Temperature control by the controller is based on the return air sensor temperature. The evaporator fans operate continuously on low speed (except during defrost).

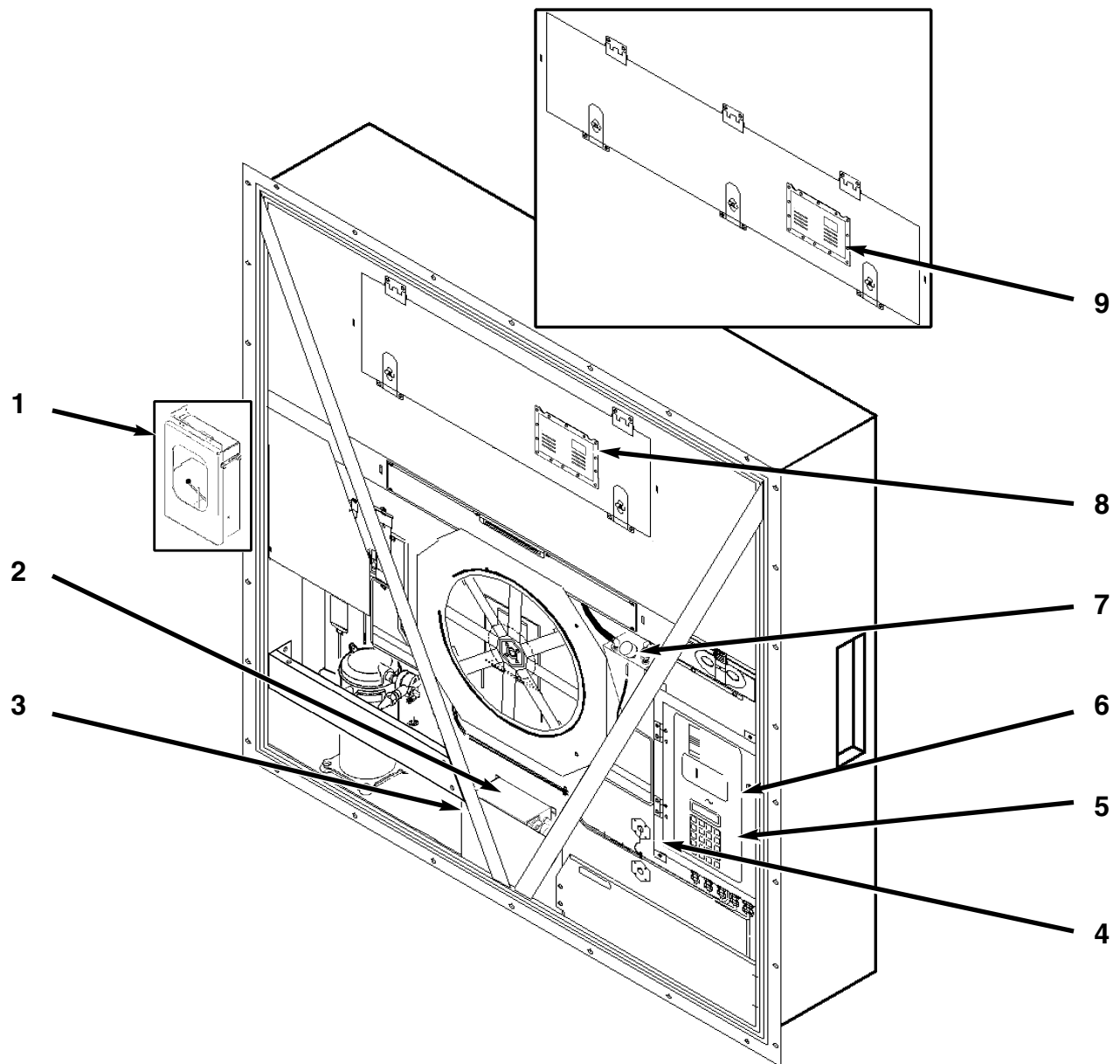
- Cool (down to 1 C [1.8 F] below setpoint)
- Null (compressor and condenser fan stops, evaporator fans operate)
- Defrost (resistance heaters on, evaporator fans stop)

NOTE: If the Economy Mode is set to ON, the evaporator fans stop when the unit shifts to Null. The controller automatically starts and operates the evaporator fans on low speed for 5 minutes every 45 minutes while the unit remains in Null.



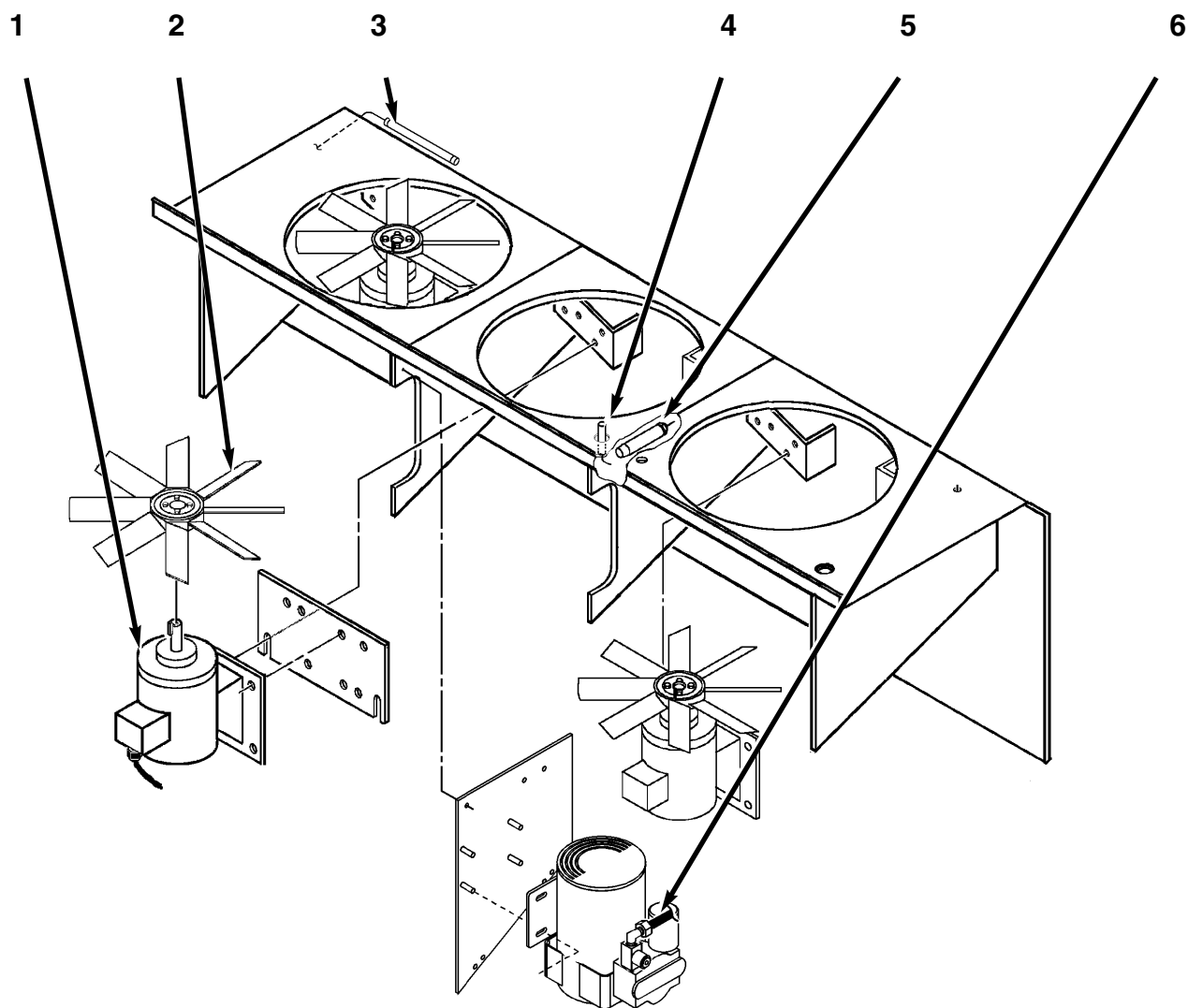
Typical Unit Front View

1. CSR20 PS and CSR40SL PS: Evaporator Access Door, 1399 mm (55.04 in.) Wide with Three Latches
2. CSR40 PS: Evaporator Access Door, 1018 mm (40.08 in.) Wide with Two Latches
3. Heater Access Panel Location
4. Condenser Fan
5. Compressor Compartment
6. Supply Air Sensor Probe Holder, Left Hand (Behind Compressor)
7. Supply Air Sensor Probe Holder, Right Hand
8. Power Cord Storage Compartment
9. Control Box
10. Rear Download and USDA Receptacle Panel (Access from Inside Container)
11. Fresh Air Exchange Vent

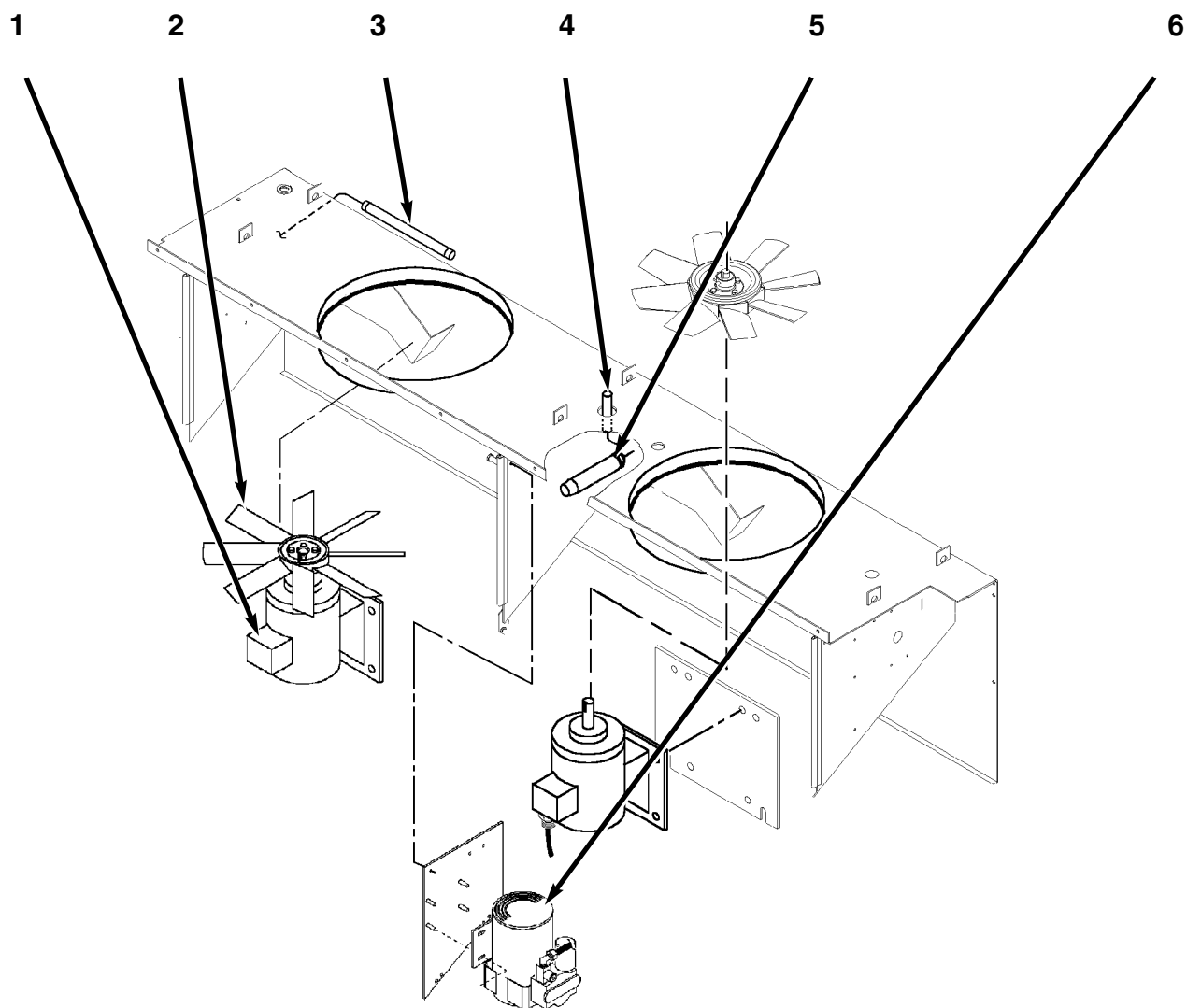


Unit Options Front View

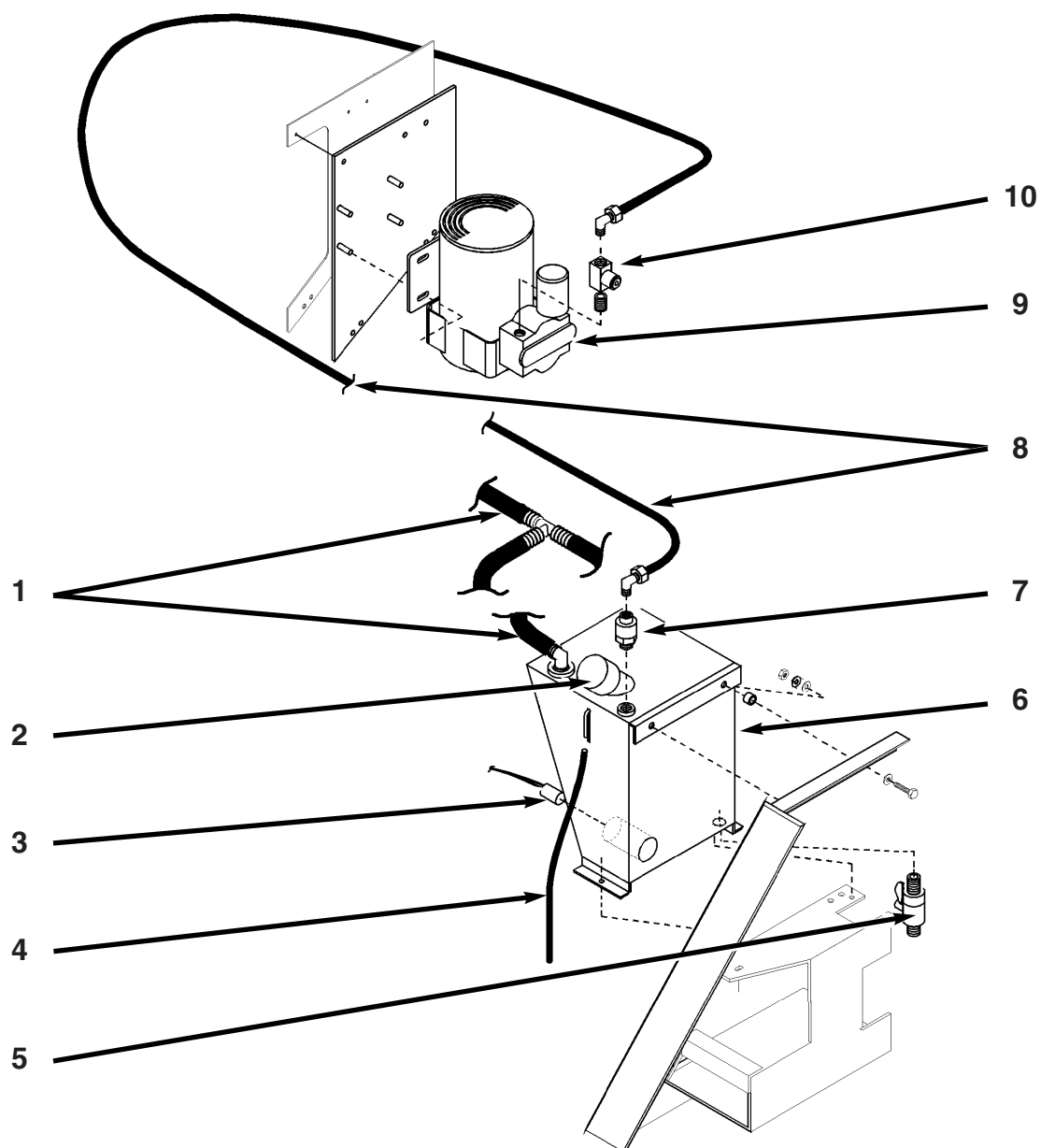
1. Recording Thermometer Option
2. Dual Voltage Option
3. TRANSFRESH Download Receptacle, Option
4. Remote Monitor Plug Option (4-Pin Connector on Bottom or Side of Control Box)
5. Thermistor Lead Option (Lead inside Control Box)
6. REFCON Remote Monitoring (RMM) Modem (Modem inside Control Box)
7. Humidify System Option
8. Full TRANSFRESH Option, CSR40 PS
9. Full TRANSFRESH Option, CSR20 PS and CSR40SL PS

**CSR20 PS and CSR40SL PS Evaporator Section — Front View**

1. Evaporator Fan Motor
2. Evaporator Fan Blade:
 - CSR20 PS: 280 mm (11.02 in.) diameter, 19° pitch
 - CSR40SL PS: 312 mm (12.25 in.) diameter, 25° pitch
3. Return Air Sensing Bulb for Recording Thermometer (Option)
4. Return Air Sensor
5. Humidity Sensor (Option)
6. Humidify System Compressor (Option), see page 2-8

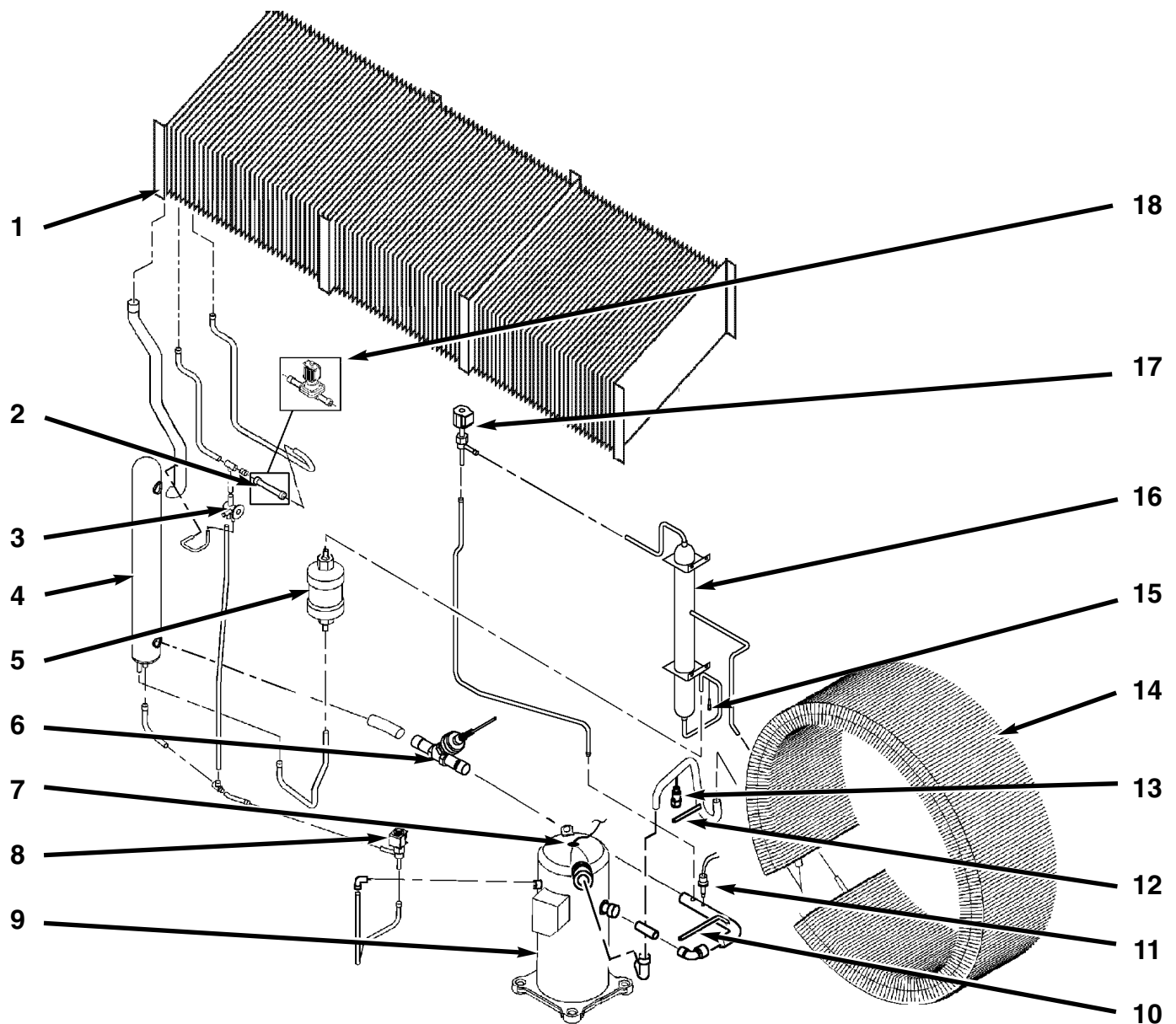
**CSR40 PS Evaporator Section — Front View**

1. Evaporator Fan Motor
2. Evaporator Fan Blade:
 - CSR40 PS: 355 mm (14.0 in.) diameter, 25° pitch
3. Return Air Sensing Bulb for Recording Thermometer (Option)
4. Return Air Sensor
5. Humidity Sensor (Option)
6. Humidify System Compressor (Option), see page 2-8



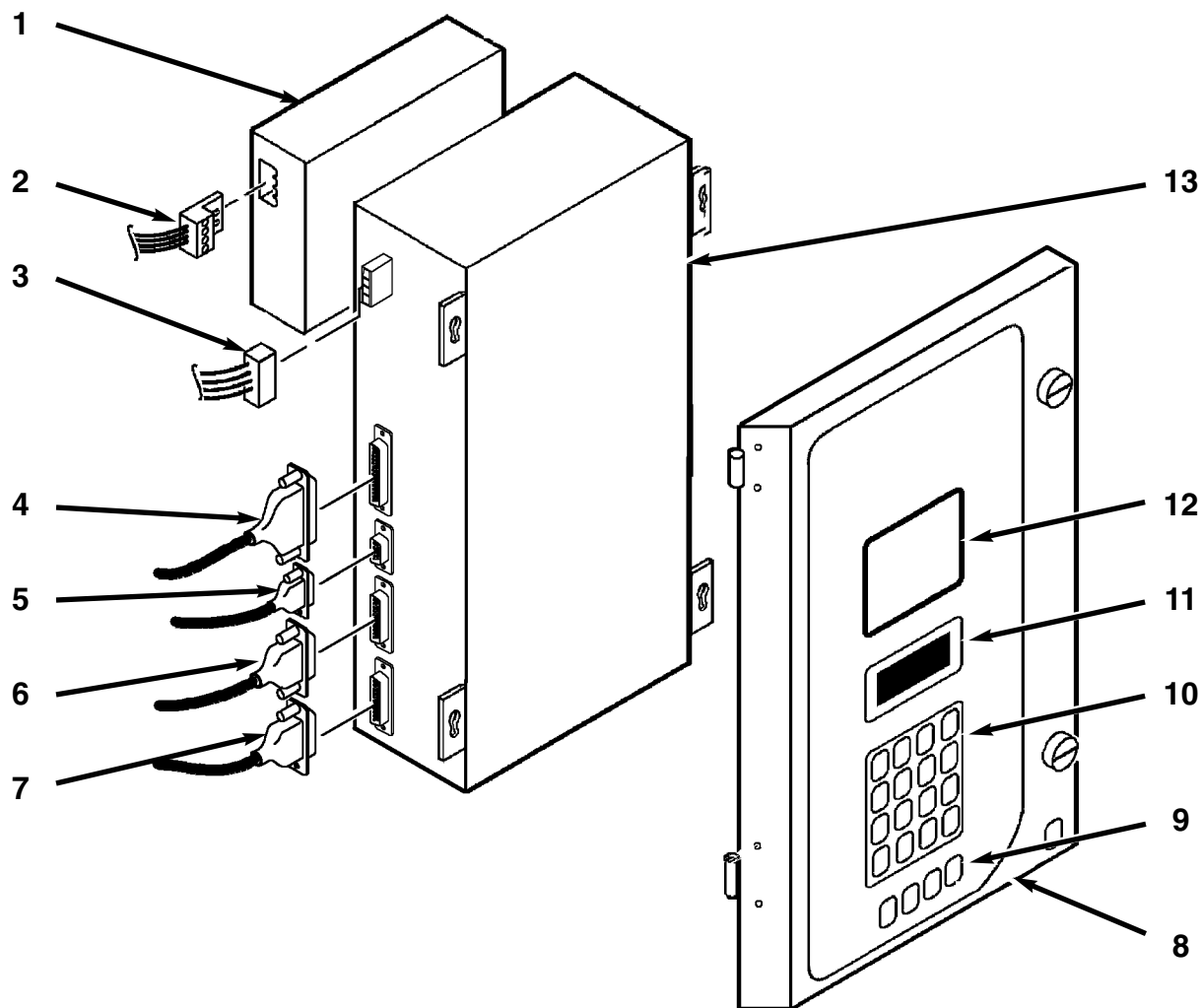
Humidify System Option

1. Evaporator Drain Hose
2. Fill Cap
3. Water Tank Heater
4. Tank Overflow Hose
5. Drain Cock
6. Water Tank
7. Water Filter
8. Water Supply Hose
9. Air Compressor
10. Liquid Spray Nozzle



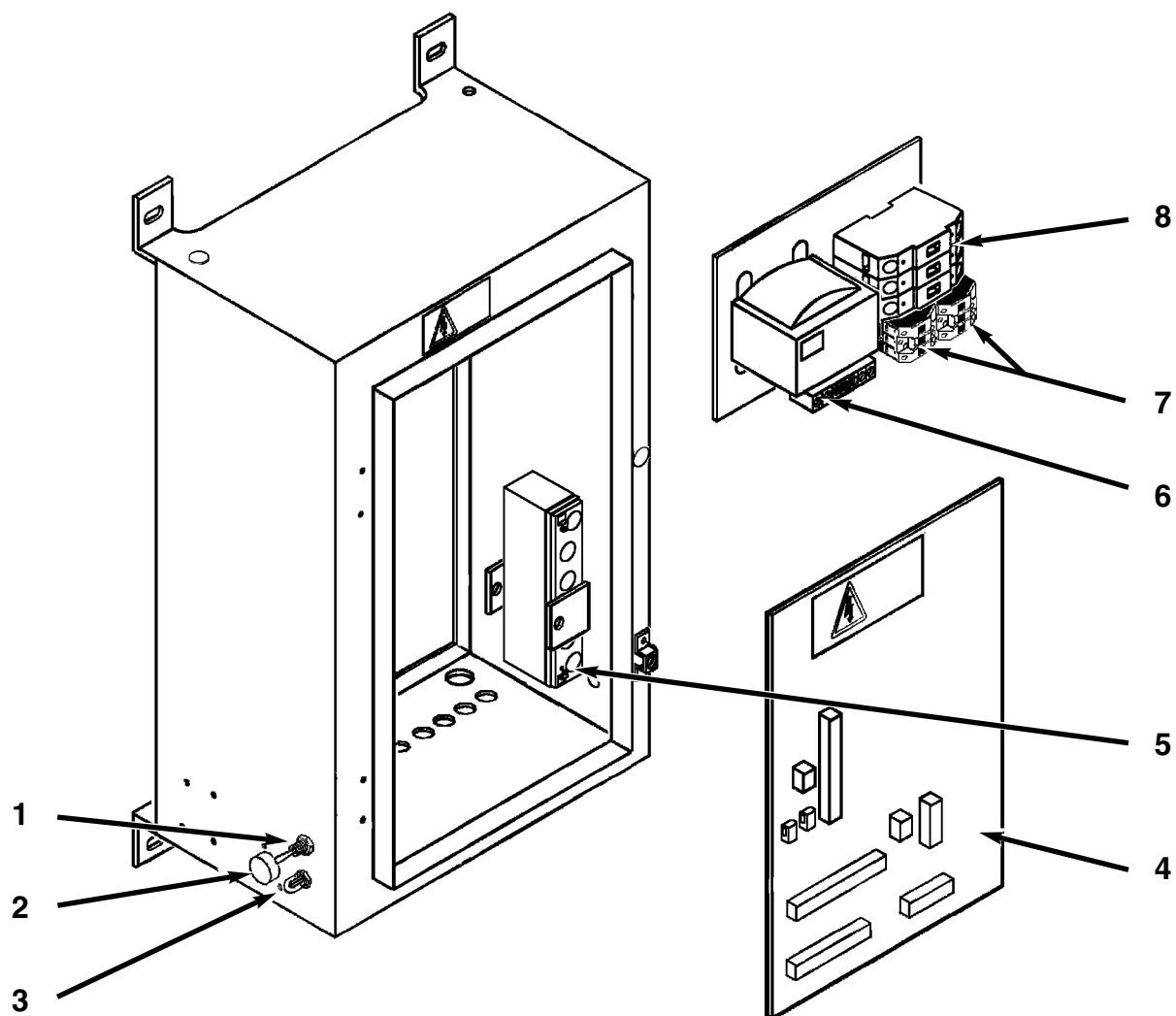
Hermetic Refrigeration System

- | | |
|--|--|
| 1. Evaporator Coil | 17. Warm Gas Bypass Solenoid Valve |
| 2. Tube (Standard) | 18. Dehumidify Valve (Option replaces standard tube) |
| 3. Expansion Valve | |
| 4. Heat Exchanger | |
| 5. One-piece Filter Drier/In-line Filter | |
| 6. Stepper Motor Valve | |
| 7. Compressor Discharge Temperature Sensor | |
| 8. Liquid Injection Solenoid Valve | |
| 9. Scroll Compressor | |
| 10. Suction Line Process Tube | |
| 11. Low Pressure Cutout Switch | |
| 12. Discharge Line Process Tube | |
| 13. High Pressure Cutout Switch | |
| 14. Condenser Coil | |
| 15. High Pressure Relief Valve | |
| 16. Receiver Tank | |

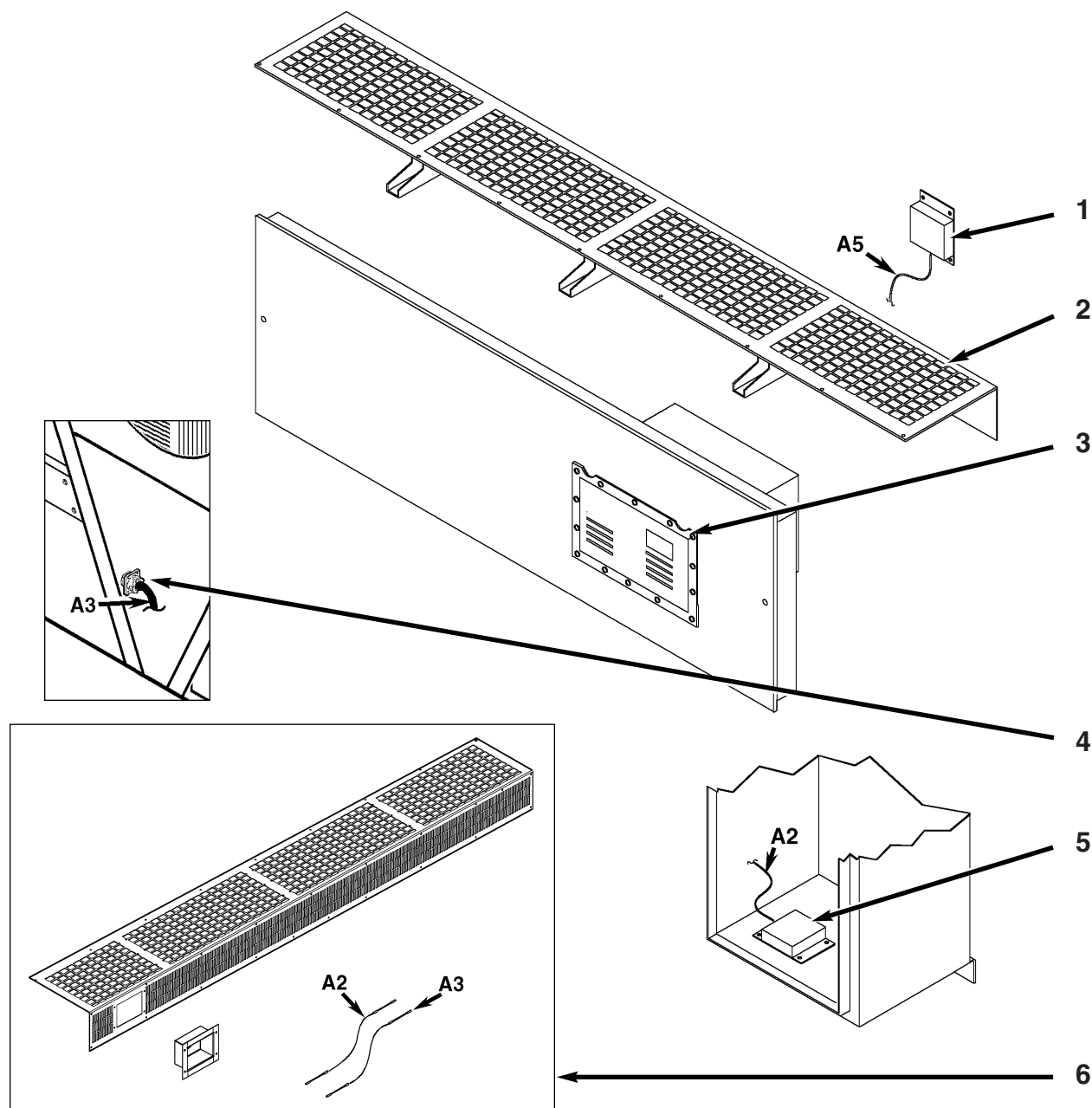


Controller and Remote Monitoring Modem

1. Remote Monitoring Modem (Option)
2. RMM Communication Cable (Option)
3. Battery Cable Connection to Controller
4. Cable No. 2 Connection to Controller
5. Download Cable Connection to Controller
6. Cable No. 3 Connection to Controller
7. Cable No. 1 Connection to Controller
8. Control Box Cover and Controller Keyboard Decal
9. Special Function Keypad
10. General Purpose Keypad
11. LCD Display (Setpoint Temperature, Message and Controller Main Menu Tree Display)
12. LED Display (Return or Supply Air Temperature Display and Status Indicator LEDs)
13. MP-3000 Controller

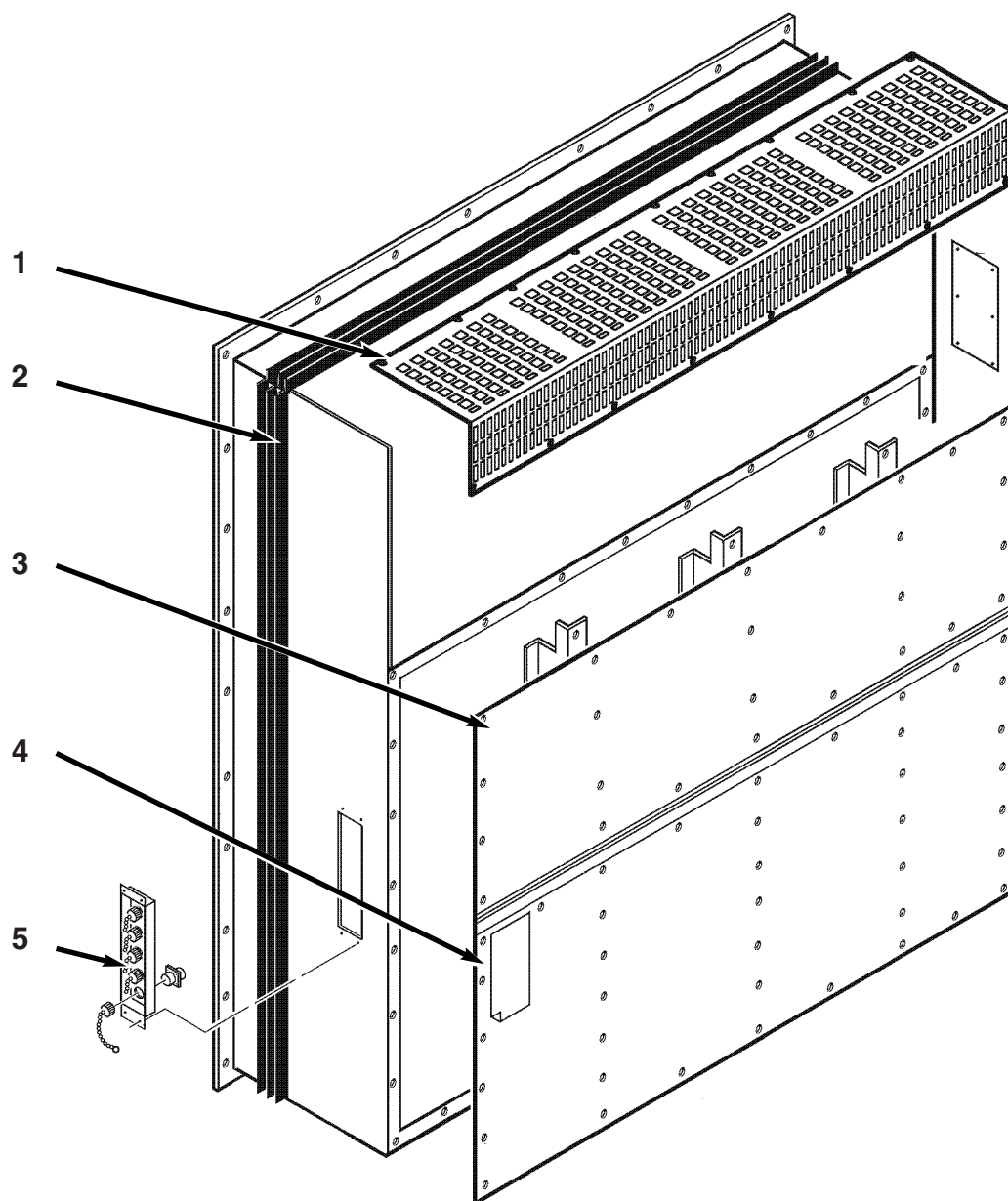
**Unit Control Box**

1. Unit On/Off Switch
2. Communications Connector for Data Retrieval
3. Circuit Breaker
4. Main Relay Board
5. 12 Vdc Battery
6. Control Power Transformer
7. Compressor Contactors (2)
8. 25 Ampere Main Power Circuit Breaker



TRANSFRESH System Options

1. TRANSFRESH Scrubber Connection and A5 Wire Harnesses
2. Evaporator Grille
3. TRANSFRESH Security Enclosure
4. TRANSFRESH Download Port
5. Transformer Assembly mounted in Control Box
6. TRANSFRESH Ready Option includes:
 - A2 Wire Harness (without connectors) from control box to evaporator section
 - A3 Wire Harness (without connectors) from condenser section to evaporator section
 - Evaporator Grille Access Opening

**Typical Unit Back View**

1. Evaporator Grille
2. Unit Gasket
3. Top Rear Plate
4. Bottom Rear Plate
5. Sensor Connector Assembly:
 - Controller Communications and Data Download Port
 - Cargo (Pulp) Sensor Connection
 - USDA1 Sensor Connection
 - USDA2 Sensor Connection
 - USDA3 Sensor Connection

3

Operating Instructions

Unit Controls

Unit Control Box

1. UNIT ON/OFF SWITCH.
 - a. ON position. Unit will operate on cool or heat depending on the controller setpoint temperature and the container air temperature.
 - b. OFF position. The unit will not operate.

MP-3000 Controller

The MP-3000 microprocessor controls all unit functions to maintain the cargo at the proper temperature. The controller also monitors and records system faults and performs pre-trip.

1. KEYPAD. Sixteen general purpose keys are used to display information, change the setpoint, change programmable features and initiate control tasks.
2. °C-°F KEY. Press this key to view temperatures in the LED display in the alternate temperature value. Alternate value (C or F) shows while the key is pressed.
3. RET/SUP KEY. Press this key to view the alternate sensor temperature in the LED display. Alternate sensor (return or supply) shows while the key is pressed.
4. DEFROST KEY. Press this key to initiate a manual defrost cycle. If the evaporator coil temperature is below 18 C (65 F), the unit will defrost. Otherwise the controller will display "Defrost Not Activated" in the LCD display and the unit will continue normal operation.
5. SETPOINT KEY. Press this key to change the setpoint. Cursor in the LCD display automatically appears in the "TEMP SETP" line of the Data menu. See "Changing the Setpoint" in the MP-3000 Controller chapter for complete instructions.

6. STATUS INDICATOR LEDs located in the large LED display signal:
 - Supply (Air Temperature)
 - Return (Air Temperature)
 - Humidity Mode (Humidification Option set to On in Setpoint menu)
 - Compressor (Cooling On)
 - Heat (On)
 - Defrost
 - In-Range (Temperature)
 - Alarm

The In-range LED illuminates when the controlling air sensor temperature is less than 1.5 C (2.7 F) above setpoint (standard). The controller maintains the in-range signal during defrost and after defrost for 60 minutes.

7. LED DISPLAY. Large red LED display shows current control temperature during normal operation. LED display also shows current test state during a Pretrip (PTI) or Function test.
8. LCD DISPLAY. A 4-line LCD message display shows setpoint during normal operation. LCD display also shows controller menu and unit operation information when special keys are pressed.

Other Unit Controls

1. EVAPORATOR OVERHEAT SWITCH. A temperature switch near the evaporator coil opens to de-energize the heater contactor if the evaporator temperature reaches 54 +/- 3 C (130 +/- 5 F). The switch closes (resets) when the evaporator temperature decreases to 38 +/- 4.5 C (100 +/- 8 F).

Unit Instruments

1. **THERMISTOR LEAD (OPTION).** A thermistor lead is located in the unit control box to provide air temperature verification. The bulb of the thermistor lead is attached to the return or supply air sensor in the evaporator section.
2. **REMOTE MONITOR CONNECTOR, 4-PIN (OPTION).** A receptacle is provided on the side of the control box for connecting the ship's 4-pin bridge light system to the unit. The connector provided circuits for Compressor On, Defrost and In-range. The remote in-range light is activated when the controlling air sensor temperature is between 1.7 C (3.0 F) above setpoint and 2.5 C (4.5 F) below setpoint.
3. **RECORDING THERMOMETER (OPTION).** The recording thermometer indicates and permanently records the temperature of the air returning to the evaporator section on a calibrated chart.
4. **POWER LINE COMMUNICATIONS MODEM (OPTION).** A REFCON remote monitoring modem is available to provide remote monitoring via the power cable. High speed transmission reads all controller information.

Unit Protection Devices

1. **MAIN CIRCUIT BREAKER.** A 25 ampere manual reset circuit breaker protects the 460/380V power supply circuit to the unit electric motors and control system transformer. The main power circuit breaker is located in the control box.
2. **CONTROL SYSTEM CIRCUIT BREAKER.** A 7 ampere manual reset circuit breaker protects the 29 Vac control circuit. This circuit breaker is located in the control box beside the On/Off switch.
3. **FUSES.** A number of fuses are located on the main relay board and controller plug to protect unit circuits and components.
 - Three 20 amp fuses protect high voltage circuits on the main relay board.
 - A 2 amp fuse protects the controller's 28 V system.
 - A 2 amp fuse protects the controller's battery charging circuit.

4. **COMPRESSOR DISCHARGE GAS TEMPERATURE SENSOR.** A refrigerant injection system uses the compressor discharge temperature to determine when cold refrigerant will be injected into the center scroll of the compressor to protect the compressor from excessively high operating temperatures.
 - a. **Chill Mode Liquid Injection:**
 - Controller energizes the liquid injection valve when compressor discharge gas temperature increases to 138 C (280 F).
 - Controller de-energizes the liquid injection valve to stop liquid injection when the discharge gas temperature decreases to 132 C (270 F).
 - b. **High Temperature Protection:**
 - The controller immediately stops unit operation if the discharge gas temperature increases to 148 C (298 F). The controller activates the Alarm LED and records Alarm 56, Compressor Temperature Too High. The controller restarts the unit when the condition corrects itself.
5. **HIGH PRESSURE CUTOOUT (HPCO) SWITCH.** If the compressor discharge pressure rises above 3243 +/- 7 kPa, 32.43 +/- 0.48 bar, 470 +/- 7 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:
 - Compressor STOPS immediately.
 - Evaporator and condenser fans continue normal operation. Controller determines that a high pressure cutout switch is open when the unit current draw decreases by 7 amps for more than 3 seconds.
 - The controller LCD display shows a High Pressure Cutout message: "High Pressure Cutout Check Condenser Probe" or "High Pressure Cutout Check Condenser Fan".
 - After 1 minute, the controller energizes the compressor contactor so the compressor will restart when the overload condition is corrected (switch resets) if power is available. The high pressure switch resets (closes) when the pressure drops to 1590 +/- 70 kPa, 15.9 +/- 0.7 bar, 230 +/- 10 psig.
 - If the switch remains open for 5 minutes, controller also activates Alarm LED and records Alarm 37, Total Power Consumption Too Low.

6. **LOW PRESSURE CUTOOUT (LPCO) SWITCH.** If the compressor discharge pressure decreases to +21 to -21 kPa, +0.21 to -0.21 bar, 3 psig to 6 in. Hg vacuum; the low pressure cutout opens:
- Compressor STOPS immediately.
 - Evaporator and condenser fans continue normal operation.
 - Compressor will restart if the low refrigerant condition is corrected (switch closes) as long as power is available. The low pressure switch resets (closes) when the pressure increases to 48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig.

NOTE: *If the low pressure cutout switch remains open, check for an obstruction or refrigerant leak in the low or high pressure side of the refrigeration system.*

7. **HIGH PRESSURE RELIEF VALVE.** A high pressure relief valve is installed in the liquid line between the receiver tank and filter drier. The relief valve protects against excessive pressure build-up within the refrigeration system from extraordinary and unforeseen circumstances. The valve is a spring-loaded piston that lifts when refrigerant pressure exceeds 3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig. The valve is located so that refrigerant pressure expelled from the valve would be directed away from anyone servicing the unit. The valve will reset when this pressure drops to 2758 kPa, 27.58 bar, 400 psig. The valve is non-repairable and requires no adjustment. If the valve fails to reseal properly, recover the refrigerant charge and replace the valve.
8. **OVERLOAD PROTECTION.** The condenser fan motor, evaporator fan motors and compressor motors include internal overload protection with automatic reset.
9. **PHASE SEQUENCE SELECTION.** When the On/Off switch is turned ON, phase sensors on the main relay board determine the incoming power phase to ensure the correct sure proper condenser fan and evaporator fan rotation. The controller then determines the correct phase sequence for the compressor and energizes the correct compressor contactor.

Pretrip Inspection

Visual Inspection

The following inspections should be made before the container is loaded:

1. Visually check the unit for physical damage.
2. Check the electrical connections in the unit control box, making sure they are fastened securely.
3. Check the conditions of wires and terminals. Repair or replace if necessary.
4. Check the refrigeration system for leaks. Inspect for evidence of oil leaks at all joints and connections.
5. Check the condenser and evaporator coils. Clean if necessary. Use an air or water spray jet directed against the coil from the air discharge side. Also inspect the condenser fan grille for damage. If the grille is damaged or missing, abnormally high head pressure may result. Repair or replace the grille if necessary.

CAUTION: *Air or water spray jet pressure should not be high enough to damage (bend) coil fins.*

6. Check the mounting bolts on the unit, compressor and fan motors. Tighten if necessary.
7. Clean the defrost drains.
8. Optional: Check water level in humidity system tank. Add only demineralized or distilled water to prevent plugging of the atomizing nozzle.
9. Observe the unit for proper operation and functions during Pre-load Operation.
10. Check to be sure the container ID that appears in the Configuration menu is correct.

Functional Inspection

To properly perform a Full Pretrip Test on units equipped with a MP-3000 controller, the container must be empty with the rear doors closed.

1. Start the unit (see “Starting the Unit and Adjusting the Controller Setpoint” on page 3-5). A second sequence start of the required loads occurs during the Pretrip test:
 - Controller LED display turns On and then Off.
 - LED display briefly shows setpoint and then displays the controlling (return) air sensor temperature.
 - Controller senses the incoming power phase and selects the correct power phase to unit components.
 - Controller energizes unit loads, starting the evaporator fans. The condenser fan may also start (if required).

- If the controller calls for cooling, the compressor motor starts. If the unit starts in Modulation Cool the stepper motor valve opens or closes to the required setting.
- If the controller calls for heating, the electric heaters are energized.

NOTE: *If the compressor fails to start, turn the On/Off switch OFF. Then repeat steps 1 through 3. If the unit still does not start, refer to “Alarm Codes, Descriptions and Corrective Actions” in the MP-3000 Controller chapter of this manual.*

2. Check controller setpoint for proper setting. Adjust if necessary.

NOTE: *New setpoint must be between -29 C and +29 C (-20.2 F and +84.2 F) or controller will return to the previous setpoint display.*

3. Check the direction of the condenser airflow (see “Condenser Fan and Evaporator Fan Rotation” in the Electrical Maintenance chapter of this manual).
4. Check direction of evaporator airflow (see “Condenser Fan and Evaporator Fan Rotation” in Electrical Maintenance chapter of this manual).
5. Perform a Pretrip (PTI) Test to check the unit refrigeration and electrical systems for proper operation.

CAUTION: *The PTI test should only be performed on an empty container!*

NOTE: *Correct all existing alarm conditions and clear the alarm codes before performing a PTI test. The controller will automatically clear all existing alarms before beginning the PTI test.*

To perform a PTI test:

- Press F2 key to enter Main Menu.
- Press F2 or F3 key to scroll up or down in menu to “COMMANDS”.
- Press F4 key to access COMMANDS menu.
- Press F2 or F3 key to scroll up or down to “PTI”.
- Press F4 to start the PTI (Pretrip) Test.
- The controller then performs the Pretrip Test.
- Observe the unit for proper operation and functions during pretrip test.

- LCD display shows PTI Test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.
- If an operating problem occurs during the Pretrip Test, the Alarm LED will turn ON and FLASH. An “E” may also appear in the right side of the LED display. View and correct any alarm conditions. Then clear (acknowledge) the Alarm Code(s) and repeat the PTI Test.

NOTE: *Clear the Alarm codes ONLY after the alarm codes are documented and problems repaired. A permanent record of the alarm codes remains stored in the datalogger memory for retrieval via DRU-II or SmartSponge retriever software.*

6. Enter trip ID information into the controller using the keypad.
7. Set the fresh air vent to the desired air exchange rate.

NOTE: *If Dehumidification is turned ON, the fresh air vent should be closed.*

8. Optional: Operate the humidity system (see “Changing the Humidity Mode Setting” on page 4-15). Verify that the air compressor operates and that water is drawn into the atomizing nozzle and injected into the return air stream (see “Humidify System” on page 7-3).
9. Install a new chart and prepare the recording thermometer for temperature recording (if so equipped):
 - Wind the chart drive on the recording thermometer (Partlow recorders).
 - Check the battery charge on the recording thermometer (Saginomiya recorders).
10. Stop the unit by moving the On/Off switch to the OFF position.

Starting the Unit and Adjusting the Controller Setpoint

CAUTION: Supply power connections from the unit to the power source must always be made with the refrigeration Unit On/Off switch and power supply On/Off switch in the OFF positions. Never attempt to start or stop the refrigeration unit with the unit power cable.

1. Verify that the Unit On/Off switch is in OFF position.
2. Connect the unit power cord to proper power source:
 - 460/380V power cord to 460/380V, 60-50 Hz power source.
 - Turn the power supply On/Off switch ON.
3. Switch the Unit On/Off switch to ON position. Check for condenser fan and evaporator fan motor operation (see “Condenser Fan and Evaporator Fan Rotation” in the Electrical Maintenance chapter of this manual). If the unit was properly pretripped, correct condenser fan rotation will also indicate correct evaporator fan rotation.
4. Adjust controller setpoint to the desired temperature:

NOTE: The setpoint temperature can be set between -29 C and +29 C (-20.2 F and +84.2 F) in either °F or °C using the °C/°F key. Just press and hold the F/C key (to display the alternate temperature scale).

- Press SETPOINT key to display cursor flashing in the “TEMP SETP” line.
- Press F4 key to activate the setpoint change function. An Enter Arrow appears in the menu line and the current setpoint disappears.
- Enter minus sign (if required) first by pressing EXIT key. Then press numeric keys to enter new setpoint.
- With correct setpoint in display, press and hold F4 key until cursor stops flashing. Controller places new setpoint in controller memory and shows new setpoint in LCD display.

NOTE: New setpoint must be between -29 C and +29 C (-20.2 F and +84.2 F) or controller will return to the previous setpoint display.

NOTE: If the setpoint is not entered within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat step 3.

Loading Procedure

1. Make sure the Unit On/Off switch is OFF before opening the container doors. (The unit may be operating when loading the container from a warehouse with door seals.)
2. Spot check and record load temperature while loading. Especially note any off-temperature product.

Post Load Procedure

1. Make sure all doors are closed and locked.
2. Start unit if unit is OFF.
3. Check controller setpoint for proper setting.
4. Enter trip identification information into the controller memory by selecting “Cargo Data” from the MISC FUNCTIONS menu of the controller.
5. One-half hour after loading, initiate a manual defrost cycle:
 - Press the DEFROST key. The Defrost and Heat LEDs turns ON as the unit enters Defrost. Defrost will stop automatically.

NOTE: The evaporator coil temperature must be below 18 C (65 F) to allow the unit to enter a defrost cycle. If the evaporator coil temperature is too high, the LCD display will read “Defrost Not Activated”.

Post Trip Procedure

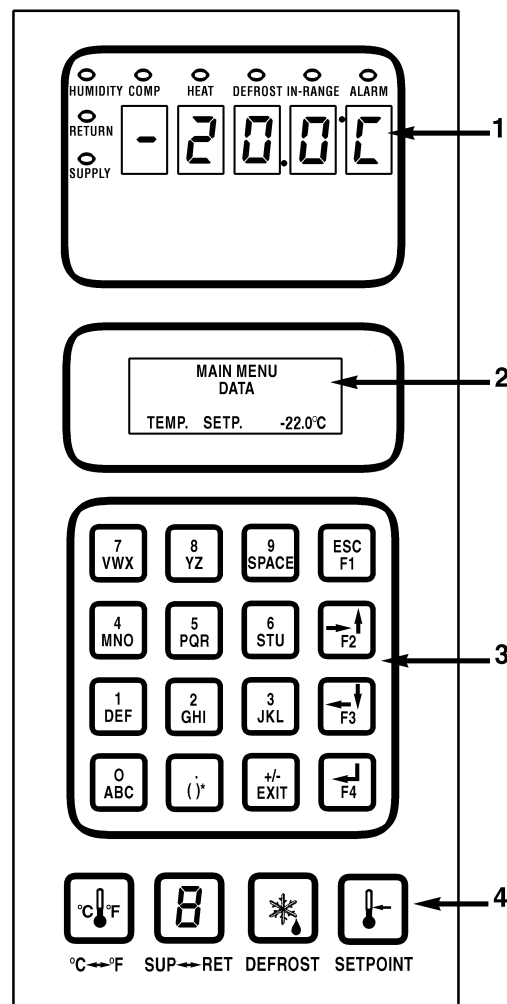
Trip data recorded by the MP-3000 datalogger may be downloaded via the communications port on the control box using a DRU-II hand-held data retriever, or laptop computer with SmartSponge retriever software; or via the REFCON remote monitor system.

Controller Description

The MP-3000 is an advanced microprocessor controller that has been specially developed for control and monitoring of refrigeration units. The controller contains the following basic features:

1. LED display for TEMPERATURE:
 - Five alpha numeric, 20.32 mm high characters: Numerical hundredths, tens, ones and tenths position, a C for Celsius or F for Fahrenheit for temperature display.
 - LED display shows controlling (return or supply) sensor temperature. Sensor temperature shown in LED display is indicated by status indicator lights. If a sensor is out of range the display shows “+Err” or “-Err”. The +/- sign indicates whether the sensor temperature is out of range high or low.
 - The LED display also shows the test stage of a Pretrip (PTI) or Function test.
2. LCD display for SETPOINT, MESSAGES and MENU:
 - 4 line, 20 character LCD display shows setpoint temperature during normal operation.
 - Alarms, messages and the controller menu also appear in the LCD display when special keys are pressed.
3. Sixteen general purpose keys are used to enter text and scroll through the controller menu tree.
 - a. Text Input:** The keyboard supports both numerical and text input. Each key can have more than one meaning. Use the special text keys F1, F2, F3 and F4 to enter text in an information screen:
 - F1 key: Press the F1 key, then press another general purpose key to enter the number shown on the key.
 - F2 key: Press the F2 key, then press another general purpose key to enter the first letter shown on the key.
 - F3 key: Press the F3 key, then press another general purpose key to enter the second letter shown on the key.
 - F4 key: Press the F4 key, then press another general purpose key to enter the third letter shown on the key.

NOTE: When the F1, F2, F3 or F4 key is pressed to enter a character in the display, the keypad remains on that “character level” until another “level” is selected by pressing the F1, F2, F3 or F4 key.



MP3000 Controller

1. LED display for TEMPERATURE. Status indicator LEDs identify controlling sensor temperature (return or supply) that appears in display.
2. LCD display for SETPOINT, MESSAGES and MENU. Use the keypad to scroll through messages and the controller menu.
3. General purpose keys are used to enter text and scroll through menus.
4. Special function keys perform specific tasks.

Text Input Example: To enter THERMO in an information screen:

- a. Enter "T" by pressing F3 key, then pressing STU key.
- b. Enter "H" by pressing GHI key.
- c. Enter "E" by pressing DEF key.
- d. Enter "R" by pressing F4 key, then pressing PQR key.
- e. Enter "M" by pressing F2 key, then pressing MNO key.
- f. Enter "O" by pressing F4 key, then pressing MNO key.

b. Menu Scrolling: General text keys F1, F2, F3 and F4 also include directional arrows for entering and scrolling through the controller Main Menu:

- F1 key: ESC indicates that pressing the K1 key moves the cursor out of (exits) a menu list.
 - F2 key: FORWARD/UP ARROWS indicate that pressing the K2 key scrolls the cursor forward and/or upward through text boxes and menu lists.
 - F3 key: BACKWARD/DOWN ARROWS indicate that pressing the K3 key scrolls the cursor backward and/or downward through text boxes and menu lists.
 - F4 key: ENTER ARROW indicates that pressing the K4 key moves the cursor into the next menu level or into a menu item text box.
4. Four special function keys (see illustration on page 4-1):
 - C/F key: Press to view alternate temperature scale in LED display.
 - DEFROST key: Press to initiate defrost. Evaporator coil temperature must be below 10 C (50 F).
 - SUP/RET key: Press to view alternate return/supply sensor temperature in LED display.
 - SETPOINT key: Press to enter Setpoint Menu. The first line of the Setpoint Menu is the setpoint temperature. Press F2 or F3 key to scroll up or down through the menu list.

NOTE: Press the "5" key to increase the display time of the current LCD data screen by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests.

5. Status indicator LEDs (see "Status Indicator LEDs and Alarm Codes" in this chapter).
6. Control Transformer: Low voltage control power and ground is supplied to the MP-3000 controller and the main relay board.
7. Main Relay Board: High voltage supply power and low voltage control power and ground are supplied to the main relay board. The main relay board contains:

- Relays to energize and de-energize unit contactors and solenoids. Component relays include the heater, evaporator fan motor, condenser fan motor, and phase reversal relays.
 - Supply power circuit protection:
 - 20 amp fuses (3) protect the high voltage circuits on the main relay board.
 - Control circuit fuse and circuit breaker protection:
 - 7 amp manual reset circuit breaker protects the 24 Vdc control circuit.
 - 2 amp fuse protects the 28V ac control power circuit to the controller.
 - 2 amp fuse protects the battery charger output circuit to the controller.
 - Electronics for measuring phase sequence.
 - Electronics for measuring amperage.
 - Electronics for measuring voltage.
 - Zero current transformer for earth leaking measurement (option).
8. Replaceable sensors: Return air, left hand supply air, right hand supply air, evaporator coil (defrost), condenser coil, ambient air and compressor discharge line temperature sensors are field replaceable. Three (replaceable) spare sensor receptacles are also provided for USDA temperature recording.
 9. Probe Test (see "Probe Test" in this chapter).
 10. Defrost cycle control (see "Defrost System" in this chapter).
 11. Pretrip (PTI) test capability (see "PTI (Pretrip) Test" in this chapter).
 12. Function test capability (see "Function Test" in this chapter).
 13. Data recording capability (see "Data Recording and Downloading Data" in this chapter).
 14. Electronic phase selection: The microprocessor relay board monitors the phase of the power supply to ensure proper rotation of the condenser fan and evaporator fans. The controller determines the correct phase sequence for the compressor and energizes the correct compressor contactor.
 15. Power limit control (see "Power Limit Mode" in this chapter).
 16. Sequential component start-up control: A sequence start of the required loads occurs during initial start-up of the controller and when a control mode shift requires the compressors to start (see "Sequence of Operation" in this chapter).
 17. Compressor refrigerant injection cycle control (see "Compressor Liquid Injection" in this chapter).
 18. Hourmeters: The MP-3000 controller has multiple built-in hourmeters that can be accessed through the Main Menu.

19. Manual emergency control capability. Manual control settings in the control box allow the unit to operate even in the event of a fatal failure of the controller. Manual control offers three operating functions: Heat, Defrost and Cool (see “Manual Emergency Mode Operation” in this chapter).
20. Flash memory: Flash program memory allows the application software to be updated without replacing a EPROM chip on the controller. Application software can be updated in the field using a portable computer and the MP-3000 Loader program. Consequently, the field installed application software version may have a different revision number and may include control features not included in the original factory installed software. If the operation of your unit differs from the Sequence of Operation described for the unit in this manual, enter “Misc. Functions” in the Main Menu to check that the program version is correct (see “Menu Operating Instructions” in this chapter).
21. Display menus: The MP-3000 controller contains an extensive display menu that can be navigated via keypad. The display menu is organized into eight (8) Main Menus:

NOTE: The screens that display on the controller are determined by the controller model and the unit configuration setting. All screens are NOT present on all units.

- Setpoint Menu: Menu screens in this group are used to enter the temperature setpoint and set the economy mode. Setpoint menu option functions include: set humidify or dehumidify operation, enter humidity setpoint, set airflow, set custom airflow, set bulb mode, set AFAM operation, set AFAM delay, set AFAM rate, set O₂ Minimum and set CO₂ Maximum.
- Data Menu: Menu screens in this group are used to display unit operating information including sensor temperatures, voltage, current and frequency information.
- Alarm List Menu: Menu screens in this group display a list of alarm code(s).
- Commands Menu: Menu screens in this group are used to activate defrost, function tests, pretrip (PTI) tests and manual function test.
- Miscellaneous Functions Menu: Menu screens in this group display date/time, C/F, cargo data, program version and run time (hourmeters) information.
- Configuration Menu: Menu screens in this group display refrigerant type, in-range setting, container ID, contrast (screen), language, unit type, reefer type and zero current status.
- Datalogger Menu: Menu screens in this group display temperature log, event log, set log time and PTI log.
- Refcon Remote Monitoring (RMM) State: Menu screen show current remote monitoring state (Offline, Zombie or On-line).

Status Indicator LEDs

Eight status indicator LEDs are located in the top LED display and signal the following:

- Supply (Air Temperature)
- Return (Air Temperature)
- Humidity Mode (Humidification set to On in Setpoint menu)
- Compressor (Cooling On)
- Heat (On)
- Defrost
- In-Range (Temperature)
- Alarm

The indicator LEDs stay ON continuously to indicate sensor temperature display, unit operating mode or condition.

The Alarm LED flashes ON and OFF continuously when a Check Alarm (Level 2 Alarm) or Shutdown Alarm (Level 1 Alarm) occurs. Less serious Log Alarms (Level 3 Alarm) are recorded but do not activate the Alarm LED (see Alarms Menu on page 4-16 for more information).

Data Recording and Downloading Data

The MP-3000 datalogger can record sensor temperatures as well as loss of power, alarms, sensor failure, setpoint change and unit shutdown events. All data logs include the time and date; setpoint temperature; supply, return, ambient, USDA1, USDA2 and USDA3 sensor temperatures; and humidity sensor. All temperature logs can be viewed from the controller's LCD message display.

Data logging intervals are selectable from 1 minute or 1/2, 1, 2 or 4 hours. When a 1 hour logging interval is selected, the datalogger memory can store approximately 512 days of information.

The logging of USDA sensors is fixed at 1 hour intervals to comply with USDA requirements. A logging test of USDA sensors at 1 minute intervals is possible for 72 minutes. USDA data can be downloaded during the logging test. After 72 minutes, controller returns to previous logging interval and clears USDA test data from datalogger memory.

If the unit power supply is disconnected, the datalogger will continue to register 120 temperature logs (except humidity sensor) when battery voltage is above 11.4 volts. These will be maintained until the unit is re-connected to power, and the battery automatically re-charged.

Trip data can be retrieved (but not erased) from the datalogger memory using a DRU-II or SmartSponge handheld data retriever, or a REFCON power line remote monitoring system. DRU-II data transfer rate based on a 1 hour log interval is about 15 seconds per month of event logs and about 70 seconds per month of temperature logs. For example, download-

ing 90 days of data logs would take about 75 seconds for event logs only and about 45 seconds for temperature logs only.

Trip data from separate units is denoted by the identification information entered into the controller at the beginning of the trip via the general purpose keypad. Identification data may include the container ID number, location B.R.T., contents, loading data, voyage no., ship, load port, discharge port and comments. The container ID number is stored in the Configuration submenu.

General Theory Of Operation

The MP-3000 controller uses advanced solid-state integrated circuits to monitor and control unit functions. The controller monitors inputs from:

- Return air sensor
- Supply air sensor, left hand
- Supply air sensor, right hand
- Evaporator coil sensor
- Condenser coil sensor
- Ambient sensor
- Humidity sensor
- USDA (Spare) sensors 1, 2 and 3
- Compressor discharge line temperature sensor
- Phase measuring circuits
- Current measuring circuits
- Voltage measuring circuits

Output signals from the controller automatically regulate all unit functions including:

- Compressor operation
- Condenser fan operation
- Evaporator fan motor operation
- Liquid line solenoid valve
- Stepper motor valve
- Liquid injection valve
- Dehumidify valve
- Electric heaters
- Phase selection

Chill Loads (Setpoint at -9.9 C [14.1 F] and Above)

The unit operates on Cool with Modulation and Heat to provide accurate control of chill loads. During Cool with Modulation, the controller uses a proportional-integral derivative (PID) algorithm and a stepper motor valve to provide accurate control of the container temperature in direct response to load demand.

The stepper motor valve is installed in the suction line and controls the amount of refrigerant returning to the compressor. The valve opens and closes in response to a controller voltage signal based on a control temperature differential. The controller uses the setpoint temperature, supply air sensor temperature (left and/or right hand sensors) and pull-down rate for the last 10 seconds, last 20 seconds and last 180 seconds to calculate the control temperature differential.

Supply Air Sensor Control

Temperature control accuracy and protection against frost damage is provided by using two separate sensors (left hand and right hand) to determine the supply temperature used to calculate the control temperature differential:

- At setpoints below -1 C (30 F), the controller uses the lowest supply air sensor temperature.
- At setpoints above 0 C (32 F), the controller uses the average temperature of the left hand and right hand supply air sensors.
- At setpoints between -1 C and 0 C (30 F and 32 F), the controller uses a sliding temperature scale from the lowest supply air sensor temperature to the average temperature of the left hand and right hand supply air sensors.

If one supply air sensor fails, the controller uses the temperature of the other supply air sensor for temperature control. If both supply air sensors fail, the controller uses the temperature of the return air sensor plus an offset for temperature control.

Temperature Control Accuracy and Frost Protection

The PID algorithm generally minimizes container temperature fluctuations to +/- 0.1 C (+/- 0.2 F). Additional frost protection is provided by pulsing the electric heaters ON and OFF on a 60 second duty cycle to increase the supply air temperature if the return air temperature decreases to within 0.3 C (0.5 F) of setpoint. The controller pulses the heater ON for 2 to 60 seconds every 60 seconds. The amount of ON time depends on the amount of heat required to provide frost protection.

Frozen Loads (Setpoint at -10 C [14 F] and Below)

The unit operates on Full Cool and Null to provide accurate control of frozen cargo. The controller uses the return air sensor temperature and setpoint temperature to regulate unit operation.

If the return air sensor becomes disconnected or fails, the controller uses the supply air sensors plus an offset for temperature control.

Modulation Display in Data Menu

The modulation percent displayed in the Data menu indicates the percent of the total unit capacity that is currently provided. For example, when controller display shows 70%, this means the stepper motor valve has closed to reduce system cooling capacity from 100% to 70% (a 30% reduction).

Power Limit Mode

The controller uses the total unit current and the condenser temperature to provide power limit control in both the Chill and Frozen modes. When the unit is on water-cooled operation, power limit control is based on the total unit current draw only.

Initial Unit Start-up and Normal Operation (Standard)

Power Limit is active whenever the compressor is ON in both the Chill and Frozen modes. When the total current draw or the condenser temperature exceeds a predetermined threshold, the controller limits unit power consumption by sending a voltage pulse to the stepper motor valve. The stepper motor valve then closes to restrict the flow of refrigerant to the compressor. This reduces the cooling capacity load on the compressor, thereby limiting the compressor motor current draw and the condenser temperature to a predetermined threshold.

Power Limit Management

Additional power limit management flexibility is available. A maximum total current draw (17, 15 or 13 amps) and power management time interval can be selected from the Power Management feature of the Commands menu. When the power management time interval expires, the unit returns to the standard power limit control algorithm.

NOTE: Setting power management current at 13 amps can be used to provide slow pull-down of loads.

Compressor Liquid Injection

During compressor operation, a liquid injection system injects refrigerant into the center scroll of the compressor to protect against excessively high operating temperatures. When liquid injection is active, the controller energizes the liquid injection valve continuously. The controller activates liquid injection when the:

- Compressor starts. The controller turns on liquid injection for 5 minutes after each compressor start-up. Compressor start-ups include initial unit start, start after Defrost and start after Null.
- Chill or Power Limit Mode: When the modulation percent is 75% or less (in the Data menu display), the controller energizes liquid injection valve continuously.
- Compressor discharge temperature exceeds 138 C (280 F). Liquid injection stops when the compressor discharge temperature decreases to 132 C (270 F).

Warm Gas Bypass

During Chill Mode operation, a warm gas bypass system diverts refrigerant from the high side to the suction line as the supply air temperature decreases toward setpoint. This reduces unit cooling capacity and increases refrigerant flow through the compressor. The controller activates the warm gas bypass valve when:

- Chill Mode: When the modulation percent is 25% or less (in the Data menu display), the controller energizes warm gas bypass valve on a 30 second duty cycle. The amount of On (open) time increases as the modulation percentage decreases.

Evaporator Fan Control

The controller determines evaporator fan motor speed based on the setpoint temperature and the Economy mode setting.

- Evaporator fans operate on HIGH speed at setpoints of -9.9 C (14.1 F) and above. If the Economy mode is ON and temperature is In-range, the controller shifts the evaporator fans to LOW speed.
- Evaporator fans operate on LOW speed at setpoints of -10 C (14 F) and below. If the Economy mode is ON and the unit is in the Null mode, the controller STOPS the evaporator fans. The controller then operates the evaporator fans on LOW speed for 5 minutes every 45 minutes as long as the unit remains in the Null mode.

Condenser Fan Control

The controller also uses a proportional-integral derivative algorithm to control the condenser temperature and ensure a constant liquid pressure at the expansion valve. In low ambient conditions, the controller pulses the condenser fan ON and OFF to maintain a minimum condenser temperature. The controller maintains a minimum 30 C (86 F) condenser temperature on Chill loads and a minimum 20 C (68 F) condenser temperature on Frozen loads.

Economy Mode Operation

The Economy Mode reduces unit power consumption by reducing evaporator fan operation on both chill and frozen loads. The use of the Economy Mode should be established by the shipper and the type of cargo. The Economy Mode option is turned on from Setpoint menu of the controller.

NOTE: Enter Setpoint temperature before turning ON the Economy mode. The controller automatically turns the Economy mode OFF when the setpoint is changed.

Chill Loads (Setpoints of -9.9 C (14.1 F) and Above)

Evaporator fans operate on low speed whenever the container temperature is In-range.

NOTE: On Chill loads, container air temperatures may vary 1 C to 3 C (1.8 F to 5.4 F) above setpoint in high ambient temperatures.

Frozen Loads (Setpoints of -10 C (14 F) and Below)

The evaporator fans stop during the Null mode. A null state timer automatically re-starts the evaporator fans on low speed for 5 minutes every 45 minutes.

The Economy Mode also modifies the temperature control algorithm on frozen loads to extend the Null mode. The unit continues on Cool operation until return air temperature reaches ECMIN temperature. Default ECMIN setting is 2.0 C (3.6 F) below setpoint. ECMIN temperature is adjustable from 0 to 5 C (0 to 8.9 F) below setpoint through the Configuration menu of the controller.

The unit remains in Null until the return air temperature increases to ECMAX temperature at the expiration of a 45 minute Null state time sequence. Default ECMAX setting is .2 C (0.4 F) above setpoint. ECMAX setting is adjustable from 0 to 5 C (0 to 8.9 F) above setpoint through the Configuration menu of the controller.

NOTE: On Frozen loads, supply and return air temperatures may vary considerably during Economy mode operation due to long periods of no air circulation.

Probe Test

The controller constantly monitors the left hand and right hand supply sensors, return sensor and defrost (evaporator coil) sensor to determine when to initiate a demand defrost. If a demand defrost is requested and defrost has occurred within last 90 minutes, the controller initiates a Probe Test to check for a defective sensor.

During a Probe Test, the LCD display shows “Probe Test Please Wait”. The controller operates the unit on high speed evaporator fans only for 5 minutes. All sensor temperatures are then compared:

- Sensors with large temperature differences are discarded from the control algorithm. The controller then activates the appropriate Alarm codes to identify the defective sensor(s).
- If no sensors are found defective, controller LCD display shows “Running with High Supply Difference” message.

Sensor errors recorded during a Probe Test are cleared when the next Defrost is initiated or Unit On/Off switch is turned OFF.

NOTE: A manual Probe Test can be performed by a technician by selecting Sensor Check from the Manual Test Function menu.

Dehumidify Mode (Option)

During Chill mode operation, a dehumidification system is available to reduce the relative humidity in the container to the desired humidity setpoint. The Dehumidify Mode option is turned on from Setpoint menu of the controller. The relative humidity setpoint can be set from 50 to 99% from the Setpoint menu too.

Changing the Humidify/Dehumidify Mode program screen from OFF to ON activates the dehumidify control algorithm. The use of the Dehumidify Mode should be established by the shipper. When the Dehumidify Mode is ON, the supply air temperature must be in-range to activate dehumidification:

- a. When the humidity level is 2% or more above setpoint, the controller energizes (closes) the dehumidify valve. This reduces the size of the evaporator providing cooling by 50%, causing the coil to become colder and condense more moisture from the container air.
- b. When the humidity level is 5% or more above setpoint, the controller also pulses the electric heaters ON and OFF. This increases the cooling load on the evaporator coil, thereby causing the coil to become even colder and condense more moisture from the container air.

Sequence Of Operation

Unit Start-up

A 60 second sequence start of the required loads occurs during initial start-up of the controller. If cooling (or heating) is required, the unit operates in the cool (or heat) mode.

- When the unit On/Off switch is turned ON, the LED display turns On and then Off.
- The setpoint appears briefly in the LED display.

NOTE: When the setpoint appears in the LED display, both the Return and Supply LEDs are lit.

- The LED then shows the controlling air sensor temperature.
- The controller senses the incoming power phase and selects the correct power phase to unit components.
- About 40 seconds after the unit was turned ON, the evaporator fan motors start.
 - Evaporator fans operate on high speed at setpoints of - 9.9 C (14.1 F) and above.
 - Evaporator fans operate on low speed at setpoint temperatures of -10 C (14 F) and below.
- About 10 seconds later, the compressor starts if the controller calls for cooling.
- The condenser fan then starts if the condenser temperature requires condenser fan operation.
- If the controller calls for heating, the electric heaters are pulsed On and Off to provide heat.
- The controller turns ON the In-range LED when the controlling sensor temperature is within 1.5 C (2.7 F) of the setpoint.

NOTE: Random time delays during the initial unit start-up minimize peak current draw.

Continuous Temperature Control Operation

Chill Loads — Controller Setpoint at -9.9 C (14.1 F) and Above

The controller regulates the compressor, stepper motor valve and electric heaters based on a Control Temperature Differential (see “General Theory of Operation” in this chapter for more detail). This means the unit operating mode can NOT be predicted based ONLY on the setpoint and supply air temperature.

At setpoints of -9.9 C (14.1 F) and above, the controller operates the unit on:

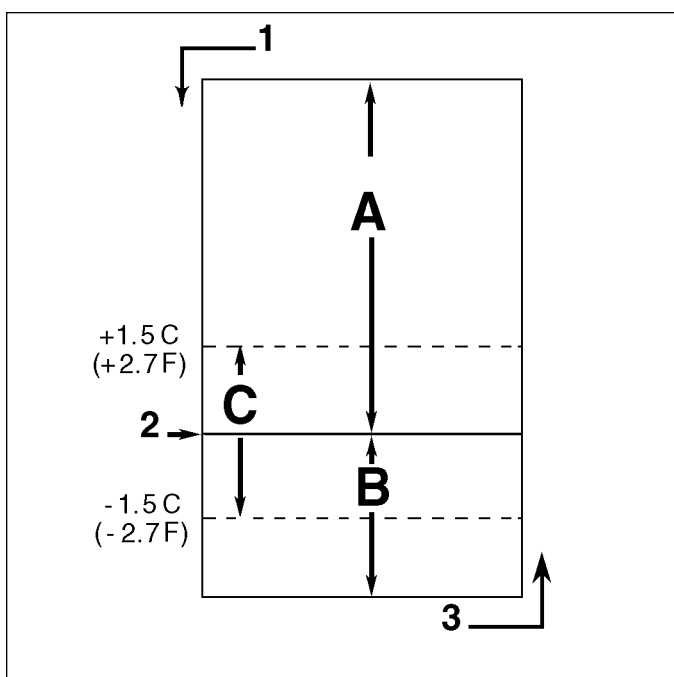
- Cool mode with Modulation
- Controller energizes the liquid injection valve continuously when the modulation percent is 75% or less.
- Controller energizes the warm gas bypass valve on a 30 second duty cycle when the modulation percent is 75% or less. The amount of ON (open) time increases as the modulation percent decreases.
- Heat mode (electric heaters pulse On and Off on a 60 second duty cycle)
- Defrost mode (electric heaters On, evaporator fans Off)
- Evaporator fans operate on high speed (except when Economy mode is ON and temperature is In-range) and continuously circulate air inside the container (except during defrost)
- Controller LED display shows the supply air sensor temperature.
- Controller LCD display shows the setpoint temperature.
- Controller uses the condenser coil temperature and a PID algorithm to cycle a single-speed condenser fan between ON and OFF on a 30 second duty cycle.
- Power limit is active when the unit is operating in the Cool mode.

Cool with Modulation

- Controller calls for the Cool mode whenever the Control Temperature Differential (based on supply air temperature) is above setpoint.
- Controller turns ON the Compressor LED when the compressor is operating.
- Controller opens and closes stepper motor valve to regulate the flow of refrigerant to the compressor. The position of the stepper motor valve balances the unit cooling capacity against the actual load requirements.
- Controller turns ON the In-range LED when the supply air sensor temperature is within 1.5 C (2.7 F) of setpoint.
- Supply air sensor control algorithm increases temperature control accuracy and protection against frost damage (see “Chill Loads” under General Theory of Operation in this chapter).
- Controller pulses electric heaters ON and OFF for additional frost protection if the return air temperature decreases to within 0.3 C (0.5 F) of setpoint.
- Controller turns ON the Heat LED whenever the heaters are pulsed ON and OFF.

Heat

- Controller pulses electric heaters ON and OFF on a 60 second duty cycle for additional frost protection if the return air temperature decreases to within 0.3 C (0.5 F) of setpoint.
- Controller turns ON the Heat LED whenever the heaters are pulsed ON and OFF.
- If the supply air temperature is too low and the Control Temperature Differential is above the setpoint, the controller stops the compressor and pulses the electric heaters ON and OFF on a 60 second duty cycle to provide heat. The controller pulses the electric heaters ON and OFF until the supply air temperature increases to setpoint.



Chill Load Control Sequence (Setpoints at -9.9 C [14.1 F] and Above)

- Cool with Modulation* (control temperature differential is above setpoint)
- Heat (electric heaters pulse ON and OFF on a 60 second duty cycle if return air temperature decreases within 0.3 C [0.5 F] of setpoint or supply air temperature is too low)
- In-Range (based on supply air temperature)
 - Decreasing Temperature
 - Setpoint
 - Increasing Temperature

***NOTE: Controller also energizes liquid injection valve and warm gas bypass valve as modulation percent decreases.**

Operating Mode Function Chart — Standard Operation

Chill Loads Setpoints at -9.9 C (14.4 F) and Above			Frozen Loads Setpoints at -10.0 C (14.0 F) and Below			Unit Function
Cool w/Mod	Heat	Defrost	Cool	Null	Defrost	
•	•					Evaporator Fans HIGH SPEED ¹
			•	•		Evaporator Fans LOW SPEED ¹
		•			•	Evaporator Fans OFF ¹
•	•					Proportional-integral Derivative (Supply Air) Control
			•	•		Return Air Sensor Control
		•			•	Evaporator Coil Sensor Control
•			•			Compressor ON
•			•			Compressor Liquid Injection ON (valve energized) ²
•						Warm Gas Bypass Solenoid Valve OPEN (energized) ³
•			•			Condenser Fan ON ⁴
•			• ⁵			Stepper Motor Valve MODULATING (energized) ⁵
•	•	•			•	Electric Heaters PULSING or ON (energized) ⁶

¹Setpoint temperature determines the evaporator fan speed except when Economy Mode is ON. When Economy Mode is ON:

- Chill Loads: If supply air temperature is in-range, evaporator fans operate on low speed.
- Frozen Loads: If return air temperature is in-range, evaporator fans stop during Null mode. A null state timer automatically re-starts the fans on low speed for 5 minutes every 45 minutes.

²Controller OPENS (energizes) the liquid injection valve continuously:

- For 5 minutes whenever the compressor starts.
- Chill or Power Limit Mode: When the modulation percent is 75% or less.
- When the compressor discharge temperature exceeds 138 C (280 F).

³Controller OPENS (energizes) the warm gas bypass valve on a 30 second duty cycle:

- Chill Mode: When the modulation percent is 25% or less. The amount of OPEN (energized) time increases as the modulation valve closes until the bypass valve remains energized continuously (modulation = 0%).

⁴Condenser fan operation is determined by a control algorithm so ON/OFF operation can not be predicted. In low ambient conditions, controller pulses the condenser fan ON and OFF on a 30 second duty cycle to maintain a minimum condenser temperature:

- Chill Loads: Controller maintains a minimum 30 C (86 F) condenser temperature.
- Frozen Loads: Controller maintains a minimum 20 C (68 F) condenser temperature.

NOTE: The condenser fan operates continuously if the compressor or condenser temperature sensor is defective.

⁵Stepper motor valve MODULATES:

- Chill Loads: Whenever the unit is in a cooling mode.
- Power Limit: Whenever the unit is in Power Limit mode.

⁶Controller energizes electric heaters for frost protection, heat and defrost modes:

- Frost Protection (during compressor operation): If return air temperature decreases to within 0.3 C (0.5 F) of setpoint, controller PULSES heaters ON and OFF on a 30 second duty cycle.
- Heat mode (compressor OFF): If supply air temperature is too low, the controller PULSES heaters ON and OFF on a 60 second duty cycle.
- Defrost mode: Controller turn heaters ON until evaporator coil temperature increases to:
 - Chill Loads: 30 C (86 F) or exceeds 18 C (65 F) for 15 minutes.
 - Frozen Loads: 18 C (65 F) or exceeds 8 C (46 F) for 15 minutes.

Frozen Loads — Controller Setpoint at -10 C (14 F) and Below

At setpoints of -10 C (14 F) and below, the controller locks out the Modulation and Heat modes. The controller regulates compressor operation based the return air sensor and setpoint temperatures.

At setpoints of -10 C (14 F) and below, the controller operates the unit on:

- Cool mode
- Null mode
- Defrost mode (electric heaters On, evaporator fans Off)
- Evaporator fans operate on low speed and continuously circulate air inside the container (except during defrost; or when Economy mode is ON and the unit is in Null mode)
- Controller LED display shows the return air sensor temperature.
- Controller LCD display shows the setpoint temperature.
- Controller uses the condenser coil sensor temperature and PID algorithm to cycle a single-speed condenser fan ON and OFF on a 30 second duty cycle.
- Power limit is active during initial start-up and pull-down when the unit is cooling at return air temperatures above -10 C (14 F).

Cool

- After initial start-up and pull-down to 1.0 C (1.8 F) below setpoint, the controller calls for the Cool mode whenever:
 - Return air temperature increases more than 1.0 C (1.8 F) above setpoint; or
 - Compressor has been OFF for 15 minutes (maximum).
- Controller turns ON the Compressor LED when the compressor is operating.
- Compressor must operate for a minimum of 5 minutes after startup.
- After initial pull-down to setpoint, controller keeps the In-range LED ON as long as the return air temperature remains less than 1.5 C (2.7 F) above setpoint.

Null

- The controller calls for Null when the Return Air Temperature decreases more than 1.0 C (1.8 F) below setpoint.
- The controller stops the compressor and condenser fan.
- The evaporator fans continue to operate (except when Economy mode is ON).
- Compressor remains OFF for a minimum of 5 minutes.

Operating Mode Function Chart — Optional Feature Operation

Chill Loads Setpoints at -9.9 C (14.4 F) and Above			Frozen Loads Setpoints at -10.0 C (14.0 F) and Below			
Cool w/Mod	Heat	Defrost	Cool	Null	Defrost	Unit Function
						Economy Mode ON: Evaporator Fans HIGH SPEED ¹
•	•		•			Economy Mode ON: Evaporator Fans LOW SPEED ¹
		•		•	•	Economy Mode ON: Evaporator Fans OFF ¹
•						Dehumidify ON: Dehumidify Valve CLOSED (energized) ²
•						Dehumidify ON: Electric Heaters ON (energized) ²
•	•					Humidify ON: Air Compressor ON (energized) ³

¹Economy Mode ON: • On Chill Loads, the evaporator fans operate on low speed when the supply air temperature is In-range.
• On Frozen Loads, the evaporator fans stop during the Null mode when the return air temperature is In-range. A timer re-starts the evaporator fans on low speed for 5 minutes every 45 minutes. If cooling is required, the evaporator fans operate until the unit returns to Null mode.

²Dehumidification Option: When the Dehumidify Mode is set to ON, the supply air temperature must be in-range to CLOSE (energize) the dehumidify valve:

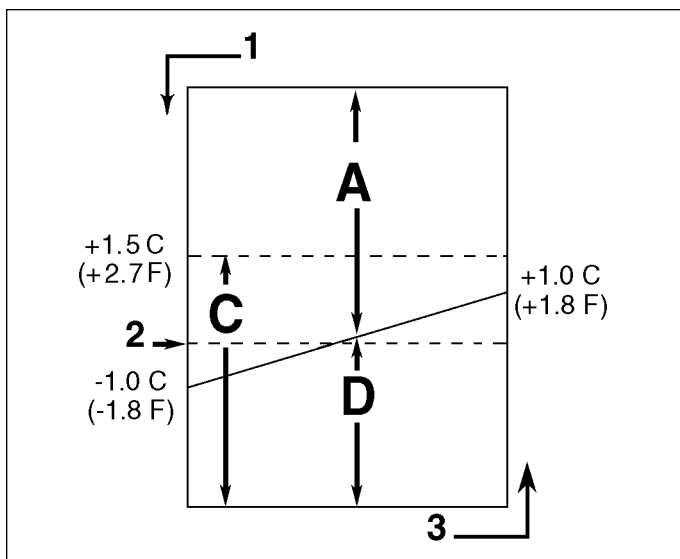
- When the humidity is 2% or more above humidity setpoint, the controller CLOSES (energizes) the dehumidify valve.
- When the humidity is more than 5% above humidity setpoint, the controller also pulses the electric heaters ON and OFF.

³Humidification Option: When the container humidity is more than 2% below the humidity setpoint, the controller operates (energizes) the air compressor to inject atomized water directly into the evaporator supply air stream.

Defrost

The evaporator coil sensor temperature must be below 18 C (65 F) to initiate a Demand Defrost or Manual Defrost. The evaporator coil sensor temperature must be below 10 C (50 F) to initiate a Timed Defrost.

- Demand defrost function initiates defrost immediately when:
 - Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large
 - Temperature difference between the left hand and right hand supply air sensors is too large and unit has operated for more than 90 minutes since last defrost
 - Temperature difference between the supply sensors and return air sensor is too large
- Manual Defrost may be initiated immediately by pressing the Defrost key or by Refcon Remote Monitoring Modem (RMM).
- A Timed Defrost always starts at 1 minute past the hour immediately following a defrost timer request for defrost. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. The datalogger will record a Defrost event for each log interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs on 1 hour logging interval).



Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)

- A. Cool*
- C. In-Range
- D. Null*
- 1. Decreasing Temperature
- 2. Setpoint
- 3. Increasing Temperature

*If the compressor stops, it must remain OFF for a minimum of 5 minutes. When the compressor re-starts, it must stay ON for a minimum of 5 minutes.

- On Chill Loads (setpoints at -9.9 C [14.1 F] and above), the initial time interval is:
 - 8 hours of compressor operation at supply air temperatures of 5.1 C (41.2 F) or above.
 - 2.5 hours of compressor operation at supply air temperatures of 5.0 C (41.0 F) or below. One-half (0.5) hour is added to the time interval each timed defrost interval. Defrost synchronization creates step intervals of 3, 4, 4, 5, 5, 6, 6 and 7 hours. Maximum time interval is 7 hours.
- On Frozen Loads, the initial time interval is 8 hours. Two (2) hours are added to the time interval each timed defrost interval. Maximum accumulated time interval is 24 hours.
- Defrost timer resets if the unit is Off more than 12 hours, setpoint is changed more than 5 C (8.9 F) or PTI Pretrip test occurs.

NOTE: If unit operating conditions do not allow the unit to enter a defrost cycle, "Defrost Not Activated" appears on LCD display when the DEFROST key is pressed.

When the defrost mode is initiated:

- The controller stops the compressor, condenser fan and evaporator fans.
- When the compressor stops, the controller turns ON the Defrost LED, Heat LED and energizes the heater contactor, turning on the electric heaters.

The controller terminates the defrost mode when:

- Evaporator temperature:
 - Chill mode: Evaporator coil sensor temperature reaches 30 C (86 F); or exceeds 18 C (65 F) for 15 minutes.
 - Frozen mode: Evaporator coil sensor temperature reaches 18 C (65 F); or exceeds 8 C (46 F) for 15 minutes.
- Interval timer: Controller terminates defrost after 90 minutes on 60 Hz power (120 on 50 Hz power). Alarm code 20 will be generated if this occurs.
- Power OFF: Turning unit On/Off switch Off terminates defrost.

When the defrost mode is terminated:

- The Heat and Defrost LEDs turn OFF and the heater contactor is de-energized. The controller starts the compressor to pre-cool the evaporator coil. The condenser fan starts if required.
- The controller pre-cools the evaporator coil to the supply air temperature (or for 3 minutes maximum) to minimize heat energy release into the container. The liquid injection valve is energized if the modulation percent is 75% or less. The controller then starts the evaporator fans.



Changing the Setpoint

NOTE: Humidity control, humidity setpoint and economy mode can also be set from the Setpoint menu. See “Setpoint Menu” under Menu Operating Instructions in this chapter.

To change the controller setpoint, turn the unit On/Off switch ON. With the standard LCD message display showing on the controller (i.e. setpoint temperature):

1. Press the SETPOINT key. The SETPOINT menu appears with the cursor in the “TEMP SETP” line.
2. Press the F4 key. An Enter Arrow appears in the menu line and the current setpoint disappears.
3. Enter (type) the new setpoint in the LCD display using the general purpose keypad. To enter a minus setpoint, press the EXIT (+/-) key first. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

NOTE: Always check that the setpoint entered in the LCD display is correct before proceeding.

4. Press and hold the F4 key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.

NOTE: If the setpoint is not entered within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat steps 1 through 4.



Initiating a Manual Defrost

With the unit On/Off switch ON:

1. Press the DEFROST key.
 - If the unit operating conditions allow a manual defrost (e.g. evaporator coil temperature is less than 18 C [56 F]), the unit enters defrost as the Defrost and Heat LEDs turn ON. LCD message display shows “DEFROST ACTIVATED”.
 - If unit operating conditions do NOT allow defrost, the LCD message display shows “DEFROST NOT ACTIVATED”.
2. The defrost cycle automatically terminates.

NOTE: If frost or ice can not be removed from the evaporator coil by an automatic defrost cycle, a “timed” defrost of the evaporator coil can be performed:

- Activate HEAT ON in the Manual Function Test sub-menu.
- Then press “5” key six times. Heaters will be activated for 70 minutes. Unit then returns to normal operation.



Displaying Alternate Controlling (Supply or Return) Air Sensor Temperature

The controller can show either the supply or return air temperature in the LED Display. With the unit On/Off switch ON and the controller showing the standard LED Display:

1. Check the indicator LEDs to determine which sensor temperature (supply air or return air) currently appears in the right display. This is the controlling sensor.
2. To view the alternate (supply or return) air temperature, press and hold the SUP/RET key. The controller will show the alternate sensor temperature as long as the SUP/RET key is depressed.
3. The display then returns to the controlling sensor temperature when the SUP/RET key is released.



Displaying Alternate Fahrenheit (F) or Celsius (C) Temperatures

The controller can display temperatures in Fahrenheit or Celsius. With the unit On/Off switch ON and the controller showing a standard LED Display:

1. Press and hold the C/F key. The controller will show both the LED and LCD display temperatures in the alternate temperature scale (Fahrenheit or Celsius) as long as the C/F key is depressed.
2. The display then returns to the original display when the C/F key is released.

NOTE: To change the default temperature unit display, press and hold the C/F key, then press the SET-POINT key for 1 second.

Navigating the Controller Menu

NOTE: To view the controller's menu or download data when external power is disconnected from the unit, press a special key: C/F key, SUP/RET key, DEFROST key or SETPOINT key. The controller LCD display will appear using 12 Vdc battery power.

The MP-3000 Main Menu is divided into seven major menus:

- Setpoint
- Data
- Alarm List
- Commands
- Misc. Functions
- Configuration
- Datalogger
- Remote Monitoring (RMM) State

Moving through these seven menus and their submenus and entering commands requires the use of four text keys:



F1 key: Press the F1 key each time you want to exit a submenu and/or retrieve current system data for display.



or



F2 or F3 key: Press the F2 or F3 key each time you want to scroll up or down to view another item in a menu or submenu; or scroll forward or backward in a menu line.



F4 key: Press the F4 key to enter a new menu or submenu; to access a menu line to enter information; or to load a command or value.

General Operating Tips

- Quickly change display temperature units between C and F: Press and hold the C/F key, then press the SETPOINT key for 1 second.
- Increase display time for current LCD data screen: Press the “5” key to increase display time by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests.
- Slowly cool (initial pull-down) a warm load: Set power management to 13 amps.
- Password for Configuration changes is “A”: Press F2 key, “A” key, F4 key and then EXIT key.
- Delay Defrost for 24 hours during unit diagnosis or testing: Press “7” key and F1 key at the same time. Press F3 key to scroll cursor down to DELAY DEF menu line. Then press F4 key, F2 key, “A” key, F4 key and EXIT key. Cursor moves to end of line and flashes. Press F3 key to toggle OFF to ON. Then press and hold F4 key until cursor stops flashing.
- Perform a “timed” defrost of evaporator coil: Activate HEAT ON in the Manual Function Test submenu. Then press “5” key six times. Heaters will be activated for 70 minutes. Unit automatically returns to normal operation.

Setpoint Menu

Pressing the SETPOINT key displays a list of tasks and values that can be activated or set:

- Setpoint Temperature
- Economy Mode
- Airflow
- Custom Airflow
- Bulb Mode
- Humidity Control
- Humidity Setpoint
- AFAM Control
- AFAM Delay
- AFAM Rate
- O₂ Minimum
- CO₂ Maximum

Changing the Setpoint Temperature

See “Changing the Setpoint” on page 4-12.

Changing the Economy Mode Setting

NOTE: Enter Setpoint temperature before turning ON the Economy mode. The controller automatically turns the Economy mode OFF when the setpoint is changed.

1. Press the SETPOINT key. The SETPOINT menu appears with the cursor in the “TEMP SETP” line.
2. Press F2 key to scroll to “ECONOMY MODE” line.
3. To change the mode setting, press F4 key. Cursor moves to end of menu line and flashes.
4. Press F2 key to toggle between OFF and ON.
5. With the desired state in the menu line, press and hold F4 key until cursor stops flashing. New mode setting appears in display.

NOTE: On frozen loads, the Economy Mode also modifies the temperature control algorithm to to extend the Null mode. See “Economy Min.” and “Economy Max.” under Configuration Menu in this chapter to check the current settings or enter new settings.

6. Press ESC key to exit the SETPOINT screen.

Changing the Humidity Mode Setting

1. Press the SETPOINT key. The SETPOINT menu appears with the cursor in the "TEMP SETP" line.
2. Press F2 key to scroll to "HUM CONTROL" line.
3. To change the mode setting, press F4 key. Cursor moves to end of menu line and flashes.
4. Press F2 key to toggle between OFF and ON.
5. With the desired state in the menu line, press and hold F4 key until cursor stops flashing. New mode setting appears in display.
6. Press ESC key to exit the SETPOINT screen.

Changing the Humidity Setpoint

1. Press the SETPOINT key. The SETPOINT menu appears with the cursor in the "TEMP SETP" line.
2. Press F2 key to scroll to "HUM SETP" line.
3. To enter a new setpoint, press the F4 key. An Enter Arrow appears in the menu line and the current setpoint disappears.
4. Enter (type) the new setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

NOTE: Always check that the setpoint entered in the LCD display is correct before proceeding.

5. Press and hold the F4 key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.
6. Press ESC key to exit the SETPOINT screen.

Data Menu

NOTE: Information can ONLY be displayed using the Data menu. Items can NOT be changed.

The Data menu displays general unit operating information including sensor temperatures, unit electrical data, etc.

Viewing the Data Menu

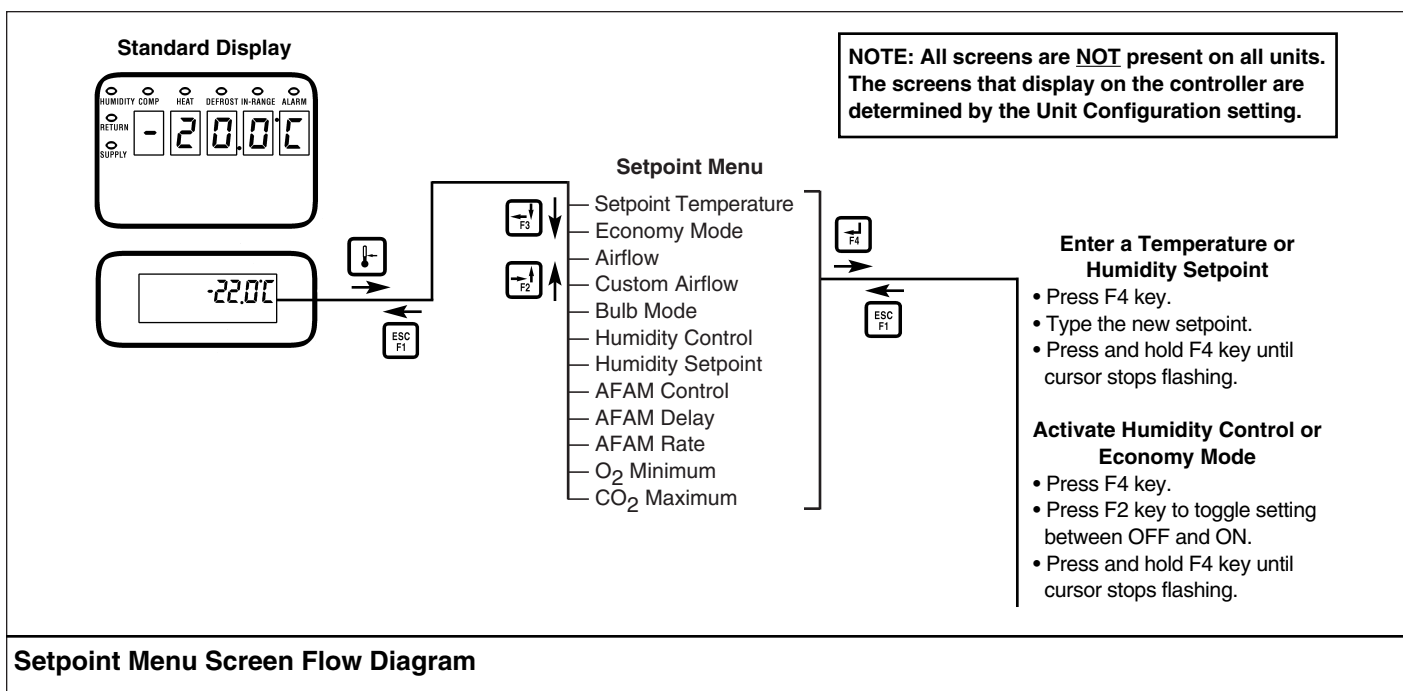
With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F4 key to directly enter the Data menu. Menu items appear in LCD display.

2. Press F3 to scroll the cursor down through the menu list.

The Data menu displays the following functions:

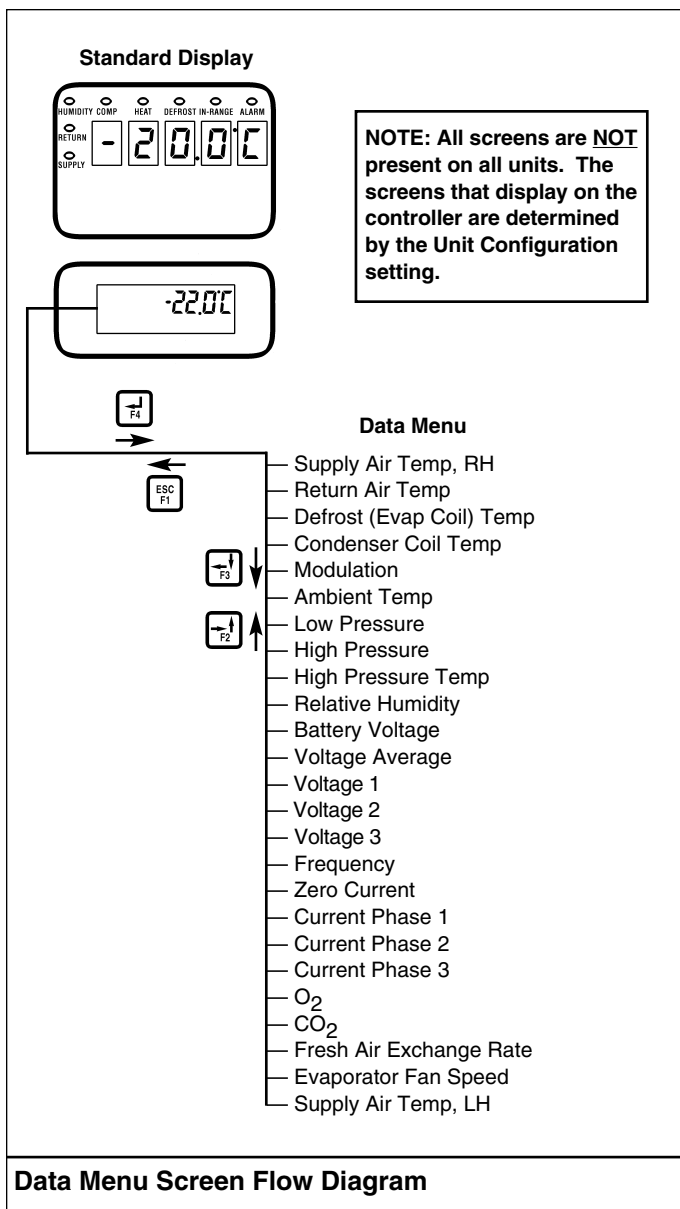
- Supply Air Temperature, Right Hand
- Return Air Temperature
- Evaporator Coil (Defrost) Temperature
- Condenser Coil Temperature
- Modulation
- Ambient Temperature
- Low Pressure
- High Pressure
- High Pressure Temperature (Compressor Discharge Line Temperature)
- Relative Humidity
- Battery Voltage
- Voltage Average (380/460V Power Supply)
- Voltage 1 (Main Power Supply)
- Voltage 2 (Main Power Supply)
- Voltage 3 (Main Power Supply)
- Frequency (Main Power Supply)
- Zero Current
- Current Phase 1 (Main Power Supply)



- Current Phase 2 (Main Power Supply)
- Current Phase 3 (Main Power Supply)
- O₂
- CO₂
- Fresh Air Exchange Rate
- Evaporator Fan Speed
- Supply Air Temperature, Left Hand

NOTE: Press the “5” key to lock a Data screen in the LCD display for 5 minutes. Press any key to unlock the display.

NOTE: Controller returns to previous menu level or LCD Standard Display after 30 seconds.



Alarms Menu

The Alarm List menu displays alarm codes. Alarm codes are recorded in the controller memory to simplify unit diagnosis procedures. Some alarm codes are only recorded during a Pretrip (PTI) Test or Function Test. Fault codes are retained by the controller in a non-volatile memory. If the Alarm LED is ON or flashing ON and OFF, enter the ALARM LIST to view the alarm code(s).

Alarm Types

There are three types of alarms:

- Shutdown Alarm (Level 1): Alarm LED flashes and unit stops. Shutdown alarms indicate the unit has been stopped to prevent damage to the unit or cargo. The condition must be corrected before restarting the unit. Alarm code 56 (compressor temperature too high) is a shutdown alarm.
- Check Alarm (Level 2): Alarm LED flashes until alarm is acknowledged. Check alarms indicate corrective action should be taken before a problem becomes severe. Alarm codes 00-17, 18, 19, 20, 22-35, 41-46, 52-54, 58, 60, 99-112 are Check alarms.
- Log Alarm (Level 3): Alarm is recorded in datalogger only (inspect event log). Alarm LED does not flash or turn on. Alarm codes 36-37, 59, 97, 98 are Log alarms.

Alarm Code States

There are three alarm code states for Shutdown and Check alarms:

- NOT ACTIVE: An alarm condition has occurred but no longer exists in the unit. Not Active means the condition was corrected and did not recur for 1 hour; or the unit On/Off switch was turned OFF and then ON.
 - When a NOT ACTIVE alarm code is acknowledged (F4 key pressed while alarm code appears in LCD display), the Alarm LED will turn OFF and the alarm code disappears from the alarm list.
- ACTIVE: An alarm condition has occurred and continues to exist in the unit; or the alarm condition occurred within the past 1 hour but does not currently exist in the unit.
 - If the alarm condition currently exists in the unit and the alarm code is acknowledged, the Alarm LED will stop flashing but remain ON. The alarm code state will change to ACKNOWLEDGE in the alarm list.
 - If the alarm condition no longer exists in the unit and the alarm code is acknowledged, the Alarm LED will turn OFF and the alarm code disappears from the alarm list.

- **ACKNOWLEDGE:** An alarm code has been viewed and acknowledged in the alarm list. The Alarm LED remains ON but does not flash.
 - If the alarm condition is corrected, the Alarm LED will turn OFF and the alarm code disappears from the alarm list.

Viewing the Alarm List Menu

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F2 key to directly enter the Alarms menu. The first alarm code number, alarm state and alarm description appears in LCD display.

NOTE: Alarm codes are displayed in sequential order, not in the order of occurrence.

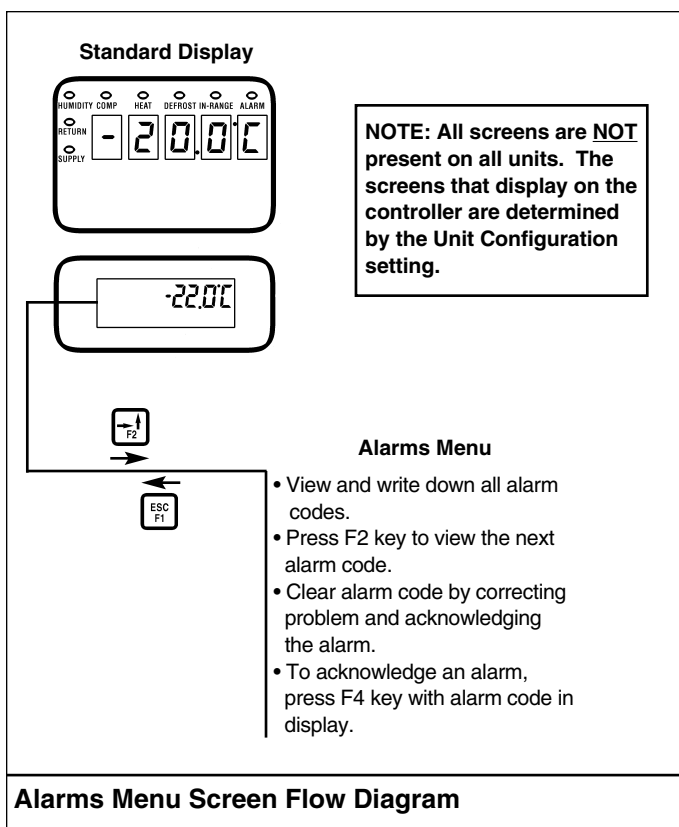
2. Write down the first alarm code. Then press F2 key to view the next alarm code when more than one alarm code has been recorded.
3. Repeat step 4 until all alarm codes have been recorded. To scroll backward to return to a previous alarm code, press F3 key.
4. To clear all alarm codes from the current display list and turn off the Alarm LED, all problems must be corrected and the alarm code “acknowledged” in the Alarm List menu.

NOTE: To acknowledge an alarm, press F4 while the alarm code appears on the screen. The alarm state will change from ACTIVE or NOT ACTIVE to ACKNOWLEDGE.

NOTE: If no key is pressed for 30 seconds, the controller returns to the previous menu level or the LCD Standard Display.

Alarm List

Alarm Code	Type	Description
00	Check	Supply Air Sensor Open Circuit
01	Check	Supply Air Sensor Short Circuit
02	Check	Return Air Sensor Open Circuit
03	Check	Return Air Sensor Short Circuit
04	Check	Evaporator Coil Open Circuit
05	Check	Evaporator Coil Sensor Short Circuit
06	Check	Compressor Current Too High
07	Check	Compressor Current Too Low
10	Check	Heater Current Too High
11	Check	Heater Current Too Low
12	Check	Evaporator Fan High Speed Current Too High
13	Check	Evaporator Fan High Speed Current Too Low
14	Check	Evaporator Fan Low Speed Current Too High
15	Check	Evaporator Fan Low Speed Current Too Low
16	Check	Condenser Fan Current Too High
17	Check	Condenser Fan Current Too Low
18	Log	Power Supply Phase Error
19	Check	Temperature Too Far from Setpoint
20	Check	Defrost Time Too Long
22	Check	Capacity Test 1 Error
23	Check	Capacity Test 2 Error
24	Check	Capacity Test 3 Error
25	Check	Evaporator Temperature Test Error
27	Check	Heat Capacity Test Error
28	Check	Suction Stepper Valve Error
29	Check	Liquid Injection Valve Error
30	Check	Bypass (Warm Gas) Valve Error



31	Check	Low Pressure Cutout Error
32	Check	Condenser Air Sensor Open Circuit
33	Check	Condenser Air Sensor Short Circuit
34	Check	Ambient Air Sensor Open Circuit
35	Check	Ambient Air Sensor Short Circuit
36	Check	Current Too High
37	Check	Current Too Low
41	Check	Supply Air Temperature Too High
42	Check	Supply Air Temperature Too Low
43	Check	Return Air Temperature Too High
45	Check	Evaporator Coil Temperature Too High
46	Check	Evaporator Coil Temperature Too Low
52	Check	Probe Error
53	Check	High Pressure Cutout Switch Off Error
54	Check	High Pressure Cutout Switch On Error
56	Shutdown	Compressor Temperature Too High
58	Check	Phase Sensor Error
59	Check	Delta Current Error
60	Check	Humidity Sensor Error
97	Log	Compressor Sensor Open Circuit
98	Log	Compressor Sensor Short Circuit
99	Check	USDA 1 Sensor Open Circuit
112	Check	Zero Current Too High

Commands Menu

The Commands menu displays a list of tasks that can be activated. The following commands are available:

- Defrost: Manual defrost can be initiated. When command is activated, LCD message display will show ACTIVATED, NOT ACTIVATED (evaporator temperature above 18 C [50 F]) or ALREADY ACTIVATED (defrost in progress).
- Function Test: Controller automatically tests the operation of individual unit components. This is not a performance test of the complete system. See “Function Test” in this chapter for test details.
- PTI (Pretrip) Test: Controller automatically completes a test of individual components and checks unit refrigeration capacity, heating capacity and temperature control. See “PTI (Pretrip) Test” in this chapter for test details.

CAUTION: The PTI test should only be performed on an empty container!

- Manual Function Test: Controller tests individual components selected by the technician for diagnosis. LCD display will show expected and actual current of the component being tested.
- Power Management: Sets the power limit and power limit activation (“On”) time.

Viewing the Commands Menu

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press the F3 key to enter the Main Menu.
2. Press F2 key to scroll through Main Menu until “COMMANDS” appears in LCD display.
3. Press F4 key to access the Commands menu. The first command in the submenu (Defrost) appears in the LCD display.
4. Press F2 or F3 key to scroll to the desired command:
 - Defrost
 - Function Test
 - PTI (Pretrip)
 - Manual Function Test
 - Power Management
5. Press F4 key to activate the command selected.
 - Defrost: LCD display shows DEFROST ACTIVATED, NOT ACTIVATED (evaporator temperature above 18 C [50 F]) or ALREADY ACTIVATED (defrost in progress). Defrost cycle ends automatically.

- **Function Test:** LCD display shows functional test currently being performed. Function test ends automatically. Unit automatically returns to normal operation.
- **PTI (Pretrip):** LCD display shows PTI Test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.
- **Manual Function Test:** LCD display shows list of unit components. Test the operation of individual components or turn several components ON at the same time to perform a system test.
- **Power Management:** LCD display shows current Power Limit setting and Power Time setting. Turn Power Limit feature ON and OFF, change power limit setting or change power limit time.

Defrost

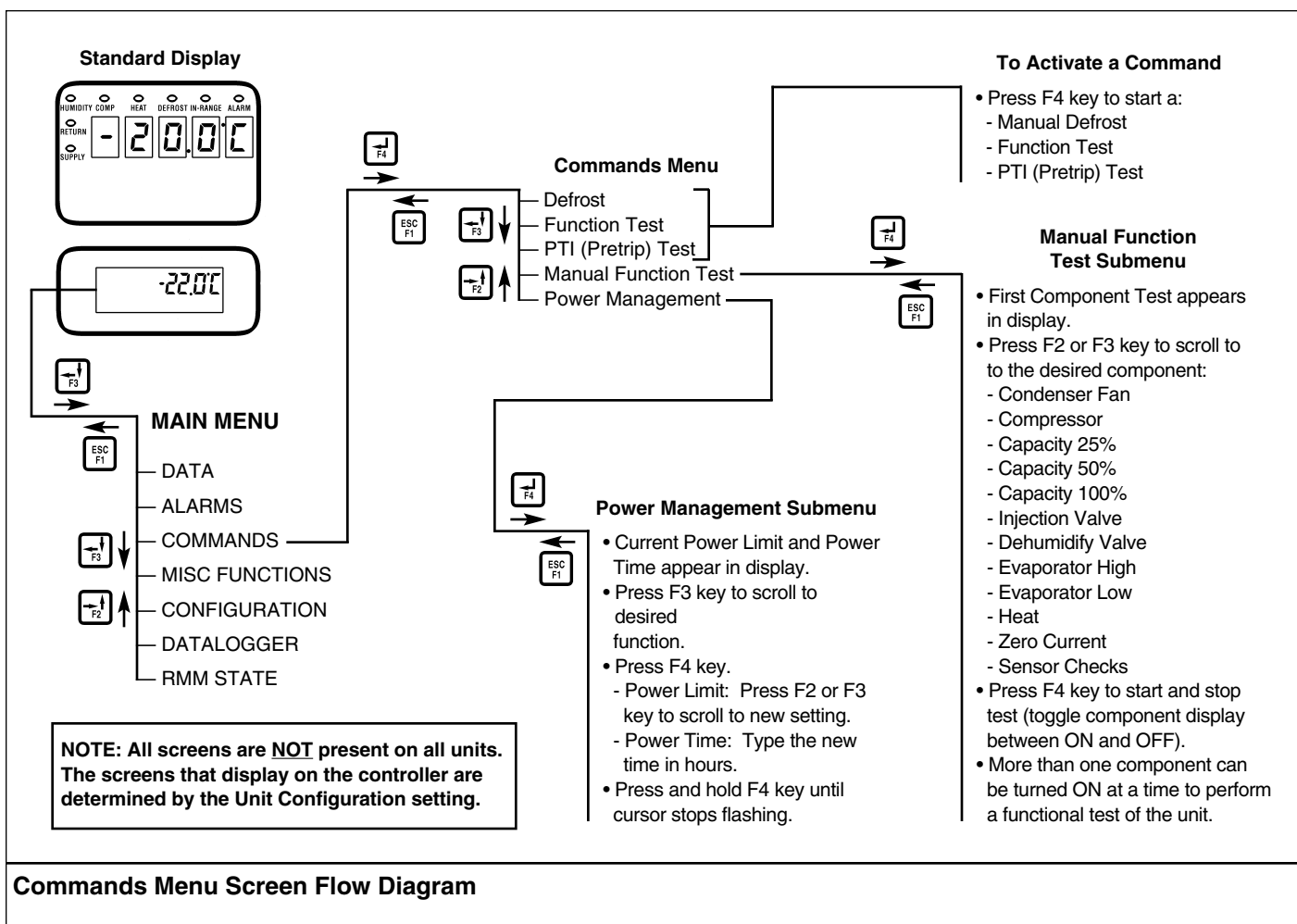
For a description of the Defrost function, see “Initiating a Manual Defrost” on page 4-12.

Function Test

The MP-3000 controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values.

For a detailed description of the Function Test, see pages 4-21 and 4-22. Any alarm codes recorded during the test can be viewed through the controller’s Alarm List menu at the end of the test.

NOTE: The Function Test does not test the actual performance of the complete system. Therefore it is not a Pretrip test and should not be used instead of the PTI Test.



Pretrip (PTI) Test

CAUTION: *The PTI test should only be performed on an empty container!*

NOTE: *Units equipped with a water-cooled condenser must be set to operate on air-cooled condensing to perform a complete system capacity test.*

The MP-3000 controller contains a special PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, contactors, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values. The test takes about 2 to 2.5 hours to complete, depending on the container and ambient temperature.

NOTE: *Correct all existing alarm conditions and clear the alarm codes before performing a PTI test. The controller will automatically clear all existing alarms before beginning the PTI test.*

For a detailed description of the PTI Test, see pages 4-23 through 4-27. Detailed PTI test results are stored in the MP-3000 Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.

Manual Function Test

The Manual Function Test menu allows technicians to perform specific diagnostic tests on individual components or turn several components ON at the same time to perform a system test.

NOTE: *When the Manual Function Test menu is entered, the UNIT STOPS. A technician can then select the control circuit or component to be checked/tested from the items shown in the menu.*

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the menu list. Repeatedly press F2 key to scroll through Main Menu until "COMMANDS" appears in LCD display.
2. Press F4 key to access the Commands menu. The first command in the submenu (Defrost) appears in the LCD display.
3. Press F2 or F3 key to scroll to Manual Function Test.
4. Press F4 key to enter the Manual Function Test: "CONDENSER OFF" appears in the LCD display.

5. • To test a unit component:
 - a. Press F2 or F3 key to scroll to desired component test:
 - Condenser Fan
 - Compressor
 - Capacity 25% (Stepper valve position)
 - Capacity 50% (Stepper valve position)
 - Capacity 100% (Stepper valve position)
 - Injection Valve
 - Dehumidify Valve
 - Evaporator High
 - Evaporator Low
 - Heat
 - Zero Current (View value only)
 - Sensor Checks (Probe Test): Operates high speed evaporator fans only. After 5 minutes, check the temperatures of the left and right hand supply sensors, return sensor and defrost sensor. Temperatures should be approximately equal.
 - b. Press F4 key to start the component test. LCD display will change the component state from OFF to ON.
 - c. Verify component performance: LCD display will show expected current and actual current on phase 1, 2 and 3.
 - d. Press F4 key again to stop test. LCD display will change component state from ON to OFF.

NOTE: *Controller returns unit to normal operation if no keys are pressed for 10 minutes. Pressing "5" key extends test time by 10 minutes each time it is pressed (maximum time = 100 minutes). Pressing any other key resets test time to 10 minutes.*

6. • System Test (test multiple components at the same time):
 - a. Press F2 or F3 key to scroll to the first component.
 - b. Press F4 key to turn the component ON.
 - c. Press F3 key to scroll to select next component. Press F4 to turn component ON.
 - d. Repeat step 6c. until all required components are ON. For example, to operate unit in Full Cool mode, start the following components:
 - Condenser Fan
 - Compressor
 - Capacity 100%
 - Evaporator High or Low
 - e. Observe current draw and system performance to verify component(s) performance.

CSR PS Function Test Procedure

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
F1.00	Display Test Activated 0.1 A 0.0 A 0.1 A	Event Log for Function Test begins. All alarms are turned OFF. Alarm list is cleared. All lights and bars in display turn ON.	None	10 Seconds
F1.01	Sensor Test Activated 0.1 A 0.0 A 0.1 A	All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 28, 31, 32, 33, 34, 35, 97, 98, 112	2 Seconds
F1.02	Evaporator Fan Low Activated 1.1 A 1.0 A 1.1 A	Amp draw is measured and compared to voltage and frequency. • CSR40 PS: 0.8 Amps approx. at 50 Hz, 1.1 Amps approx. at 60 Hz • CSR20 PS and CSR40SL PS: 1.2 Amps approx. at 50 Hz, 1.6 Amps approx. at 60 Hz	14, 15	10 Seconds
F1.03	Evaporator Fan High Activated 2.4 A 2.3 A 2.4 A	Amp draw is measured and compared to voltage and frequency: • CSR40 PS: 2.2 Amps approx. at 50 Hz, 2.6 Amps approx. at 60 Hz • CSR20 PS and CSR40SL PS: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz	12, 13	10 Seconds
F1.04	Condenser Fan Activated 0.8 A 0.7 A 0.8 A	Amp draw is measured and compared to voltage and frequency: 1.2 Amps Maximum.	16, 17	10 Seconds
F1.05	Reverse Phase Activated 0.8 A 0.7 A 0.8 A	Condenser fan stops. Reverse phase selector relay is energized and condenser motor is started in reverse for 2 seconds. Amp draw difference between correct and wrong motor rotation must be less than 0.2 amps.	58	30 Seconds
F1.06	Compressor Test Activated 7.1 A 7.0 A 7.1 A	With condenser fan ON and compressor ON, compressor is operated at 25% capacity. Amp draw is measured and compared to voltage. Evaporator temperature and condenser coil temperature are measured and stored.	06, 07, 31	14 Seconds
F1.07	Injection Valve Test Activated 7.6 A 7.5 A 7.6 A	Condenser fan and compressor remain ON. Liquid injection valve is turned ON. Amp draw is measured and verified to be a minimum of 0.2 amps higher than test F1.06.	29, 31	10 Seconds

CSR PS Function Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
F1.08	Low Pressure Test Activated 0.8 A 0.7 A 0.8 A	Condenser fan, compressor and liquid injection valve remain ON. Stepper valve is closed and low pressure cutout is verified to open.	31	10 Seconds
F1.09	Warm Gas Bypass Valve Activated 8.3 A 8.2 A 8.3 A	With condenser fan and compressor ON, compressor is operated at 25% capacity. Liquid injection valve is OFF. Bypass valve is turned ON. Amp draw measured and verified to be a minimum of 0.2 amps higher than test F1.06.	30	10 Seconds
F1.10	Heat Test Activated 5.2 A 5.1 A 5.2 A	Amp draw is measured and compared to voltage: • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V.	10, 11	10 Seconds
F1.11	Humidify Valve Test Activated 0.1 A 0.0 A 0.1 A	Dehumidify valve is turned ON for 2 seconds, OFF for 2 seconds and ON for 2 seconds to verify valve operation. Function Test log ends. Alarms (if any) are cleared from data logger. However, alarms (if any) remain in alarm list as not active until acknowledged.	None	6 Seconds

CSR PS Pretrip (PTI) Test Procedure

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.00	Display Test Activated 0.1 A 0.0 A 0.1 A	Event Log for PTI begins. All alarms are turned OFF. Alarm list is cleared. All lights and bars in display turn ON.	None	10 Seconds
P1.01	Sensor Test Activated 0.1 A 0.0 A 0.1 A	All sensors must have values within their measuring range. When CONTAINER ID begins with MAE, MSF or MWC prefix, at least 1 USDA sensor must be installed or USDA No. 1 OPEN alarm will be logged.	00, 01, 02, 03, 04, 05, 28, 31, 32, 33, 34, 35, 97, 98, 99 112	10 Seconds
P1.02	Heat Test Activated 5.2 A 5.1 A 5.2 A	Electric heaters are turned ON. Amp draw is measured and compared to voltage: • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V. Heater amperes are recorded in PTI log.	10, 11	10 Seconds
P1.03	Defrost Activated 5.2 A 5.1 A 5.2 A	If evaporator sensor is below +10 C (50 F), heat remains on until evaporator sensor reaches +18 C (65 F).	20	1 Hour Maximum
P1.04	Pre-Cool Activated 15.2 A 15.1 A 15.2 A	If the evaporator sensor is above +20 C (68 F), unit operates in Cool until sensor temperature is below +15 C (59 F).	22	1 Hour Maximum
P1.05	Evaporator Fan High Activated 2.4 A 2.3 A 2.4 A	Condenser fan and compressor are turned OFF. With evaporator fan on high speed, Amp draw is measured and compared to voltage and frequency: • CSR40 PS: 2.2 Amps approx. at 50 Hz, 2.6 Amps approx. at 60 Hz • CSR20 PS and CSR40SL PS: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz Evaporator fan high speed amperes are recorded in PTI log.	12, 13	10 Seconds

CSR PS Pretrip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.06	Probe Test Activated 2.4 A 2.3 A 2.4 A	Evaporator fans operate on high speed for 3 minutes. Then probe test runs until temperature difference between sensors stops increasing. Maximum temperature difference allowed: <ul style="list-style-type: none"> • Return/Evaporator: 1.5 C (2.7 F); return air sensor temperature must be 0.5 C (1.0 F) above evaporator sensor temperature • Return/Supply: 0.8 C (1.4 F); return air sensor temperature must be 0.5 C (1.0 F) above supply air temperature • LH Supply/RH Supply (if equipped): 0.5 C (0.9 F) 	52	3 Minutes Minimum to 13 Minutes Maximum
P1.07	Condenser Fan Activated 0.8 A 0.7 A 0.8 A	Condenser fan is turned ON. Amp draw is measured and compared to voltage and frequency: 1.2 Amps Maximum. Condenser fan amperes are recorded in PTI log.	16, 17	10 Seconds
P1.08	Reverse Phase Activated 0.8 A 0.7 A 0.8 A	Condenser fan stops. Reverse phase selector relay is energized and condenser motor is started in reverse for 2 seconds. Amp draw difference between correct and wrong motor rotation must be less than 0.2 amps.	58	30 Seconds
P1.09	Compressor Test Activated 7.1 A 7.0 A 7.1 A	With condenser fan ON and compressor ON, compressor is operated at 25% capacity. Amp draw is measured and compared to voltage. Evaporator temperature and condenser coil temperature are measured and recorded in PTI log.	06, 07	14 Seconds
P1.10	Injection Valve Test Activated 7.6 A 7.5 A 7.6 A	Condenser fan and compressor remain ON. Liquid injection valve is turned ON. Amp draw is measured and verified to be a minimum of 0.2 amps higher than test P1.09.	29	10 Seconds
P1.11	Low Pressure Test Activated 0.8 A 0.7 A 0.8 A	Condenser fan, compressor and liquid injection valve remain ON. Stepper valve is closed and low pressure cutout is verified to open.	31	10 Seconds

CSR PS Pretrip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.12	Warm Gas Bypass Valve Activated 8.3 A 8.2 A 8.3 A	With condenser fan and compressor ON, compressor is operated at 25% capacity. Liquid injection valve is OFF. Bypass valve is turned ON. Amp draw measured and verified to be a minimum of 0.2 amps higher than test P1.09.	30	10 Seconds
P1.13	Compressor High Pressure Activated 12.2 A 12.0 A 12.2 A	Stepper valve opened to 50% capacity. With compressor ON, evaporator fan operates on high speed until high pressure cutout occurs, causing significant amps drop. Maximum time depends on condenser coil temperature at start of test.	53	10 to 300 Seconds
P1.13	Compressor High Pressure Activated 4.5 A 4.4 A 4.5 A	With compressor OFF, condenser fan starts and operates until compressor starts, causing a significant amps increase. Compressor is then turned OFF. Condenser fan operates 60 seconds more to lower condenser temperature.	54	3 to 50 Seconds plus 60 Seconds
P1.14	Evaporator Fan Low Activated 1.1 A 1.0 A 1.1 A	Condenser fan and compressor are turned OFF. With evaporator fan on low speed, Amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> • CSR40 PS: 0.8 Amps approx. at 50 Hz, 1.1 Amps approx. at 60 Hz • CSR20 PS and CSR40SL PS: 1.2 Amps approx. at 50 Hz, 1.6 Amps approx. at 60 Hz 	14, 15	10 Seconds
P1.15	Capacity Test 1 Activated 12.1 A 12.0 A 12.1 A	With condenser fan ON, compressor ON, and evaporator fans on low speed, stepper valve is set to 50% capacity. Liquid injection valve is turned ON. A difference of approx. 4.5 C (8.0 F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures.	22	3 Minutes (4 Minutes on CSR20)

CSR PS Pretrip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.16	Capacity Test 2 Activated 13.2 A 13.0 A 13.2 A	With condenser fan ON, compressor ON, liquid injection valve ON and stepper valve set to 50% capacity, evaporator fans are changed to high speed. A difference of approx. 3.0 C (5.4 F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures. However, temperature difference must be less than in test P1.15.	23	2 Minutes
P1.17	Capacity Test 3 Activated 11.2 A 11.1 A 11.2 A	Stepper valve is almost closed (set to 250 value). With condenser fan ON, compressor ON liquid injection ON, bypass valve ON and evaporator fans on high speed, alarm is recorded if temperature difference exceeds: • CSR40 PS: 1.5 C (2.7 F) • CSR20 PS and CSR40SL PS: 3.0 C (5.4 F)	24	4 Minutes (5 Minutes on CSR20)
P1.18	Heat Test Activated 7.3 A 7.2 A 7.3 A	With heaters ON and evaporator fans on high speed, alarm is recorded if supply temperature is not at least 0.4 C (0.7 F) above the return air temperature.	27	4 Minutes
P1.19	Evaporator Temperature Test Activated 12.3 A 12.1 A 12.3 A	Stepper valve is set to 50% capacity. With condenser fan ON, compressor ON, and liquid injection valve ON, evaporator fans are turned OFF. The evaporator coil temperature must decrease to approx. -15 C (+5 F), depending on the return air temperature.	25	5 Minutes Maximum
P1.21	PTI Part 1 End 2.4 A 2.3 A 2.4 A	"PTI Part 1 End" is recorded in PTI log. Return/supply air temperature difference from tests P1.15, P1.16, P1.17 and P1.18 are recorded in PTI log. Condenser fan and compressor stop. Evaporator fans start and operate on high speed.	None	5 Minutes
P1.22	Pre-Heat Activated 7.9 A 7.9 A 7.9 A	If return air temperature is below 5 C (41 F), evaporator fans operate on high speed and heaters turn ON. Unit operates until return air temperature is above 5 C (41 F).	None	120 Minutes Maximum

CSR PS Pretrip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
Supply Temp.	PTI Running Setpoint: 0 C (32 F)	Unit operates in normal cool mode with 0 C (32 F) setpoint. When supply air temperature decreases to setpoint, "Chill Arrival" temperatures are recorded in PTI log.	23	120 Minutes Maximum
Supply Temp.	PTI Running Setpoint: 0 C (32 F)	Unit operates in normal mode with 0 C (32 F) setpoint for 30 minutes after previous test is completed. At the end of 30 minutes, "Chill End" temperatures are recorded in PTI log.	None	30 Minutes
Return Temp.	Defrost Activated 4.5 A 4.4 A 4.5 A	Unit operates in normal mode with -18 C (0 F) setpoint. When return air temperature decreases to -18 C (0 F), defrost is initiated. Defrost terminates when evaporator temperature increases to 18 C (65 F).	20	90 Minutes Maximum
Return Temp.	PTI Running Setpoint: -18 C (0 F)	<p>Unit operates in normal mode with -18 C (0 F) setpoint. When return air temperature decreases to setpoint, "Frozen Arrival" temperatures are recorded in PTI log.</p> <p>If unit is configured with humidity sensor, relative humidity must be between 20% and 95% or a Humidity Sensor alarm is recorded and stored in the PTI log.</p> <p>"PTI End" is recorded in the PTI log. A Trip Start is automatically activated.</p> <p>Current load port, discharge port, comment, and USDA entries are cleared from controller memory.</p> <p>Alarms (if any) are cleared from data logger. However, alarms (if any) remain in alarm list as not active until acknowledged.</p>	22, 60	180 Minutes Maximum
Return Temp.	PTI PASS: Press (Any) Key	<p>If alarms (errors) occurred during PTI test, LCD display shows PTI FAIL. Press any key to clear display.</p> <p>Unit will remain OFF unit any key is pressed again.</p>	NONE	—

- f. Press F4 key again to turn OFF components individually. Or press ESC key to exit Manual Function Test menu and turn ALL components OFF.
- g. Press ESC key to exit the Manual Function Test submenu.

NOTE: Controller returns unit to normal operation if no keys are pressed for 10 minutes. Pressing "5" key extends test time by 10 minutes each time it is pressed (maximum time = 100 minutes). Pressing any other key resets test time to 10 minutes.

Power Management

Selecting a Power Limit from the Power Limit screen turns ON the power reduction control algorithm that reduces total unit electric power consumption based on the Power Limit and Power Time settings.

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the menu list. Repeatedly press F2 key to scroll through Main Menu until "COMMANDS" appears in LCD display.
2. Press F4 key to access the Commands menu. The first command in the submenu (Defrost) appears in the LCD display.
3. Press F2 or F3 key to scroll to Power Management.
4. Press F4 key to enter Power Management submenu. LCD display shows the current Power Limit setting and Power Time setting.
5. To activate or change the power limit:
 - a. Press F4 key with cursor in the Power Limit menu line. Cursor moves to end of menu line and flashes.
 - b. Press F2 or F3 key to scroll to the desired power limit setting: OFF, 13 amps, 15 amps or 17 amps.
 - c. With the desired power limit in the menu line, press and hold F4 key until cursor stops flashing. Cursor stops flashing and new value appears in display.
6. To change the length of time power limit is active (ON):
 - a. Press F2 key to scroll to Power Time menu line (standard setting = 48 hours).
 - b. Press F4 key with cursor in the Power Time menu line. An Enter Arrow appears in the menu line and the previous time disappears.
 - c. Enter new active period in hours.
 - d. With the correct hours entered in the menu line, press and hold F4 key until cursor stops flashing. Cursor stops flashing and new value appears in display.
7. Press ESC key to exit the Power Management submenu.

Misc. Functions Menu

The Misc. Functions menu displays a list of functions that identifies trips and determines how the controller records and displays operating information. The following functions are available:

- Date Time: Sets the controller time and date.
- C/F Mode: Sets the temperature value (Celsius or Fahrenheit) the controller uses to record and display temperature (including historical data).
- Cargo Data: Sets important trip information about the container and the load in the controller.
- Program Version: Displays the current software version loaded in the controller: Controller (CTRL), EPROM and program serial numbers (SER NO).

NOTE: The Controller Label on the side of the control box shows the controller serial number and the EPROM version.

- Run Time: Displays and sets operating hours for the unit and components.

Viewing the Misc. Functions Menu

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the menu list. Press F2 key to scroll through Main Menu until "MISC. FUNCTIONS" appears in LCD display.
2. Press F4 key to access the Misc. Functions menu. The first command in the submenu appears in the LCD display: Date Time.
3. Press F2 or F3 key to scroll to the desired function:
 - Date Time
 - C/F Mode
 - Cargo Data
 - Program Version
 - Run Time
4. Press F4 key to access the function selected.

Setting the Date and Time

1. Press F3 key to enter the menu list. Press F2 key to scroll to "MISC. FUNCTIONS".
2. Press F4 key to access the Misc. Functions menu. "Date Time" appears in the LCD display.
3. Press F4 key to access the Date Time screen. Date Time screen appears with cursor in the Time menu line. Display shows time in "HH.MM.SS" where H = hour, M = minute and S = second.
4. To enter a new time, press F4 key with cursor in Time menu line. An Enter Arrow appears in the menu line and the previous time disappears.

- Enter new time in “HH.MM.SS” format. Decimal points must be included in the entry between the hour, minute and second.

NOTE: To scroll backward in the Time or Date menu line, press and hold the F4 key, then press F3 key. Press F1 key to return keyboard to “numerical” entry before typing again.

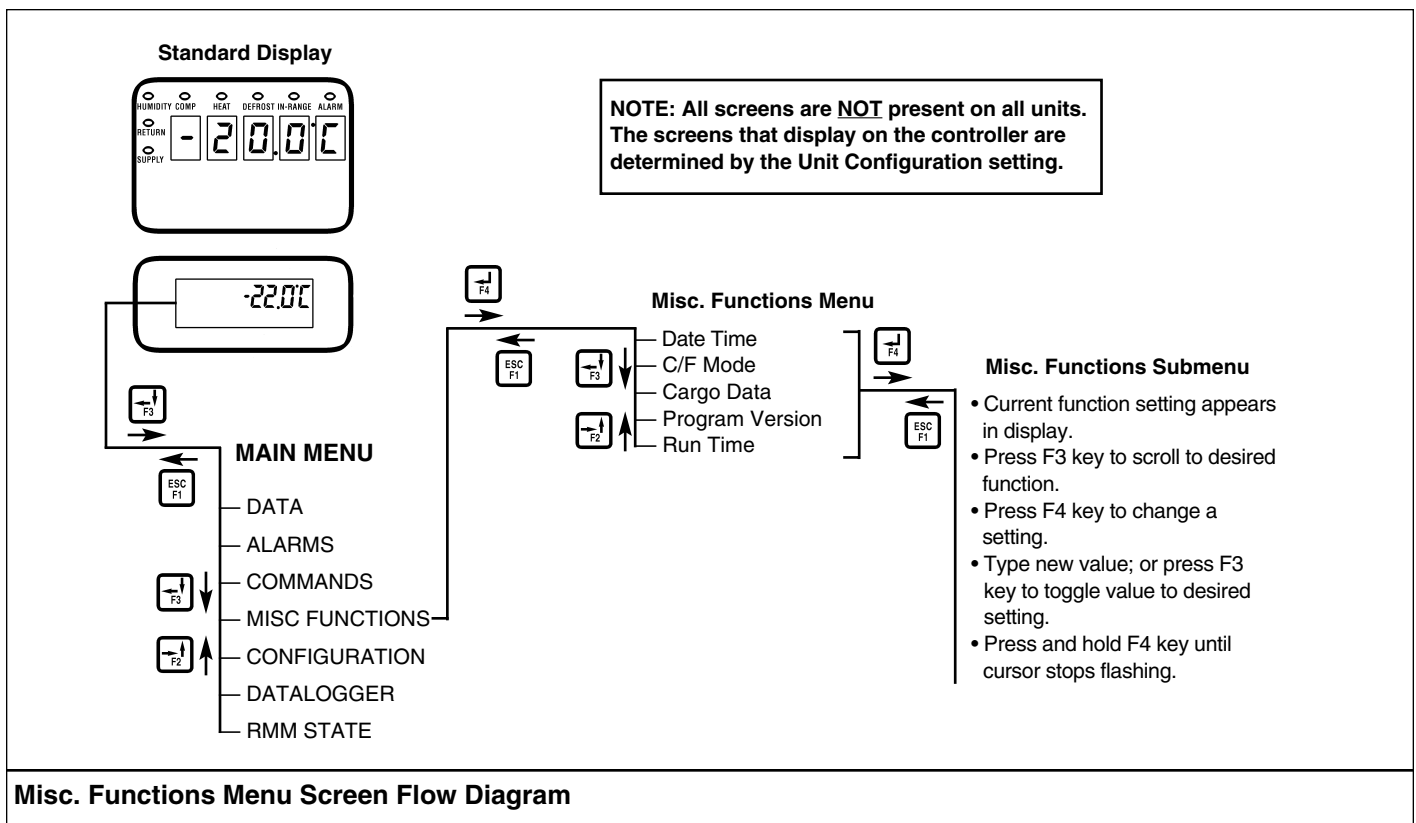
- With the correct time entered in the menu line, press F4 key. Then press EXIT key to enter time in controller memory. Cursor stops blinking and new time appears in display.
- To enter a new date, press F3 key to move cursor to Date menu line. Display shows date in and date in “YY.MM.DD” where Y = year, M = month and D = day.
- Press F4 key with cursor in Date menu line. An Enter Arrow appears in the menu line and the previous date disappears.
- Enter new date in “YY.MM.DD” where Y = year, M = month and D = day. Decimal points must be included in the entry between the year, month and day.
- With the correct date entered in the menu line, press F4 key. Then press EXIT key to enter date in controller memory. Cursor stops blinking and new date appears in the display.
- Press ESC key to exit the Date Time screen.

Changing the Temperature Display Value (C/F)

- Press F3 key to enter the menu list. Press F2 key to scroll to “MISC. FUNCTIONS”.
- Press F4 key to access the Misc. Functions menu. “Date Time” appears in the LCD display. Press F2 key to scroll to “C/F MODE”.
- Press F4 key to access the C/F Mode screen. C/F Mode screen appears with cursor in the temperature value menu line. Display shows “C/F MODE °C” where C = Celsius and F = Fahrenheit.
- To change the temperature value, press F4 key. Cursor moves to end of menu line and flashes.
- Press F2 key to toggle temperature value in the menu line between C and F.
- With the desired temperature value in the menu line, press and hold F4 key until cursor stops flashing. Cursor stops blinking and new temperature value appears in display.
- Press ESC key to exit the C/F Mode screen.

Setting Cargo Data

- Press F3 key to enter the menu list. Press F2 key to scroll to “MISC. FUNCTIONS”.
- Press F4 key to access the Misc. Functions menu. “Date Time” appears in the LCD display. Press F2 key to scroll to “CARGO DATA”.
- Press F4 key to access the Cargo Data screen. Cargo Data screen appears with cursor in LOC. BRT menu line.
- Press F3 key to scroll cursor down through cargo data list:
 - LOC. BRT
 - CONTENTS



- DATE (Loading Date)
 - VOYAGE
 - SHIP
 - LD PORT (Loading Port)
 - DIS PORT (Discharge Port)
 - COMMENTS
5. To enter text in a cargo data line, press F4 key with cursor in the desired menu line. An Enter Arrow appears and the cursor flashes in the selected line. Enter (type) the desired text. When entering information:
 - Enter up to 10 characters of text/numbers for each menu item.
 - To scroll backwards in the text box, press and hold the F4 key, then the press F3 key.
 - To delete text from a previous entry, press F4 key and then the SPACE key.
 - To start entry over or quickly return to the beginning of the text box, press F4 key, then EXIT key and then F4 key again.
 - When the F1, F2, F3 or F4 key is pressed to enter a character in the display, the keypad remains on that “character level” until another “level” is selected by pressing the F1, F2, F3 or F4 key.
 6. When the desired text entry is complete, press F4 key. Then press EXIT key. The cursor stops flashing and the new text appears in the menu line.
 7. Repeat steps 5 through 7 until all information has been entered in the Cargo Data screen.
 8. Press ESC key to exit the Cargo Data screen.

Viewing or Setting Run Time

1. Press F3 key to enter the menu list. Press F2 key to scroll to “MISC. FUNCTIONS”.
2. Press F4 key to access the Misc. Functions menu. “Date Time” appears in the LCD display. Press F2 key to scroll to “RUN TIME”.
3. Press F4 key to access the Run Time screen. The Run Time screen appears with cursor in HEAT menu line.
4. Press F3 key to scroll cursor down through cargo data list:
 - HEAT
 - COMPRESSOR
 - EVAPORATOR HIGH
 - EVAPORATOR LOW
 - CONDENSER
 - TOTAL
5. To reset an hourmeter or set hours on a replacement controller:
 - a. Press F4 key with cursor in the desired menu line. The Password screen appears.
 - b. Press F2 key, “A” key (password is “A”), F4 key and then EXIT key. An Enter Arrow appears in the hourmeter line.
 - c. Enter the desired run time setting (up to 5 characters).
 - d. When the entry is complete, press and hold the F4 key until the cursor stops flashing. The new run time appears in the menu line.
6. Repeat steps 5 and 6 to reset additional hourmeters.
7. Press ESC key to exit the Run Time screen.

Configuration Menu

The Configuration menu displays a list of functions that identifies unit operating features and current settings. The following functions are available: In-Range, Container ID, Contrast, Language, Economy Max, Economy Min, Humidity Option, Reefer Type, Zero Current, Supply LH, Controlled Atmosphere Option, Evaporator Fans, AFAM Setup, Auto Configuration and Serial Number.

NOTE: When a spare parts controller is installed and powered up for the first time, an automatic configuration feature detects the unit options installed on a unit. After the initial unit powerup, the controller turns the Auto Configuration feature Off. See “Replacing the Controller” in this chapter for more information.

Viewing or Setting Functions

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

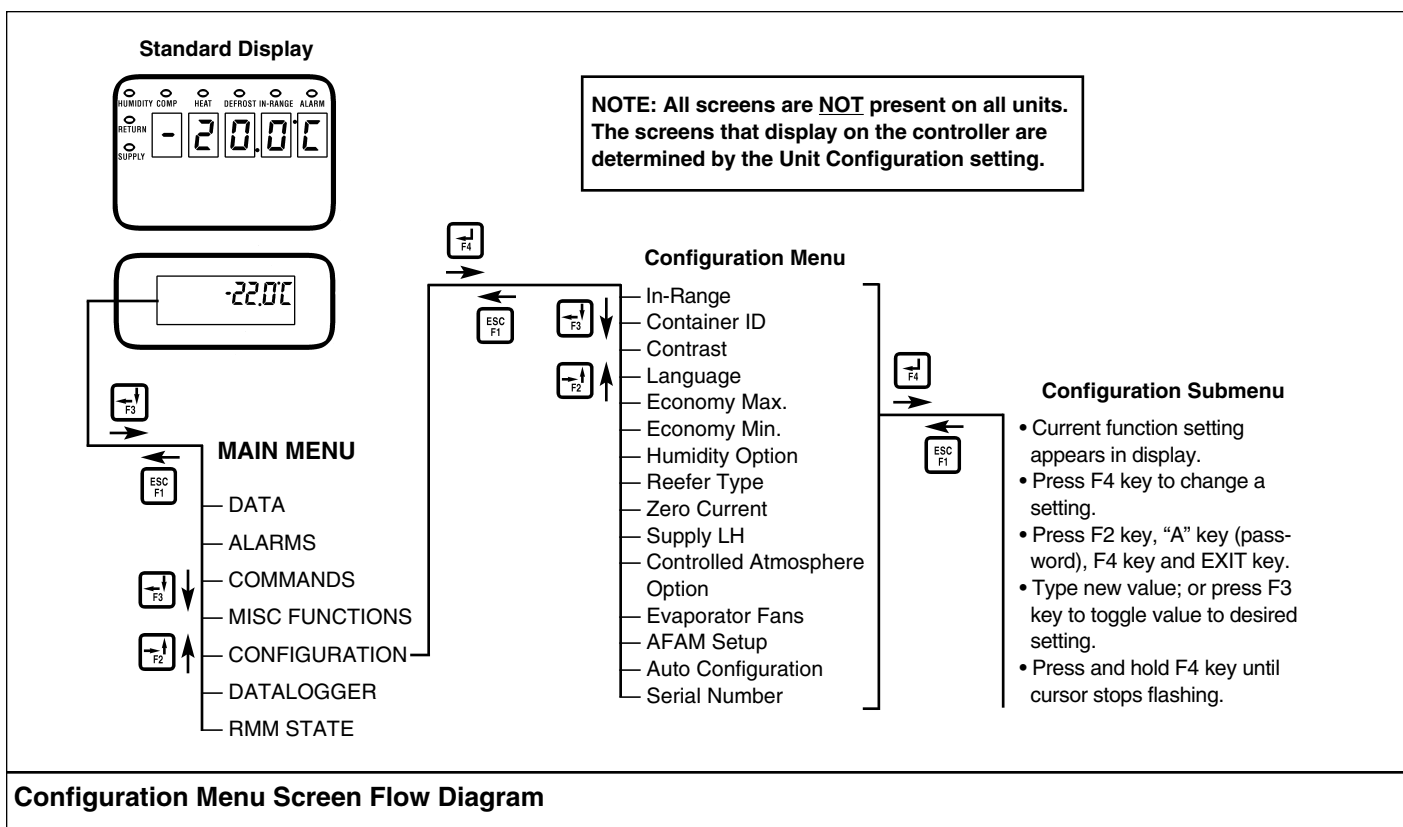
1. Press the F3 key to enter the Main Menu.
2. Press F2 key to scroll through Main Menu until “CONFIGURATIONS” appears in LCD display.
3. Press F4 key to access the Configurations screen. Configurations screen appears with cursor in the In-Range menu line.
4. Press F3 key to scroll cursor to view or reset the desired function:
 - In-Range: Sets the temperature value for the controller’s In-range LED and datalogger functions (factory default = 1.5 C [2.7 F]). Enter a value from 0.5 to 5.0 C (0.9 to 8.9 F).
 - Container ID: Sets the container identification number. Enter up to 11 characters (numbers or letters).
 - Contrast: Controller automatically regulates black and white contrast value on LCD display according to display temperature. Standard setting is 45. Resetting this value is not recommended.
 - Language: English is only setting currently available.
 - Economy Max: Sets the Economy mode maximum temperature limit (factory default = 0.2 C). Enter a value from 0 to 5.0 C (0 to 8.9 F).
 - Economy Min: Sets the Economy mode minimum temperature limit (factory default = 2.0 C). Enter a value from 0 to 5.0 C (0 to 8.9 F).
 - Humidity Option: View display value (factory default = NO HUM). Controller automatically activates when a humidity sensor is installed for more than 1 minute. Setting this value is not necessary.

- Reefer Type: Sets the unit model state to CSR20 PS or CSR40SL PS/CSR40 PS. Must be manually set to unit type on unit serial number plate.
 - Zero Current: View display ON or OFF value (factory default = ON). However, no errors occur if a Zero Current transformer is not installed and configuration is set to ON.
 - Supply LH: View display ON or OFF value (factory default = OFF). Controller automatically activates when a left hand supply sensor is installed for more than 1 minute. Setting this value is not necessary.
 - Controlled Atmosphere Option: View display value (factory default = NO). Controller automatically activates when a O₂ or CO₂ sensor is installed for more than one minute.
 - Evaporator Fans: Sets the number of evaporator fans to 2 or 3. Must be manually set.
 - AFAM Option: View display ON or OFF value (factory default = ON). Set value to OFF when customer want AFAM door to remain closed.
 - Auto Configuration: View display ON or OFF value (factory default = OFF). Set value to ON to automatically configure unit to installed components. See “Automatic Configuration of Spare Parts Controller” in this chapter for additional information.
 - Serial Number: Sets the unit serial number. Enter up to 11 characters (number or letters). Must be manually set. Required to enable automatic detection of USDA sensors units with serial number beginning with MAE, MSF or MWC prefix.
5. To set a new Configuration screen value:
 - a. Press F4 key with cursor in the desired menu line. The Password screen appears.
 - b. Press F2 key, “A” key (password is “A”), F4 key and then EXIT key. An Enter Arrow appears in the hourmeter line.
 - c. Use the general purpose keypad to enter the desired value; or press the F3 key to toggle the value to the desired setting.
 - d. When the entry is complete, press and hold the F4 key until the cursor stops flashing. The new value appears in the menu line.
 6. Repeat steps 4 and 5 to reset additional configuration values.
 7. Press ESC key to exit the Configurations screen.

Datalogger Menu

The Datalogger menu contains a list of functions that display unit operating information recorded in the MP-3000 datalogger. The following functions are available:

- Inspect Temperature Log: Displays temperature logs by time and date for the Setpoint; Supply (Controlling Temperature), Return, USDA1, USDA2, USDA3 and Ambient sensors; humidity sensor; and event flags.
- Inspect Event Log: Displays important event logs by time and date for events such as unit alarms, power On/Off, set-point change, clock reset, trip start, defrost, etc.



- Set Log Time: Sets the data log interval (1 minute or 1/2, 1, 2 or 4 hours).
- Activate Tripstart: Sets the date and time of the trip start.
- Inspect PTI Log: Displays results of last PTI test including component volt and amps data and sensor temperatures. Test values are recorded at the start and end of the Chilled and Frozen Mode test.

Viewing the Datalogger Menu

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press the F3 key to enter the Main Menu.
2. Press F2 key to scroll through Main Menu until "DATA-LOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. The first function appears in the LCD display: Inspect Temp Log.
4. Press F2 or F3 key to scroll to the desired function:
 - Inspect Temp Log
 - Inspect Event Log
 - Set Log Time
 - Activate Tripstart
 - Inspect PTI Log
5. Press F4 key to access the function selected.

Inspect Temp Log

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the Main Menu.
2. Press F2 key to scroll through Main Menu until "DATA-LOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. "Inspect Temp Log" appears in the LCD display.
4. Press F4 key to enter Temp Log. LCD display shows the Log Time and the Setpoint, Supply and Return temperatures of the most recent log in the first screen.
 - To scroll through previous logs of the sensor temperatures currently in the display, press F3 key. All temperature logs recorded in the datalogger memory may be viewed on the LCD display.
5. To view additional sensor log and event flag screens, press F4 key again. LCD display shows USDA1, USDA2, USDA3, Relative Humidity (rH), Ambient, etc. sensor readings, and flags.
 - To scroll through previous logs of the sensor temperatures currently in the display, press F3 key.

Event Flags for Temperature Log

T = Tripstart Activated

P = Primary Power Off

D = Defrost in Last Interval

O = Temperature Not In-range

h = Humidity Control Active

E = Evaporator High Temperature

H = High Refrigeration Pressure

d = Defrost terminated on time limit

e = Economy mode activated

s = Reefer unit stopped (after PTI)

w = Water-cooled operation (Condenser Fan switch is in the WATER position)

A = Alarm in last interval

NOTE: All event flags that occurred during a log interval are displayed.

6. Press ESC key to exit the Temp Log.

Inspect Event Log

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the Main Menu.
2. Press F2 key to scroll through Main Menu until "DATA-LOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. "Inspect Temp Log" appears in the LCD display.
4. Press F2 or F3 key to scroll through submenu until "Inspect Event Log" appears in LCD display.
5. Press F4 key to enter Event Log. LCD display shows the Log Time and the most recent event.
 - To scroll through previous event log screens, press F3 key. All event logs recorded in the datalogger memory may be viewed on the LCD display.

Event Examples

- Controller alarm status (alarms set/cleared)
- Main power On/Off status (humidity On/Off, temperature setpoint, and main power Hz)
- 12 Vdc battery discharge test (battery voltage, total unit and compressor hours if main power On) — this event logged at once a day
- Change temperature setpoint (new/old setpoint)
- Change RH setpoint (new/old RH setpoint)
- Change RH status (On/Off)
- Event log retrieval
- Temperature log retrieval
- Trip start
- New container ID
- PTI start (Unit configuration)
- PTI part 1 end (Temperature differences for tests 1, 2, 3 and heat test)
- PTI end
- Defrost start (logged with demand or manual defrost only)
- Defrost end (start time)

6. Press ESC key to exit the Event Log.

Set Log Time

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the Main Menu.
2. Press F2 key to scroll through menu list until "DATA-LOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. "Inspect Temp Log" appears in the LCD display.
4. Press F2 or F3 key to scroll through submenu until "Set Log Time" appears in LCD display.
5. Press F4 key to enter Temp Log. LCD display shows the current Log Time interval.
6. To enter a new log interval, press F4 key again with cursor in Log Time menu line. Arrow appears in menu line.
7. Press F3 key to scroll through a list of log time intervals:
 - 1 Minute*
 - 1/2 Hour
 - 1 Hour
 - 2 Hour
 - 4 Hour

***NOTE: When a 1 Minute Log Test is selected, the datalogger records unit operating information every minute for 72 minutes. During the 1 Minute Log Test, only the 1 Minute Log can be retrieved for viewing. The Temperature Log and Event Logs can not be viewed. When the 1 Minute Log Test is complete, the 1 minute log is**

cleared from the datalogger memory. The datalogger resumes logging using the previous log time setting.

8. When the correct log time appears in the menu line, press and hold F4 key until cursor stops flashing. The new Log Time appears in the display.
9. Press ESC key to exit the Temp Log.

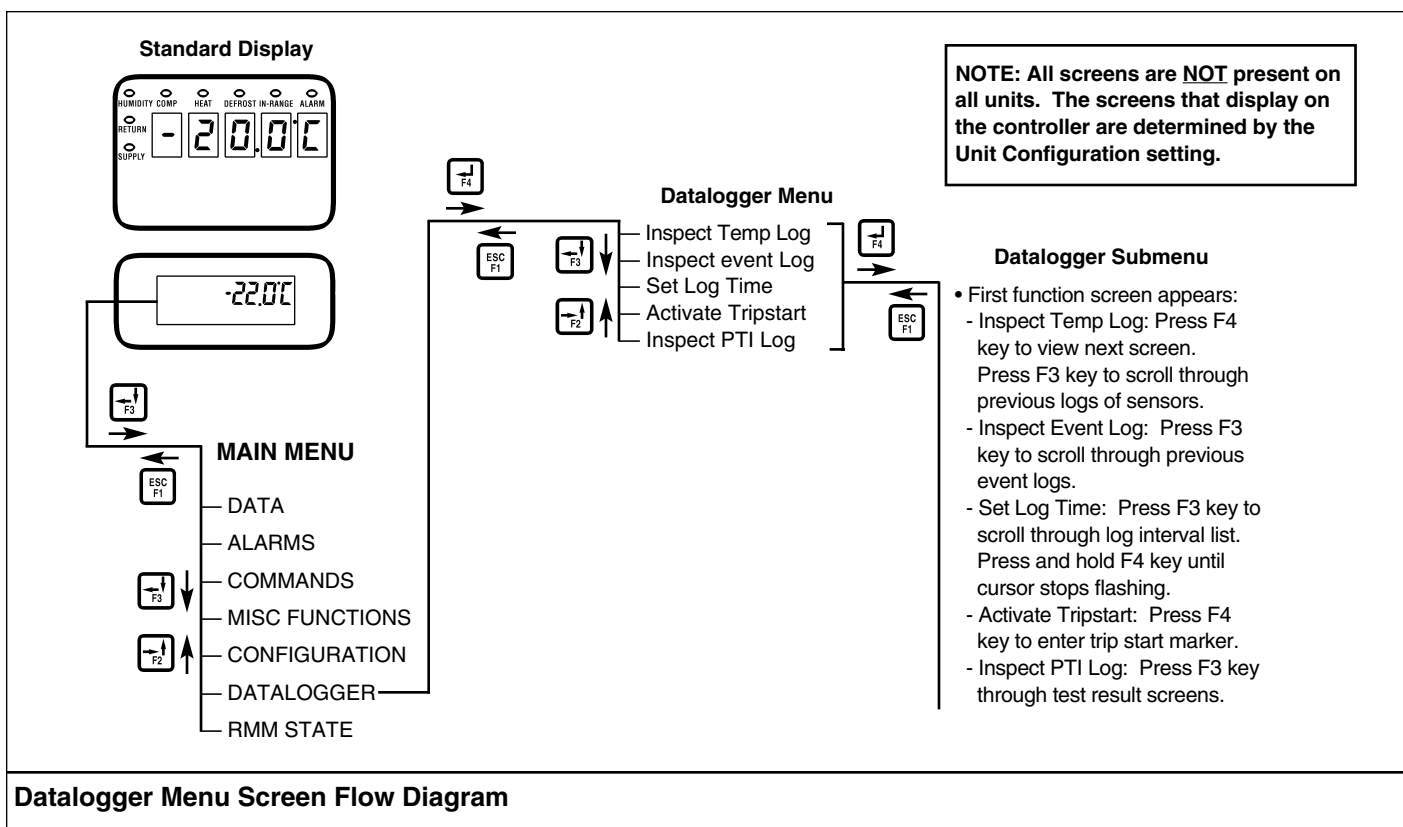
Set a Trip Start

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the Main Menu.
2. Press F2 key to scroll through menu list until "DATA-LOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. "Inspect Temp Log" appears in the LCD display.
4. Press F2 or F3 key to scroll through submenu until "Activate Tripstart" appears in LCD display.
5. Press F4 key to enter Tripstart function. The date and time of the last trip start appears in the screen.
6. Press F4 key again to enter a new start of trip date and time in the log.

NOTE: When a PTI Test is completed, the controller automatically enters a Tripstart in the log.

7. Press ESC key to exit the Datalogger menu.



Inspect PTI Log

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press F3 key to enter the Main Menu.
2. Press F2 key to scroll through menu list until "DATA-LOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. "Inspect Temp Log" appears in the LCD display.
4. Press F2 or F3 key to scroll through submenu until "Inspect PTI Log" appears in LCD display.
5. Press F4 key to enter PTI Log. LCD display shows the Start Time and PTI test results of the most recent PTI log.
 - To scroll through additional test results in the log, press F3 key.

PTI Examples

- PTI stores volt and amps of all power consuming components
- PTI stores temperatures logged at both the start and end of Chilled Mode and Frozen Mode capacity tests

6. Press ESC key to exit the PTI Log.

RMM State Menu

The RMM (Remote Monitoring Modem) State menu displays the current communications status with a REFCON system:

- Offline: No communication between the controller RMM and a REFCON system.
- Zombie: The controller has detected a REFCON system master module and is waiting for communication.
- On-line: The controller RMM is logged-in on a REFCON system.

Viewing the RMM State Screen

With the unit On/Off switch ON and the LCD display showing the standard display (setpoint):

1. Press the F3 key to enter the Main Menu.
2. Press F2 key to scroll through Main Menu until "RMM STATE" appears in LCD display.
3. Press F4 key to access the RMM State screen. The screen will show: Offline, Zombie or On-line.
4. Press ESC key to exit the RMM State screen.

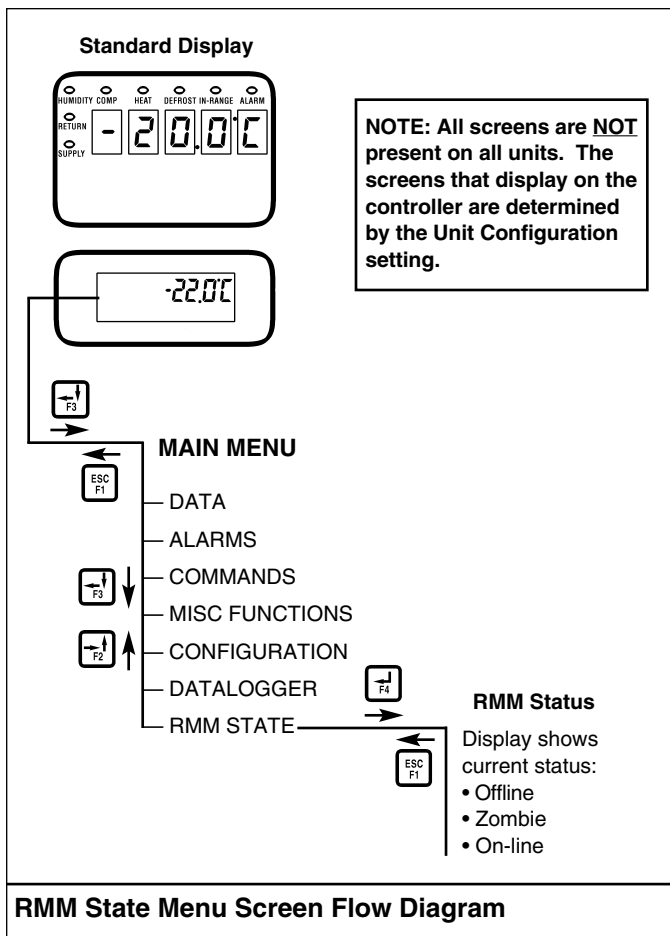
Manual Emergency Mode Operation

In the event of an emergency situation where a fatal failure of the controller occurs, a manual emergency mode function can be used to operate the unit. Manual control offers a selection of six operating positions:

- Position 1: Cool 1: Continuous cooling with condenser fan operation and high speed evaporator fan operation.
- Position 2: Cool 2: Continuous cooling with condenser fan operation, high speed evaporator fan operation and continuous liquid injection.
- Position 3: Not Used (Moduload Units Only)
- Position 4: Not Used (Moduload Units Only)
- Position 5: Defrost: Heaters are activated (evaporator fans off).
- Position 6: Heat: Evaporator fans operate at high speed to introduce fan motor heat only into the container (no electric heater operation).

CAUTION: The unit must be cycled manually to maintain the desired temperature. Monitor container temperature with an external thermometer.

NOTE: The unit cooling capacity on Chill loads can be reduced by almost closing the suction service valve when Cool 1 is selected. If the compressor overheats, select Cool 2.



To select Manual Control:

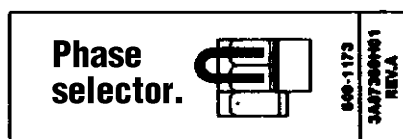
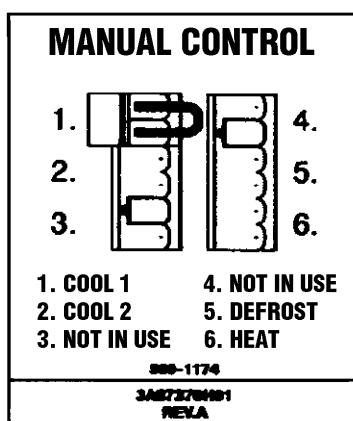
1. Turn the Unit On/Off switch to OFF.
2. Disconnect the unit power cord from the power supply.

WARNING: High voltage (460/380 volts) is present on the contactors and relays in the control box. To prevent dangerous electrical shock, disconnect the supply power to the unit whenever possible when working in this area.

3. Disconnect cable no. 2 from the controller and main relay board (see electrical schematic). The main relay board will now control the unit based on the manual control setting.

NOTE: MUST check 2-pin plug location on J501 connections of main relay board to ensure correct unit operation.

4. If necessary, remove 2-pin plug from J501 (see decal on main relay board) and re-locate based on the unit operating mode required.
5. Connect the unit power cord to the proper power supply.
6. Turn Unit On/Off switch to ON. Unit will start and operate.
7. Check for correct rotation of condenser fan and evaporator fans. Condenser air should be blowing out from the center of the grille. Evaporator air should be blowing down through the evaporator coil. If the fans are running backwards, the power supply phase must be changed. To reverse power phase:
 - a. Turn On/Off switch OFF.
 - b. Disconnect unit power cord from power supply.
 - c. Relocate the phase selector terminal plug from J18 (see decal on main relay board). Relocate from A to B (B to A) as required.



Manual Emergency Control Connections

- d. Connect unit power cord to the proper power supply.
- e. Turn the Unit On/Off switch to ON. Check condenser and evaporator airflow again to confirm correct fan rotation.

Replacing the Controller

1. Turn the unit On/Off switch OFF. Then unplug the unit power cord from the power supply.
2. Disconnect battery power connection from the controller (top plug on the controller).
3. Disconnect the communication cables from the controller and remote monitoring modem.
4. Remove the screws that secure the remote monitoring modem to the controller.
5. Remove the screws that secure the controller to the inside of the control box door.
6. Remove the controller from the door.
7. Install the replacement controller in the door using the existing hardware. Connect the keyboard cable to the controller.
8. Install the remote monitoring modem on the back of the controller.
9. Connect the communication cables to the remote monitoring modem and controller.
10. Set the software selection switch on the back of the controller to position "2".

NOTE: Be certain that all connector plugs are fully seated.

CAUTION: Be sure to enter the container ID before releasing the unit for service. The container ID is required to identify the data downloaded from the controller datalogger via a laptop computer or a REFCON remote communications system.

NOTE: Several programmable features may need to be set to completely configure the unit to customer specifications. Adjust any additional programmable settings to customer requirements before releasing the unit for service.

NOTE: If a controller from another unit has been installed, see "Controller Software Selection" in this chapter to set software selection dial correctly.

Automatic Configuration of Spare Parts Controller

An automatic configuration feature detects the unit options installed on a unit when a spare parts controller is installed in the unit and powered up for the first time. After the initial unit powerup, the controller turns the Auto Configuration feature Off.

The Auto Configuration feature detects the following options and sets the correct value in Configuration menu:

- Number of Supply Air Sensors (1 or 2): Controller detects left hand and right supply air sensors.
- Number of Evaporator Fans (2 or 3)
- Dehumidify (On or OFF): If controller detects a humidity sensor, it then checks for current draw on a dehumidify valve.
- Humidification (On or OFF): If controller detects a humidity sensor, it then checks for current draw on an air compressor.

7. The controller then checks the new software and loads the new control program into memory.

NOTE: If the flash load procedure is interrupted or fails, the controller will continue to use the previous control program.

NOTE: Installing new software does not change any configuration settings or the setpoint setting, or erase the data log currently stored in the controller.

Controller Software Selection

If a replacement controller was removed from another unit, check the small dial located on the back of the controller for the correct software selection. Current active software settings for dial positions are:

- Position 0: All TNE 508 units with Moduload compressor
- Position 1: All CRR-40/TNE 508 units with KVQ valve
- Position 2: All CSR20 PS, CSR40SL PS and CSR40 PS units with a stepper motor valve
- Position 7: Unit testing and service only.

Changing Software Selection Dial Position

1. Turn Unit On/Off switch OFF.
2. Set dial indicator to correct position.
3. Turn Unit On/Off switch ON. New software selection is loaded during controller start-up.

Temperature Sensors

Thermistor type temperature sensors are used. Each sensor is connected to a shielded cable and placed in a sealed stainless steel tube. The temperature signal from the sensor is transmitted through the shielded cable. Temperature sensors include:

- Supply Air, Left Hand
- Supply Air, Right Hand
- Return Air
- Evaporator Coil
- Condenser Coil
- Compressor Discharge (Top Cap) Temperature
- Ambient Air

CAUTION: Sensors are permanently calibrated and can be checked using an ohmmeter. Ohm readings should agree with the data shown in the Sensor resistance tables on page 4-36 and 4-37.

Flash Loading Controller Software

Controller software must be flash loaded when software has been revised. To flash load software:

1. Turn the unit On/Off switch OFF.
2. Plug cable from a portable computer with controller software into the data retrieval connector on the control box.
3. Press one of the special functions keys to activate controller LCD display on battery power; or turn the Unit On/Off switch ON.
4. Press and hold the “7” key and F1 key at the same time. LCD display will show “FLASHLOAD”.

NOTE: If the communications cable is defective or not connected to the download port, the controller will start in emergency mode and LCD display will show “EMERGENCY MODE”. Secure cable connection to proceed with flash loading of software.

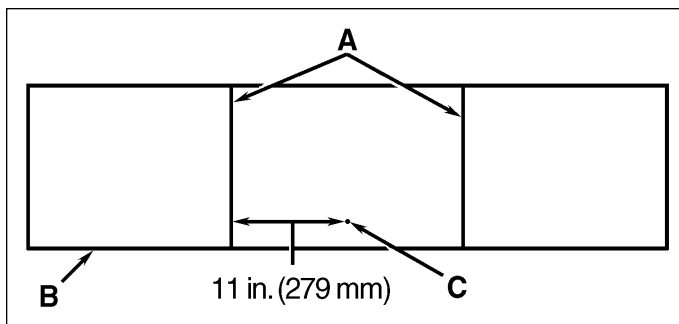
5. Start flash load program on portable computer.
6. Flash loading of new software is complete when “FLASH LOADING” clears from the LCD display.

Resistance Values for Supply, Return, Evaporator Coil, Condenser Coil and Ambient Air Sensors

Temp. °F	Temp. °C	OHMS	Temp. °F	Temp. °C	OHMS
-40	-40	42618	53.6	12	3360
-31	-35	32198	57.2	14	3094
-22	-30	24532	60.8	16	2852
-13	-25	18850	64.4	18	2632
-4	-20	14618	68	20	2431
5	-15	11383	71.6	22	2347
10.4	-12	9838	75.2	24	2079
14	-10	8941	78.8	26	1925
17.6	-8	8132	82.4	28	1785
21.2	-6	7406	86	30	1657
24.8	-4	6752	89.6	32	1539
28.4	-2	6164	93.2	34	1430
32	0	5634	96.8	36	1330
35.6	2	5155	100.4	38	1239
39.2	4	4721	104	40	1154
42.8	6	4329	107.6	42	1076
46.4	8	3907	111.2	44	1004
50	10	3652	113	45	970

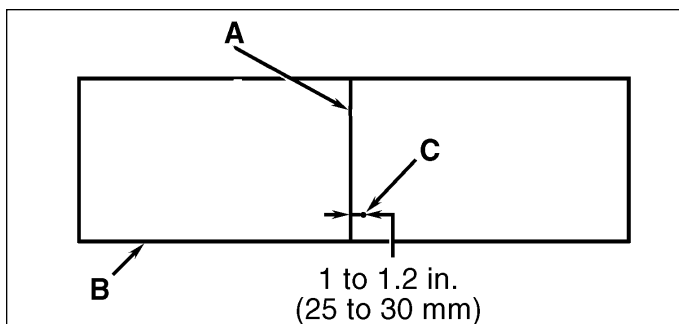
All sensors should be properly installed:

- Supply air sensors must be inserted to the bottom of the sensor tube and completely sealed by the grommet connection.
- Left hand supply sensor installs in the sensor tube behind the compressor.
- Right hand supply sensor installed in the sensor tube next to the control box.
- Return air sensor installs in a grommet between the evaporator fans.
- Evaporator coil (defrost) sensor must be placed in the middle of the coil and at least 75 mm deep between the fins.
- Condenser sensor must be placed on the upper left side of the condenser coil and at least 70 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor sensor must be placed in the manifold on the discharge tube before the discharge service valve.



CSR20 PS and CSR40SL PS Evaporator Coil (Defrost) Sensor Location

- A. Coil Support Brackets
 B. Unit Front
 C. Insert Sensor at least 75 mm into coil between Tube Rows 2 and 3

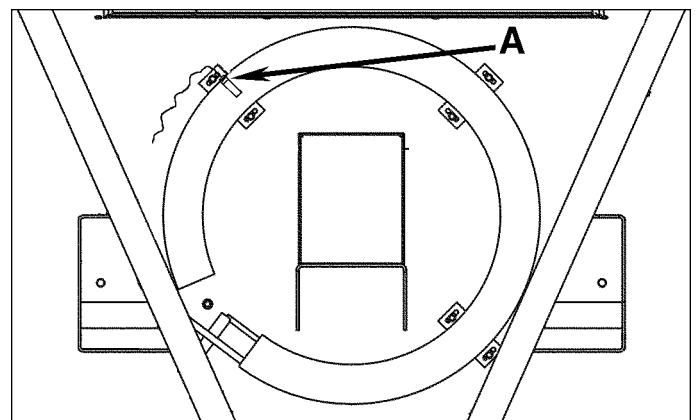


CSR40 PS Evaporator Coil (Defrost) Sensor Location

- A. Coil Support Bracket
 B. Unit Front
 C. Insert Sensor at least 75 mm into coil between Tube Rows 2 and 3

Resistance Values for Compressor Discharge (Top Cap) Temperature Sensor

Temp. °F	Temp. °C	OHMS	Temp. °F	Temp. °C	OHMS
-13	-25	1,121,457	185	85	9,202
-4	-20	834,716	194	90	7,869
5	-15	627,284	203	95	6,768
14	-10	475,743	212	100	5,848
23	-5	363,986	221	105	5,091
32	0	280,824	230	110	4,446
41	5	218,406	239	115	3,870
50	10	171,166	248	120	3,354
59	15	135,140	257	125	2,924
68	20	107,440	266	130	2,580
77	25	86,000	275	135	2,279
86	30	69,282	284	140	2,021
95	35	56,158	293	145	1,797
104	40	45,812	302	150	1,591
113	45	37,582	311	155	1,393
122	50	30,986	320	160	1,247
131	55	25,680	329	165	1,118
140	60	21,397	338	170	1,015
149	65	17,914	347	175	920
158	70	15,067	356	180	834
167	75	12,728	365	185	748
176	80	10,793	374	190	679



Condenser Coil Sensor Location

- A. Insert Sensor into condenser coil between Tube Rows 1 and 2

Diagnosis and Repair

If the unit appears to be operating incorrectly, view any alarm codes that may be stored in the controller display memory.

Diagnose and correct the problem associated with each alarm code (see “Alarm Codes, Alarm Types and Corrective Actions” in this chapter).

NOTE: Defrost can be delayed for 24 hours during unit diagnosis or testing: Press “7” key and F1 key at the same time from any controller screen display. Press F3 key to scroll cursor down to DELAY DEF menu line. Then press F4 key, F2 key, “A” key, F4 key and EXIT key. Cursor moves to end of line and flashes. Press F3 key to toggle OFF to ON. Then press and hold F4 key until cursor stops flashing.

If you have viewed and corrected these problems and the unit still appears to be operating incorrectly, eliminate any possibility that the problem is caused by failure of components other than the controller.

External Cause Checks

- Poor contact between male and female connector plugs (loose connection).
- Defective wire harness (broken wires, loose connections).
- External electrical causes such as faulty (open or stuck) contactors.
- Malfunction of refrigeration system components.

Error Messages and Controller Actions

The controller displays error messages in the LCD display for several general faults. More than one error message may appear at a time. Press F2 or F3 key to scroll through message displays.

Message No.	Error Message	Controller Action
1	Power Error, Check 20A Fuses Indicates: <ul style="list-style-type: none"> • One or more phases are missing • Compressor is able to draw amps on all phases while heater lacks amps on one or more phases. 	<ul style="list-style-type: none"> • Controller activates Alarm 18 • Controller will try to restart unit after 60 minutes.
2	High Pressure Cutout, Check Water Cooling Indicates: <ul style="list-style-type: none"> • Unit stops due to high pressure cutout and condenser fan switch is in WATER position. 	<ul style="list-style-type: none"> • Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low (alarm 37) or supply air temperature is too high (alarm 41).
3	Probe Test, Please Wait Indicates: <ul style="list-style-type: none"> • Incorrect temperature difference between Supply-LH, Supply-RH, or Return air sensor for 10 minutes with evaporator fan amps ok. 	<ul style="list-style-type: none"> • Controller automatically activates Probe Test to check for a defective sensor. Message clears when test is complete. • Controller displays new message if test indicates a sensor is defective.
4	Supply–Right Hand Problem, Sensor Disabled Indicates: <ul style="list-style-type: none"> • Controller disables sensor due to open or short circuit or sensor failed a Probe Test.. 	<ul style="list-style-type: none"> • Controller activates Alarm 52 • Controller activates Alarm 00 or 01, depending on type of sensor failure. • Controller clears message during Defrost mode and when Unit On/Off switch is turned OFF. • Controller uses left hand supply sensor to control unit if right hand sensor is defective. • Controller uses return sensor plus an offset to control unit if both supply sensors are defective.
5	Supply–Left Hand Problem, Sensor Disabled Indicates: <ul style="list-style-type: none"> • Controller disables sensor due to open or short circuit or sensor failed a Probe Test.. 	<ul style="list-style-type: none"> • Controller activates Alarm 52 • Controller activates Alarm 00 or 01, depending on type of sensor failure. • Controller clears message during Defrost mode and when Unit On/Off switch is turned OFF. • Controller uses right hand supply sensor to control unit if left hand sensor is defective. • Controller uses return sensor plus an offset to control unit if both supply sensors are defective.

Error Messages and Controller Actions (Continued)

Message No.	Error Message	Controller Action
6	KVQ Valve Found, Please Change Type Indicates: <ul style="list-style-type: none"> Controller is set for Moduload and start-up is initiated on KVQ unit. Correct by turning Unit On/Off switch OFF. Then set controller software switch to position 1. 	None. On Moduload units, KVQ sensor input must be left open.
7	High Pressure Cutout, Check Condenser Probe Indicates: <ul style="list-style-type: none"> Units stops due to high pressure cutout, condenser fan switch is in FAN AIR position and condenser temperature is low. 	<ul style="list-style-type: none"> Controller clears message on compressor start-up. No alarm is set until Controller determines that unit current draw is too low (alarm 37) or supply air temperature is too high (alarm 41).
8	Running with High Supply Difference Indicates: <ul style="list-style-type: none"> Temperature difference between the left hand and right hand Supply sensors is too large; even after Probe Test indicates no sensor errors. Possible causes include air leak around sensor cable, low refrigerant charge, defective expansion valve, etc. 	<ul style="list-style-type: none"> Controller clears message during defrost and when Unit On/Off switch is turned OFF.
9	High Pressure Cutout, Check Condenser Fan Indicates: <ul style="list-style-type: none"> Unit stops due to high pressure cutout, condenser fan switch is in FAN AIR position and condenser temperature is high. 	<ul style="list-style-type: none"> Controller clears message on compressor start-up. No alarm is set until Controller determines that unit current draw is too low (alarm 37) or supply air temperature is too high (alarm 41).

Alarm Codes, Descriptions and Corrective Actions

NOTE: Sensors used with the MP-3000 controller do not require calibration. Check sensor resistance with an ohmmeter.

- **Shutdown Alarm (Level 1 Alarm):** Alarm light on display flashes and unit stops. Correct alarm condition and acknowledge alarm before restarting.
- **Check Alarm (Level 2 Alarm):** Alarm light on display flashes until alarm is acknowledged.
- **Event Log (Level 3 Alarm):** Alarm is recorded in datalogger only (inspect event log).

Alarm List

Code	Description	Corrective Action
00	Supply Air Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -70 C (-94 F). • Indicates: <ul style="list-style-type: none"> - Open circuit to left or right hand sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 or cable No. 3 - Defective controller 	<ul style="list-style-type: none"> • Identify defective sensor (left hand or right hand) by viewing Data menu. • Check sensor resistance between pins 1 and 2 on plug J15 and between pins 7 and 8 on plug J14. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 and cable No. 3 between the controller and relay board. • Check evaporator airflow.
01	Supply Air Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature below 80 C (176 F). • Indicates: <ul style="list-style-type: none"> - Short circuit to left or right hand sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 or cable No. 3 - Defective controller 	<ul style="list-style-type: none"> • Identify defective sensor (left hand or right hand) by viewing Data menu. • Check sensor resistance between pins 1 and 2 on plug J15 and between pins 7 and 8 on plug J14. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 and cable No. 3 between the controller and relay board.
02	Return Air Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -70 C (-94 F). • Indicates: <ul style="list-style-type: none"> - Open circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.

Code	Description	Corrective Action
03	Return Air Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> - Short circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
04	Evaporator Coil Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -70 C (-94 F). • Indicates: <ul style="list-style-type: none"> - Open circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller - Low evaporator coil temperature 	<ul style="list-style-type: none"> • Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board. • Check evaporator airflow.
05	Evaporator Coil Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> - Short circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.

Code	Description	Corrective Action
06*	<p>Compressor Current Too High (Check Alarm)</p> <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Compressor power consumption is 25% above expected current draw (above approximately 13 amps); or compressor phase current level difference of 10% or more, depending on ambient temperature. Indicates: <ul style="list-style-type: none"> Defective Stepper valve Defective compressor or valve plate Defective volt or amp meter on relay board Inaccurate ambient, condenser or evaporator temperature measurement Out of range power supply Excessive condenser pressure due to air or wrong refrigerant in system, or refrigerant over charge 	<ul style="list-style-type: none"> Check evaporator, condenser and ambient sensor temperatures for correct value (+/- 5 C [+/- 9 F]) by viewing Data menu. Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 100%, condenser fan and evaporator fan (high and low). Check volt and ampere meter. Check power supply volts.
07*	<p>Compressor Current Too Low (Check Alarm)</p> <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Compressor power consumption is 25% below expected current draw (below approximately 9 amps). Indicates: <ul style="list-style-type: none"> Defective or open fuse CB 7A, high pressure cutout switch or connection in plug J19 between pins 7 & 8 No signal on plug J11 on pin 8 Defective compressor relay Defective volt or amp meter on relay board Low refrigerant charge Defective compressor or valve plate 	<ul style="list-style-type: none"> Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 25%, condenser fan and evaporator fan (high and low). If relay does NOT energize and the LED above the compressor relay is NOT ON, check for a defective cable No. 2, main relay board or controller. Check volt and ampere meter. Check power supply volts. Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5.

***NOTE: If both alarms 06 and 07 are activated, the alarms are caused by a large difference in measured amps. Enter Function Test and start condenser fan, compressor, compressor 100% and evaporator fans on HIGH speed. Check the amps measurements. If necessary, check the resistance of the motor windings.**

Code	Description	Corrective Action
10*	Heater Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Heater power consumption is 25% above expected current draw (above approximately 4.4 amps and 5.1 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Incorrect heaters or heater connections Defective volt or amp meter on relay board Defective heater element 	<ul style="list-style-type: none"> Enter Manual Function Test and turn heaters ON. Check current draw on each phase. Current draw should be about 4.4 amps on each phase at 400V (5.1 amps at 460V). Check heater resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.
11*	Heater Current Too Low (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Heater power consumption is 25% below the expected current draw (below approximately 3.2 amps and 3.8 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective high evaporator temperature switch Defective heater element or heat relay Defective wire connection Incorrect heaters or heater connections 	<ul style="list-style-type: none"> Enter Manual Function Test and turn heaters ON. Make sure the heat relay energizes. Check current draw on each phase. Current draw should be 4.4 on each phase at 400V (5.1 amps at 460V). If heat relay fails to energize, check evaporator high temperature switch. Switch should be closed at temperatures below 54 C (130 F); there should be continuity between pins 5 and 6 in plug J19. Check cable No. 2 between controller and relay board. Check heater resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg. Check volt and ampere meter.
12**	Evaporator Fan High Speed Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Evaporator fan power consumption is 25% above expected current draw (above 2.8 to 4.0 amps, depending on voltage) Indicates: <ul style="list-style-type: none"> Defective or stuck evaporator fan motor Incorrect motor or motor connections Defective volt or amp meter on relay board 	<ul style="list-style-type: none"> Open evaporator door and make sure all fans rotate freely. Enter Manual Function Test and start evaporator fans on HIGH speed. Make sure all fans start on high speed. Check fan motor volts and amps. Check volt and ampere meter.

***NOTE:** If both alarms 10 and 11 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and start HEAT. Check the amps measurements. If necessary, check the resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.

****See note on next page.**

Code	Description	Corrective Action
13**	Evaporator Fan High Speed Current Too Low (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI), Function test or Probe test. Evaporator fan power consumption is 25% below expected current draw (below 1.6 to 2.4 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective evaporator fan motor relay Defective or open fan motor internal over temperature protection switch Defective volt or amp meter on relay board Incorrect motor or motor connections 	<ul style="list-style-type: none"> Open evaporator door and make sure all fans rotate freely. Enter Manual Function Test and start evaporator fans on HIGH speed. Make sure all fans start on high speed. If a motor does not start and is very hot, wait 10 minutes for internal over temperature switch to close. Check fan motor volts and amps. Check volt and ampere meter.
14**	Evaporator Fan Low Speed Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Evaporator fan power consumption is 25% above expected current draw (above 1.0 to 2.0 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective or stuck evaporator fan motor Incorrect motor or motor connections Motor high and low speed connection are interchanged Defective volt or amp meter on relay board 	<ul style="list-style-type: none"> Open evaporator door and make sure all fans rotate freely. Enter Manual Function Test and start evaporator fans on LOW speed. Make sure all fans start on low speed. Check fan motor volts and amps. Check volt and ampere meter.
15**	Evaporator Fan Low Speed Current Too Low (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Evaporator fan power consumption is 25% below expected current draw (below 0.6 to 1.2 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective evaporator fan motor relay Defective or open fan motor internal over temperature protection switch Defective volt or amp meter on relay board Incorrect motor or motor connections 	<ul style="list-style-type: none"> Open evaporator door and make sure all fans rotate freely. Enter Manual Function Test and start evaporator fans on LOW speed. Make sure all fans start on low speed. If a motor does not start and is very hot, wait 10 minutes for internal over temperature switch to close. Check fan motor volts and amps. Check volt and ampere meter.

****NOTE:** If both alarms 12 and 13; or 14 and 15 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and operate evaporator fans on low and high speed. Check the evaporator fan amps measurement. If necessary, check the resistance in the motors: High speed between EF11 and EF12, EF12 and EF13, and EF11 and EF13; Low speed between EF1 and EF2, EF2 and EF3, and EF1 and EF3. Resistance readings should be equal: High speed about 6 Ohms, total of 2 motors; Low speed about 20 Ohms, total of 2 motors.

Code	Description	Corrective Action
16*	Condenser Fan Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Condenser fan power consumption is 25% above expected current draw (above 1.5 to 1.9 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective or stuck condenser fan motor Defective volt or amp meter on relay board Incorrect motor or motor connections 	<ul style="list-style-type: none"> Enter Manual Function Test and start condenser fan. Make sure the fan starts. Check fan motor volts and amps. Check power supply volts and amps. Check volt and ampere meter.
17*	Condenser Fan Current Too Low (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. Condenser fan power consumption is 25% below expected current draw (below 0.5 to 0.7 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective condenser fan motor relay Defective or open fan motor internal over temperature protection switch Defective volt or amp meter on relay board 	<ul style="list-style-type: none"> Enter Manual Function Test and start condenser fan. Make sure the fan starts. Check fan motor volts and amps. Check power supply volts and amps. Check volt and ampere meter.
18	Power Supply Phase Error (Log Alarm) <ul style="list-style-type: none"> One or more frequency inputs are missing for more than 20 seconds. Indicates: <ul style="list-style-type: none"> One phase on power line is missing Defective fuse on relay board Defective digital inputs on relay board Defective controller 	<ul style="list-style-type: none"> Enter Data menu and view voltage reading on each phase. Check all fuses. Check cable No. 1 on relay board. Check cable No. 1 between controller and relay board. Replace relay board. Check voltage reading on each phase.

***NOTE:** If both alarms 16 and 17 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and start the condenser fan. Check the condenser fan amps measurement. If necessary, check the resistance in the motor between CF1 and CF2, CF2 and CF3, and CF1 and CF3. Resistance readings should be equal (approximately 25 Ohms).

Code	Description	Corrective Action
19	<p>Temperature Too Far from Setpoint (Check Alarm)</p> <ul style="list-style-type: none"> • After 75 minutes of operation, supply or return air temperature is not in-range and does not approach setpoint within preset pulldown rate. • Indicates: <ul style="list-style-type: none"> - Ice or frost on evaporator coil - Low refrigerant charge - Air exchange vent open too much - Container air leakage (doors open) 	<ul style="list-style-type: none"> • Press SUP/RET key to check supply and return air sensor temperatures. Compare temperatures to evaluate unit cooling capacity and performance. Temperature difference should be 4 C to 6 C. • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. • Check refrigerant charge <p>NOTE: This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.</p>
20	<p>Defrost Time Too Long (Check Alarm)</p> <ul style="list-style-type: none"> • Heat signal has been ON for more than 90 minutes on 60 Hz power during Defrost (120 minutes on 50 Hz power). • Indicates: <ul style="list-style-type: none"> - Low power supply voltage - Defective heater elements - Defective evaporator high temperature protection switch - Defective heat relay - Evaporator fans running during defrost - Evaporator sensor placed wrong 	<ul style="list-style-type: none"> • Initiate a manual defrost and check amperage draw and evaporator coil temperature. Evaluate defrost performance. • Open evaporator door and check location of evaporator coil sensor. <p>NOTE: This alarm can be activated at low voltage and very low box temperature conditions, even under normal operating conditions.</p>

Code	Description	Corrective Action
22	<p>Capacity Test 1 Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Difference between supply and return air temperature is too small with low speed evaporator fans (less than approximately 4.5 C [8 F]). • Return air temperature does not reach -18 C (0 F) within preset time. • Indicates: <ul style="list-style-type: none"> - Incorrect location of supply or return air sensor - Air leakage at supply sensor cable - Defective supply or return air sensor - Interchanged sensor connections - Incorrect evaporator fan rotation or high speed operation - Incorrect refrigeration system operation - Container/side panels defective, damaged or leaking 	<ul style="list-style-type: none"> • Enter Manual Function Test and start evaporator fans on LOW speed. Then select Sensor Checks test and operate fans 2 to 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat). NOTE: This sensor check does not detect air leakage around the sensor cables. • Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low speed. • Check the sensor connections. • Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 100%, condenser fan and evaporator fans (low). Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5. <p>NOTE: This alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.</p>

Code	Description	Corrective Action
23	<p>Capacity Test 2 Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Difference between supply and return air temperature is too small with high speed evaporator fans (less than approximately 3.0 C (5.4 F); or temperature difference is less than in test P1.15. • Return air temperature does not reach 0 C (32 F) within preset time. • Indicates: <ul style="list-style-type: none"> - Incorrect location of supply or return air sensor - Air leakage at supply, return or defrost (evaporator coil) sensor cable - Defective supply or return air sensor - Interchanged sensor connections - Incorrect evaporator fan rotation or low speed operation - Incorrect refrigeration system operation - Container/side panels defective, damaged or leaking 	<ul style="list-style-type: none"> • Enter Manual Function Test and start evaporator fans on HIGH speed. Then select Sensor Checks test and operate fans 2 to 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat). <p>NOTE: This sensor check does not detect air leakage around the sensor cables.</p> <ul style="list-style-type: none"> • Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on high speed. • Check the sensor connections. • Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 100%, condenser fan and evaporator fans (high). Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5. <p>NOTE: Alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.</p>

Code	Description	Corrective Action
24	<p>Capacity Test 3 Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Difference between supply and return air temperature is too high with Stepper valve almost closed and high speed evaporator fans (more than 1.5 C [2.7 F]). • Indicates: <ul style="list-style-type: none"> - Defective Stepper valve - Incorrect location of supply or return air sensor - Defective supply or return air sensor - Expansion valve open too much - Incorrect refrigeration system operation - Container/side panels defective, damaged or leaking 	<ul style="list-style-type: none"> • Enter Manual Function Test and start the following components: Condenser fan, evaporator fan (high), compressor and compressor 25%. Check to be sure the Stepper valve closes. • Check the supply and return air sensor connections. • Check the supply and return air sensor calibration. • Check expansion valve superheat setting.
25	<p>Evaporator Temperature Test Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Evaporator coil temperature too high with no evaporator fans running (above about -15 C [+5 F]). • Indicates: <ul style="list-style-type: none"> - Evaporator coil sensor is not in contact with evaporator coil - Return and evaporator coil sensor connections are interchanged - Expansion valve does not open enough or opens too much 	<ul style="list-style-type: none"> • Check evaporator coil sensor location. • Check evaporator coil sensor and return air sensor connections. • Check expansion valve superheat setting.

Code	Description	Corrective Action
27	Heat Capacity Test Error (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) test only. Difference between supply and return air temperature too small with high speed evaporator fans (less than 0.4 C [0.7 F]). Indicates: <ul style="list-style-type: none"> Incorrect location of supply or return air sensor Air leakage at supply, return or evaporator coil sensor cable Defective supply or return air sensor Interchanged sensor connections Defective heater elements Incorrect evaporator fan rotation or high speed operation Container/side panels defective, damaged or leaking 	<ul style="list-style-type: none"> Enter Manual Function Test and start evaporator fans on HIGH speed. Then select Sensor Checks test and operate fans 2 to 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower lower due to fan motor heat). NOTE: This sensor check does not detect air leakage around the sensor cables. Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on high speed. Check the sensor connections.
28	Stepper Motor Valve Error <ul style="list-style-type: none"> Stepper motor valve current too low or too high Indicates: <ul style="list-style-type: none"> Short circuit to valve Faulty stepper motor valve or circuit 	<ul style="list-style-type: none"> Check the wiring to stepper motor valve using unit wiring diagrams and a digital multimeter. <ul style="list-style-type: none"> Disconnect stepper motor valve leads and check circuit resistance. Resistance should be 75 +/- 7.5 ohms at 24 C (75 F) between red/green and white/yellow wire leads. Be sure to maintain the correct polarity or valve will not work.
29	Liquid Injection Valve Error (Pretrip) (Check Alarm) <ul style="list-style-type: none"> Occurs during Function or Pretrip (PTI) test only. Indicates: <ul style="list-style-type: none"> Faulty bypass valve or circuit 	<ul style="list-style-type: none"> Energize and de-energize the bypass valve using "Injection Valve" in the Controller Manual Function Test submenu. Confirm by sound that the valve energizes and de-energizes. If the valve does not operate, check the valve coil for continuity using a high quality multimeter. Check the circuit wiring in plug J11 for continuity using a high quality multimeter and a wiring diagram.

Code	Description	Corrective Action
30	Bypass (Warm Gas) Valve Error (Pretrip) (Check Alarm) <ul style="list-style-type: none"> Occurs during Function or Pretrip (PTI) test only. Indicates: <ul style="list-style-type: none"> Faulty bypass valve or circuit 	<ul style="list-style-type: none"> Energize and de-energize the bypass valve using "Bypass Valve" in the Controller Manual Function Test submenu. Confirm by sound that the valve energizes and de-energizes. If the valve does not operate, check the valve coil for continuity using a high quality multimeter. Check circuit wiring in plug J11 for continuity using a high quality multimeter and a wiring diagram.
31	Low Pressure Cutout Error (Check Alarm) <ul style="list-style-type: none"> Occurs any time. Compressor does not stop during Function or Pretrip (PTI) test. Indicates: <ul style="list-style-type: none"> Stepper motor valve will not open Bypass (warm gas) valve will not open (energize) Low refrigerant charge Defective low pressure cutout switch 	<ul style="list-style-type: none"> Check the wiring to stepper motor valve using unit wiring diagrams and a digital multimeter. <ul style="list-style-type: none"> Disconnect stepper motor valve leads and check circuit resistance. Resistance should be 75 +/- 7.5 ohms at 24 C (75 F) between red/green and white/yellow wire leads. Be sure to maintain correct polarity or valve will not work. Check bypass valve circuit wiring in plug J11 for continuity using a high quality multimeter. If the bypass valve does not operate, check valve coil for continuity using a high quality multimeter. Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5. Continuity check low pressure cutout switch wiring using a high quality multimeter. Replace switch.
32	Condenser Temperature Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> Sensor circuit resistance higher than 100,000 ohms. Temperature below -70 C (-94 F). Indicates: <ul style="list-style-type: none"> Open circuit to sensor Defective or wrong sensor Defective relay board Defective cable No. 1 Defective controller 	<ul style="list-style-type: none"> Check sensor resistance between pins 7 and 8 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). Check cable No. 1 between controller and relay board.

Code	Description	Corrective Action
33	Condenser Temperature Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> - Short circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 7 and 8 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
34	Ambient Air Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -70 C (-94 F). • Indicates: <ul style="list-style-type: none"> - Open circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
35	Ambient Air Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> - Short circuit to sensor - Defective or wrong sensor - Defective relay board - Defective cable No. 1 - Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.

Code	Description	Corrective Action
36	<p>Total Current Too High (Log Alarm)</p> <ul style="list-style-type: none"> • Unit or component current draw is 25% above expected amps for 4 minutes. • Indicates: <ul style="list-style-type: none"> - Stepper valve malfunction - Compressor, evaporator fan motor, condenser fan motor or heater current too high - Defective volt or amp meter on relay board - Power supply voltage too low 	<ul style="list-style-type: none"> • Enter Manual Function Test menu and test (operate) each component. Check volts and amps to determine which component has high amp draw. • Check power supply volts. • Check volt and ampere meter.
37	<p>Total Current Too Low (Log Alarm)</p> <ul style="list-style-type: none"> • Compressor Start-up: Unit or component current draw is 50% below expected amps for 4 minutes. • Indicates: <ul style="list-style-type: none"> - Defective or open fuse CB 7A - Defective or open high pressure cutout switch - Defective evaporator high temperature protection switch - Defective or open motor internal high temperature protection switch - Unit on water-cooled condensing with no water flow - Defective condenser coil sensor or sensor location 	<ul style="list-style-type: none"> • Check LCD display for High Pressure Cutout message. • Enter Manual Function Test menu and test (operate) each component. Check volts and amps to determine which component has low amp draw. • Check volt and ampere meter.
41	<p>Supply Air Temperature Too High (Check Alarm)</p> <ul style="list-style-type: none"> • During Chill or Frozen Mode: Supply air temperature is too high compared to return air temperature under operating conditions. • Indicates: <ul style="list-style-type: none"> - Low refrigerant charge - Incorrect connection or location of supply or return air sensor - Air leakage at supply air sensor cable - Ice or frost on evaporator coil - Incorrect evaporator fan operation 	<ul style="list-style-type: none"> • Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5. • Check for sensor or evaporator fan alarm codes. • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation. • Check supply and return sensor connections and locations.

Code	Description	Corrective Action
42	<p>Supply Air Temperature Too Low (Check Alarm)</p> <ul style="list-style-type: none"> • During Chill or Frozen Mode: Supply air temperature is too low compared to return air temperature under operating conditions. • Indicates: <ul style="list-style-type: none"> - Ice or frost on evaporator coil - Low heating capacity - Incorrect evaporator fan operation - Incorrect connection or location of supply or return air sensors 	<ul style="list-style-type: none"> • Check for sensor or evaporator fan alarm codes. • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation. • Check supply and return sensor connections and locations.
43	<p>Return Air Temperature Too High (Check Alarm)</p> <ul style="list-style-type: none"> • During Defrost: Return air temperature increases above 40 C (104 F). • Indicates: <ul style="list-style-type: none"> - Defective return or evaporator coil sensor - Return and evaporator coil sensor connections are reversed 	<ul style="list-style-type: none"> • Check for sensor alarm codes. • Check supply and return sensor connections and locations.
45	<p>Evaporator Coil Temperature Too High (Check Alarm)</p> <ul style="list-style-type: none"> • During Chill or Frozen Mode: Evaporator coil temperature is too high compared to return air temperature under operating conditions. • Indicates: <ul style="list-style-type: none"> - Low refrigerant charge. - Defective evaporator coil or return air sensor - Incorrect connection or location of evaporator coil or return air sensor 	<ul style="list-style-type: none"> • Check for sensor alarm codes. • Check evaporator coil and return air sensor connections and locations. • Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5.

Code	Description	Corrective Action
46	<p>Evaporator Coil Temperature Too Low (Check Alarm)</p> <ul style="list-style-type: none"> • During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under actual operating conditions. • Controller initiates defrost if no recent defrost. • Indicates: <ul style="list-style-type: none"> - Airflow is blocked in the container - Evaporator fans do not operate - Fresh air exchange vent open too much on frozen load - Defective evaporator coil or return air sensor 	<ul style="list-style-type: none"> • Check for sensor or evaporator fan alarm codes. • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan rotation and operation. • Inspect return air grille and cargo load. Remove any debris or cargo from blocking return air grille. • At setpoints below 5 C (41 F), maximum air vent setting is not allowed. • Check evaporator coil and return air sensor connections and locations.
52	<p>Probe Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test or Probe Test failed in Chilled mode. • Temperature difference between return air and evaporator coil sensors is too high (1.5 C [2.7 F] difference maximum) • Temperature difference between return air and supply air sensors is too high (0.8 C [1.5 F] difference maximum) • Temperature difference between LH supply and RH supply sensors is too high (0.5 C [1.0 F] difference maximum) • Indicates: <ul style="list-style-type: none"> - Incorrect temperature reading on one sensor - Supply air sensor not placed in airflow stream 	<ul style="list-style-type: none"> • Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F). • Check left hand and right hand supply air sensor locations.

Code	Description	Corrective Action
53	<p>High Pressure Cutout Switch Off Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Compressor does not stop during high pressure cutout switch test. • Indicates: <ul style="list-style-type: none"> - Faulty compressor contactor or control circuit - Low refrigerant charge - Defective high pressure cutout switch - Strong winds causing cooling of condenser coil in low ambient conditions 	<ul style="list-style-type: none"> • Enter Manual Function Test menu. Start the following components together: compressor 100%, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop (high pressure cutout switch opens). • Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5.
54	<p>High Pressure Cutout Switch On Error (Check Alarm)</p> <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Compressor does not start within normal time during high pressure cutout switch test. • Indicates: <ul style="list-style-type: none"> - High pressure cutout switch did not respond to pressure change within 5 seconds - Air in refrigeration system - Defective high pressure cutout switch 	<ul style="list-style-type: none"> • Enter Manual Function Test menu. Start the following components together: compressor 100%, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop (high pressure cutout switch opens). Then start the condenser fan. Discharge pressure must decrease quickly and compressor should start (switch closes).

Code	Description	Corrective Action
56	<p>Compressor Temperature Too High (Shutdown Alarm)</p> <ul style="list-style-type: none"> Compressor discharge line temperature is above 130 C (266 F). Compressor stopped until discharge line temperature decreases to 90 C (194 F); Indicates: <ul style="list-style-type: none"> Air in refrigeration system Low refrigerant charge Defective compressor or valve plate Defective liquid injection system Wrong or defective sensor 	<ul style="list-style-type: none"> Check the refrigerant charge using the "Unit Health Check Procedure" on page 6-5. Enter Manual Function Test menu and test (operate) Injection Valve to determine if valve opens (energizes). Check compressor discharge sensor resistance. Resistance must be 100,000 ohms at 25 C (77 F). Check discharge line temperature with a separate electronic thermometer and compare to "HIGH PR TEMP" shown in the Data menu of controller. <p>NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.</p>
58	<p>Phase Sensor Error (Check Alarm)</p> <ul style="list-style-type: none"> Occurs during Pretrip (PTI) or Function test only. During Phase Sensor Test, amperage difference between correct and wrong condenser fan rotation is more than 0.2 amps. Indicates: <ul style="list-style-type: none"> Defective phase relay Defective relay board Defective relay board cable No. 2 	<ul style="list-style-type: none"> Start a Function Test. During step F1.05, check whether the phase relays on relay board receive a signal (LED energizes). Verify that the relays respond and shift to reverse phase.
59	<p>Delta Current Error (Log Alarm)</p> <ul style="list-style-type: none"> 100% ampere difference between current phases. Indicates: <ul style="list-style-type: none"> Open connection on one phase of power supply to a motor or heater element 	<ul style="list-style-type: none"> Enter Manual Function Test menu and test (operate) each 3-phase component to locate defective connection.

Code	Description	Corrective Action
60	Humidity Sensor Error (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) test only. Relative humidity reading is not between 20% and 95%. Indicates: <ul style="list-style-type: none"> Sensor disconnected Wrong controller software configuration Defective sensor 	<ul style="list-style-type: none"> Check sensor connections. Check controller configuration for correct humidity setting. Replace sensor.
97	Compressor Sensor Open Circuit (Log Alarm) <ul style="list-style-type: none"> Sensor circuit resistance higher than 100,000 ohms. Temperature below -30 C (-22 F). Indicates: <ul style="list-style-type: none"> Open circuit to sensor Defective or wrong sensor Defective relay board Defective cable No. 1 Defective controller 	<ul style="list-style-type: none"> Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F). Check cable No. 1 between controller and relay board. <p>NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.</p>
98	Compressor Sensor Short Circuit (Log Alarm) <ul style="list-style-type: none"> Sensor circuit resistance lower than 200 ohms. Temperature above 180 C (356 F). Indicates: <ul style="list-style-type: none"> Short circuit to sensor Defective or wrong sensor Defective relay board Defective cable No. 1 Defective controller 	<ul style="list-style-type: none"> Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F). Check cable No. 1 between controller and relay board.

Code	Description	Corrective Action
99	USDA 1 Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none">• Occurs during Pretrip (PTI) test only.• Container ID starts with MAE, MSF or MWC.• Temperature below -50 C (-58 F).• Indicates:<ul style="list-style-type: none">- All 3 USDA sensors are missing- Defective cable No. 3	<ul style="list-style-type: none">• Check USDA sensors and sensor connections.• Check cable No. 3 between controller and relay board.
112	Zero Current Too High (Check Alarm) <ul style="list-style-type: none">• Ground (zero current) circuit 30 milliamps.• Indicates:<ul style="list-style-type: none">- Defective motor or heater insulation to ground	<ul style="list-style-type: none">• Enter Manual Function Test menu and test (operate) each motor and heater separately. Note when alarm occurs.

5

Electrical Maintenance

Unit Wiring

Inspect unit wiring, wire harnesses, and the controller during pre-trip inspection and every 1,000 operating hours to protect against unit malfunctions due to open or short circuits. Look for loose, chaffed or broken wires on the unit; open or short circuits and damaged components on the controller printed circuit board.

Inspect electrical contactor points for pitting or corrosion every 1,000 operating hours. Repair or replace as necessary.

High Pressure Cutout Switch

A high pressure cutout switch is located on the compressor discharge service manifold of the compressor. If the discharge pressure becomes too high, the switch opens the ground circuit to the compressor contactor coil:

- Compressor STOPS immediately. Evaporator and condenser fans continue normal operation.
- Controller determines that a high pressure cutout switch or compressor motor internal overload protector is open when the unit current draw during compressor operation is normal and then decreases by 7 amps for more than 3 seconds.
- After 1 minute, controller LCD display shows a High Pressure Cutout message:
 - High Pressure Cutout Check Condenser Probe: Water pressure switch is CLOSED and the condenser temperature is low.
 - High Pressure Cutout Check Condenser Fan: Water pressure switch is CLOSED and the condenser temperature is high.
 - High Pressure Cutout Check Water Cooling: Water pressure switch is OPEN.
- After 5 minutes, controller also activates Alarm LED and records Alarm 37, Total Power Consumption Too Low.
- Compressor will restart when the overload condition is corrected (switch closes) as long as power is available.

High Pressure Cutout Switch:

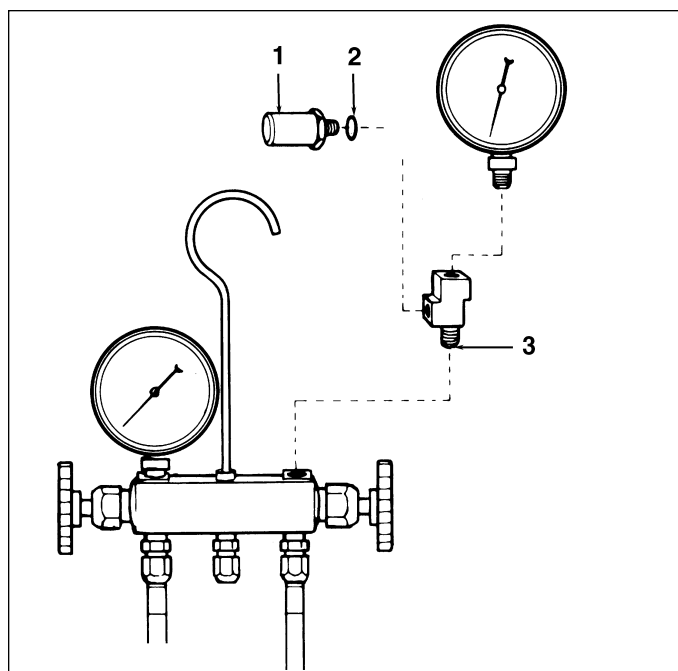
Opens: 3243 +/- 7 kPa, 32.43 +/- 0.48 bar, 470 +/- 7 psig

Closes: 2758 kPa, 27.58 bar, 400 psig

To test the switch, rework a gauge manifold per “High Pressure Cutout Manifold” illustration.

High Pressure Cutout Manifold

1. Connect the manifold gauge to the compressor discharge service valve with a heavy duty, black jacketed thick wall #HCA 144 hose with 6024 kPa, 60.24 bar, 900 psig working pressure rating.
2. Operate the unit in Cool by performing an Capacity 100% test from the Manual Function Test menu of the controller.



High Pressure Cutout Manifold

1. Relief Valve, P/N 66-6543
2. O-ring, P/N 33-1015
3. Adapter Tee (Weather Head No. 552X3)

3. Raise the discharge pressure of the compressor by blocking the condenser coil airflow. Temporarily cover the compressor compartment, control box and power cord storage compartment with cardboard to reduce condenser coil airflow. This should increase the discharge pressure enough to cause the switch to open. When the switch opens:

- The compressor and evaporator fans should STOP immediately.

NOTE: The discharge pressure should never be allowed to exceed 2,760 kPa, 27.6 bar, 400 psig.

4. Be sure to remove the cardboard installed in step 3.

If the HPCO switch fails to stop compressor operation, replace the switch and repeat steps 1 through 4.

Low Pressure Cutout Switch

A low pressure cutout switch is located on the compressor suction line. If the suction pressure becomes too low, the switch opens to stop the compressors:

- Compressor STOPS immediately.
- Evaporator and condenser fans continue normal operation.
- Compressor will restart if the low refrigerant condition is corrected (switch closes) as long as power is available. The low pressure switch resets (closes) when the pressure increases to 48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig.

Low Pressure Cutout Switch:

Opens: +21 to -21 kPa, +.21 to -.21 bar, 6 in. Hg vacuum to 3 psig

Closes: 48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig

If the low pressure cutout switch is suspected of being defective, replace it with a known good switch.

Condenser Fan and Evaporator Fan Rotation

NOTE: If both the condenser fan and evaporator fans are rotating backwards, diagnose the automatic phase selection system.

Condenser Fan

Check for proper condenser fan rotation by placing a small cloth or sheet of paper against the condenser fan grille on the

front of the unit. Proper rotation will blow the cloth or paper away from the grille. Improper rotation will hold the cloth or paper against the grille.

If the condenser fan is rotating backwards, refer to the unit wiring diagram to correct fan motor wiring at the fan motor junction box or condenser fan contactor. To correct improper fan rotation, reverse any two fan power cord leads at the condenser fan contactor (disconnect power supply before reversing leads). DO NOT move the CH ground wire.

Evaporator Fans

Visually inspect the evaporator fan blades for proper rotation. Arrows located on the underside of the fan deck indicate the correct direction of rotation.

NOTE: Check both High and Low Speed evaporator fan rotation by performing Evaporator High and Evaporator Low tests from the Manual Function Test menu of the controller.

If an evaporator fans rotate backwards on one or both speeds, refer to the unit wiring diagram to correct motor wiring at the fan motor junction box or evaporator fan contactor (disconnect power supply before reversing leads). (DO NOT move the ground wire which is labeled CH.)

NOTE: Evaporator fan motor wires EF1, EF2 and EF3 are used on LOW SPEED fan operation. Wires EF11, EF12 and EF13 are used on HIGH SPEED fan operation.

Electric Heaters

Six electric heater elements are located underneath the evaporator coil. If a heater element is suspected of malfunctioning, inspect the connections:

- If the connections appear correct and secure, isolate and check the resistance of each individual heater element by disconnecting it from the circuit.
- Check resistance with an ohmmeter.

NOTE: When repairing heater connections, protect the new connections from the ingress of moisture with heat shrink tubing. All heaters should be secured to prevent contact with sharp metal edges.

6

Refrigeration System Diagnosis and Service

NOTE: The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by State and Local laws.

All regulated refrigeration service procedures must be performed by an EPA certified technician, using approved equipment and complying with all Federal, State and Local laws.

NOTE: Hermetic units feature a large, one-piece filter drier/in-line filter. The filter drier should not require replacement unless major system contamination requires evacuation and cleanup of the refrigeration system.

Hermetic Refrigeration System Diagnosis Procedures

A hermetic refrigeration system is a totally sealed system that is highly reliable, and virtually leak and tamper proof. Consequently, CSR hermetic refrigeration units do not have service valves, schrader fittings or sight glasses to aid diagnosis and service procedures. Instead, system performance is easily and quickly verified by initiating an automatic Pretrip (PTI) Test.

A Pretrip Test should be performed during pretrip and routine maintenance inspections. If the unit fails the Pretrip Test, view and write down each alarm code. Then identify, diagnose and correct all potential mechanical and electrical system problems first. If a mechanical or electrical system problem was detected and corrected, perform another Pretrip Test to verify unit performance and operation. If the unit still fails to cool properly, identify and diagnose all potential refrigeration system problems before opening the refrigeration system.

System Diagnosis Using the Pretrip (PTI) Test

To verify system performance or diagnosis a unit cooling or heating problem, perform a Pretrip Test.

1. Turn the unit On/Off switch ON.
2. Press the F3 key to enter the Main Menu.
3. Press F2 key to scroll through Main Menu until "COM-MANDS" appears in LCD display.
4. Press F4 key to access the Commands menu. The first command in the submenu (Defrost) appears in the LCD display.
5. Press F2 or F3 key to scroll to PTI (Pretrip).
6. Press F4 key to activate the command selected. LCD display shows PTI Test currently being performed. For a detailed description of the PTI Test, see pages 4-23 through 4-27. PTI test ends automatically.

NOTE: Correct all existing alarm conditions and clear the alarm codes before performing a PTI test. The controller will automatically clear all existing alarms before beginning the PTI test.

- If a Check Alarm fault occurs during a pretrip test, the Alarm LED turns ON while the controller continues the Pretrip test.
 - If a Shutdown Alarm fault occurs during a Pretest test, the Alarm LED FLASHES and the controller stops all unit operation.
7. When the Pretrip test is complete, the display will show PTI PASS or PTI FAIL. Press any key to return the unit to normal operation.
 8. If the Alarm LED is ON or flashing ON and OFF, press the F2 key to enter the Alarm menu and view the alarm code(s).
 9. Write down the alarm code in the display. Then press the F2 key to view the next alarm code.
 10. Repeat step 9 until all alarm codes have been recorded.

WARNING: Some unit malfunctions will cause an Alarm and unit shutdown condition. When the alarm codes are cleared, the unit will start automatically.

Use Alarm Codes to Identify and Diagnose Potential Problems

See “Alarm Codes, Descriptions and Corrective Actions” in Chapter 4 of this manual to view a list of problems that may cause the controller to record a specific alarm code.

Identify, diagnose and correct any mechanical and electrical system problems listed in the “Corrective Action” column first. If no mechanical or electrical system problems can be located; or if all mechanical or electrical system problems have been corrected but the unit still fails to pass a Full Pretrip Test, identify and diagnose potential refrigeration system problems.

Several alarm codes identify specific refrigeration system problems. To simplify diagnosis, general refrigeration system problems have been grouped into three areas: Low refrigerant charge, obstruction in the low or high side and high refrigerant charge. Each alarm code that can be generated by the system problem is then listed and briefly described. Also:

- When only one of the alarm codes listed below is recorded during a Full Pretrip Test, a mechanical or electrical system cause is highly probable.
- When two or more of the alarm codes listed below are recorded, the likelihood of a problem inside the refrigeration system greatly increases.

Specific Refrigeration System Problems

- 06 Compressor Current Too High (Check Alarm)
- 07 Compressor Current Too Low (Check Alarm)
- 19 Temperature Too Far from Setpoint (Check Alarm)
- 22 Capacity Test 1 Error (Check Alarm)
- 23 Capacity Test 2 Error (Check Alarm)
- 24 Capacity Test 3 Error (Check Alarm)
- 25 Evaporator Temperature Test Error (Check Alarm)
- 28 Suction Stepper Valve Error (Check Alarm)
- 29 Liquid Injection Valve Error (Check Alarm)
- 30 Bypass (Warm Gas) Valve Error (Check Alarm)
- 31 Low Pressure Cutout Error (Check Alarm)
- 41 Supply Air Temperature Too High (Check Alarm)
- 42 Supply Air Temperature Too Low (Check Alarm)
- 43 Return Air Temperature Too High (Check Alarm)
- 45 Evaporator Coil Temperature Too High (Check Alarm)
- 46 Evaporator Coil Temperature Too Low (Check Alarm)
- 53 High Pressure Cutout Switch Off Error (Check Alarm)
- 54 High Pressure Cutout Switch On Error (Check Alarm)
- 56 Compressor Temperature Too High (Shutdown Alarm)

Low Refrigerant Charge

- 07 Compressor Current Too Low (Check Alarm)
- 19 Temperature Too Far from Setpoint (Check Alarm)
- 31 Low Pressure Cutout Error (Check Alarm)
- 41 Supply Air Temperature Too High (Check Alarm)
- 45 Evaporator Coil Temperature Too High (Check Alarm)
- 53 High Pressure Cutout Switch Off Error (Check Alarm)
- 56 Compressor Temperature Too High (Shutdown Alarm)

Obstruction in the Low Side

- 07 Compressor Current Too Low (Check Alarm)
- 19 Temperature Too Far from Setpoint (Check Alarm)
- 22 Capacity Test 1 Error (Check Alarm)
- 23 Capacity Test 2 Error (Check Alarm)
- 31 Low Pressure Cutout Error (Check Alarm)
- 41 Supply Air Temperature Too High (Check Alarm)
- 45 Evaporator Coil Temperature Too High (Check Alarm)
- 53 High Pressure Cutout Switch Off Error (Check Alarm)
- 56 Compressor Temperature Too High (Shutdown Alarm)

Obstruction in the High Side

- 06 Compressor Current Too High (Check Alarm)

High Refrigerant Charge

- 06 Compressor Current Too High (Check Alarm)

Hermetic Refrigeration System Visual Inspection and Diagnosis

First correct all mechanical or electrical system problems. If the alarm codes recorded during a Pretrip Test do not readily identify a specific refrigeration system problem, then perform a visual inspection of the container and each refrigeration system component. Refer to the Hermetic Refrigeration System Visual Inspection and Diagnosis Chart on page 6-3.

Hermetic Refrigeration System Visual Inspection and Diagnosis Chart

Potential Problem	Alarm Codes	Inspect/Check for
Low Refrigerant Charge (unit not cooling)	-07, -19, -31, -41, -45, -53 and -56	<ul style="list-style-type: none"> - Defective container insulation - Poor fitting container doors - Partial obstruction in high side - Partial obstruction in low side or filter drier - Iced or plugged evaporator coil - Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact - Expansion valve power element lost its charge - Shortage of refrigerant: Inspect refrigeration system for signs of oil loss. Locate and repair leak. - Compressor inefficient - Expansion valve partially closed by ice, dirt or wax
Obstruction in Low or High Side	-06, -07, -19, -22, -23, -31, -41, -45, -53 and -56	<p>Frosted or sweating suction line:</p> <ul style="list-style-type: none"> - Expansion valve admitting excess refrigerant - Evaporator coil needs defrosting - Restricted airflow through the evaporator coil <p>Dry, warm suction line:</p> <ul style="list-style-type: none"> - Restricted filter drier - Shortage of refrigerant: Inspect refrigeration system for signs of oil loss. Locate and repair leak. - Expansion valve partially closed by ice, dirt or wax - Expansion valve power element lost its charge - Stepper valve stuck closed <p>Frosted liquid line:</p> <ul style="list-style-type: none"> - Restricted filter drier <p>Hot liquid line:</p> <ul style="list-style-type: none"> - Expansion valve open too wide - Shortage of refrigerant: Inspect refrigeration system for signs of oil loss. Locate and repair leak.
High Refrigerant Charge	-06	<ul style="list-style-type: none"> - Condenser coil dirty or airflow restricted - Defective water pressure switch (option) - Insufficient water flow rate or plugged water-cooled condenser-receiver tank (option) - Restricted filter drier - Restricted lines on high side - Air in refrigeration system - Overcharge of refrigerant: Install service valves and gauge manifold set. Check system operating pressures. After all other components have been checked, remove refrigerant charge and weight in new charge

Hermetic Refrigeration System Service Procedures

- To connect a gauge manifold set or other service tools to the the refrigeration system, special piercing type service valves must be attached to the discharge and suction line process tubes. These process tubes are located in the compressor compartment.
- When service or maintenance is complete, the hermetic refrigeration system must be returned to normal. The suction and discharge line process tubes must be carefully sealed and the service valves must be removed from the system.

Service Tools

CAUTION: When servicing Thermo King R-404A refrigeration systems, use only those service tools (i.e., vacuum pump, refrigerant recovery equipment, gauge hoses, and gauge manifold set) certified for and dedicated to R-404A refrigerant and Polyol Ester based compressor oils. Residual non-HFC refrigerants or non-Ester based oils will contaminate HFC systems.

Refrigeration System Service Valves

To service the refrigeration system on CSR hermetic units, special piercing type service valves must be attached to the discharge and suction line process tubes.

NOTE: Special fittings may also be needed to connect gauge hoses and other service tools to the special piercing type service access valves.

Refrigerant Recovery

Use only refrigerant recovery equipment approved for and dedicated to R-404A recovery.

Leak Detection

Leaks can be detected with the use of soap bubbles and with Halogen leak detectors such as model H10G, P/N 204-712 or model H10N, P/N 204-756 (portable).

Gauge Manifold Set

The gauge manifold set should be dedicated for use with R-404A only. Piercing type service valves require that the gauge manifold set connect to 1/4" flare fittings:

- Use Gauge Manifold, P/N 204-526, and gauge hoses with self-sealing, 1/4 in. fittings:
 - P/N 204-761, 6 ft (1.8 m) blue hose
 - P/N 204-762, 6 ft (1.8 m) red hose
 - P/N 204-763, 6 ft (1.8 m) yellow hose, or
- Use a Gauge Manifold set equipped with 1/4" gauge hoses with R-134a suction and discharge couplers, plus:
 - P/N 66-7181, Suction adapter, 1/4 in. male flare fitting to 1/2 in. Acme thread fitting
 - P/N 66-7179, Discharge adapter, 1/4 in. male flare fitting to 1/2 in. Acme thread fitting

Vacuum Pump

A two-stage (P/N 204-725), three-stage or five-stage pump is recommended for evacuation. Purging the system with dry nitrogen is recommended before evacuation. Because residual refrigerant may be present in used vacuum pumps, a new vacuum pump should be used and dedicated strictly as an R-404A refrigerant pump. Use only recommended vacuum pump oils and change oil after every major evacuation.

Because vacuum pump oils are highly refined to obtain low vacuums, failure to follow these recommendations may result in acidic conditions that will destroy the pump.

System Cleanup

Cleanup devices such as suction line filters and compressor oil filters may be used if they are properly cleaned and new filters and cartridges are used. All standard petroleum and synthetic compressor oils must be removed to prevent the contamination of R-404A systems.

Recommended Solders

When repairing solder connections, use the same solder that was used in the manufacturing process:

- Copper to copper, use 15% Silver Solder, P/N 203-364
- Copper to brass or steel, use 35% Silver Solder, P/N 203-366

Use flux, P/N 203-365, with both 15% and 35% silver solder. Other types of leaks such as punctures in tubes and leaks in coils can best be repaired using 15% silver solder, P/N 203-364 (with flux, P/N 203-365).

NOTE: Thermo King recommends that service procedures use the use the same solder on connections that was used in the manufacturing process. Therefore, technicians should obtain the recommended solder and flux from Thermo King.

Compressor Oil Acid Test

Perform an oil acid test (oil test kit P/N 203-457) whenever a unit has a substantial refrigerant loss, a noisy compressor or dark/dirty oil.

Refrigerant Charge

NOTE: CSR Hermetic units do not have service valves, fittings or sight glasses installed in the refrigeration system. Therefore, the refrigerant charge level can not be visually inspected.

Perform a controller Pretrip Test to determine that a CSR Hermetic refrigeration system contains an adequate charge of refrigerant for cooling. If the unit passes the the Pretrip Test, the refrigerant charge is generally OK. However, unit cooling performance may not be affected by a marginally low refrigerant charge under all ambient operating conditions. To accurately determine the cooling performance and refrigerant charge level, see the “Unit Health Check” below.

A Pretrip Test should be performed during pretrip and routine maintenance inspections. A low charge of refrigerant will cause the container temperature to rise due to the lack of liquid refrigerant at the expansion valve even though the unit is operating in a cooling mode. Unit refrigerant charge:

- Standard receiver: 4.1 kg (9.0 lb) of R-404A.
- Water-cooled condenser-receiver: 5.0 kg (11.0 lb) of R-404A.

Unit Health Check Procedure

Unit cooling performance may not be affected by a marginally low refrigerant charge (1 to 3 lbs [0.5 to 1.4 kg] low) under all ambient operating conditions. Consequently, a unit with a slightly low refrigerant charge may pass a Pretrip Test. The refrigerant charge level of the unit can be accurately determined by operating the unit on Cool for 15 minutes or more and then checking temperature difference (dT) across the evaporator coil. To check the dT:

1. Press F4 key to directly enter the Data menu. Read:
 - Supply Air Temperature, Right Hand
 - Return Air Temperature
2. Subtract the supply air temperature (right hand) from the return air temperature to determine dT.
3. Compare the unit dT to the expected values in table below. If dT is below the value in the “possible low refrigerant charge” column, visually inspect the unit for signs of frosted or iced evaporator coil, low or high obstruction in the refrigeration system, plugged expansion valve and a loose or defective expansion valve feeler bulb before concluding the unit is low on refrigerant.

NOTE: Inspect the unit for refrigerant leaks with a reliable leak detector if the unit is suspected of being low on R-404A charge.

Unit Health Check Table — Determining Possible Low R-404A Charge

Power Supply	Ambient Temp.	Return Air Temp.	Expected dT: Return Temp. minus right hand supply temp.	dT less than figure listed below indicates possible low R-404A charge
460V, 3 Phase, 60Hz	38 °C (100 °F)	-29 °C (-20 °F)	-2.2 °C (-4.0 °F)	-1.7 °C (-3.0 °F)
		-18 °C (0 °F)	-4.3 °C (-7.7 °F)	-3.2 °C (-5.8 °F)
		-1 °C (30 °F)	-3.9 °C (-7.0 °F)	-2.9 °C (-5.3 °F)
		10 °C (50 °F)	-5.6 °C (-10.1 °F)	-4.2 °C (-7.6 °F)
	27 °C (80 °F)	-29 °C (-20 °F)	-3.0 °C (-5.4 °F)	-2.3 °C (-4.1 °F)
		-18 °C (0 °F)	-4.8 °C (-8.6 °F)	-3.6 °C (-6.5 °F)
		-1 °C (30 °F)	-3.8 °C (-6.9 °F)	-2.9 °C (-5.2 °F)
		10 °C (50 °F)	-6.7 °C (-12.0 °F)	-5.0 °C (-9.0 °F)
	16 °C (60 °F)	-29 °C (-20 °F)	-3.0 °C (-5.4 °F)	-2.3 °C (-4.1 °F)
		-18 °C (0 °F)	-4.6 °C (-8.3 °F)	-3.5 °C (-6.2 °F)
		-1 °C (30 °F)	-4.5 °C (-8.1 °F)	-3.4 °C (-6.1 °F)
		10 °C (50 °F)	-6.5 °C (-11.7 °F)	-4.9 °C (-8.8 °F)
380V, 3 Phase, 50Hz	38 °C (100 °F)	-29 °C (-20 °F)	-2.1 °C (-3.8 °F)	-1.6 °C (-2.9 °F)
		-18 °C (0 °F)	-4.2 °C (-7.5 °F)	-3.1 °C (-5.6 °F)
		-1 °C (30 °F)	-3.9 °C (-7.0 °F)	-2.9 °C (-5.3 °F)
		10 °C (50 °F)	-5.7 °C (-10.2 °F)	-4.3 °C (-7.7 °F)
	27 °C (80 °F)	-29 °C (-20 °F)	-3.0 °C (-5.4 °F)	-2.3 °C (-4.1 °F)
		-18 °C (0 °F)	-4.8 °C (-8.6 °F)	-3.6 °C (-6.5 °F)
		-1 °C (30 °F)	-4.3 °C (-7.7 °F)	-3.2 °C (-5.8 °F)
		10 °C (50 °F)	-6.4 °C (-11.5 °F)	-4.8 °C (-8.6 °F)
	16 °C (60 °F)	-29 °C (-20 °F)	-3.0 °C (-5.4 °F)	-2.3 °C (-4.1 °F)
		-18 °C (0 °F)	-4.9 °C (-8.8 °F)	-3.7 °C (-6.6 °F)
		-1 °C (30 °F)	-4.7 °C (-8.5 °F)	-3.5 °C (-6.4 °F)
		10 °C (50 °F)	-5.6 °C (-10.1 °F)	-4.2 °C (-7.6 °F)

Compressor Oil Charge

CSR Hermetic units do not have service valves, fittings or sight glasses installed in the refrigeration system. Therefore, the compressor oil level can not be visually inspected. To maintain the correct compressor oil level in the unit:

1. Whenever possible, drain and measure the compressor oil from major system components that are removed for service or replacement whenever possible. Major components include:
 - Compressor
 - Filter drier
 - Heat exchanger
 - Receiver tank
 - Water-cooled condenser-receiver tank

NOTE: *If the compressor oil is discolored, perform a compressor oil acid test (oil test kit P/N 203-457). If the compressor oil shows an acid condition, change the oil, the filter drier and perform a refrigeration system cleanup.*

2. Add an amount of new compressor oil equal to the amount removed from the old component. Use only Polyol Ester compressor oil, P/N 203-433.

CAUTION:

- **Use ONLY Polyol Ester based refrigeration compressor oil, P/N 203-433.**
- **DO NOT mix Polyol Ester based and standard synthetic compressor oils.**
- **Rubber gloves are recommended when handling Ester based compressor oil.**
- **Keep Polyol Ester based compressor oil in tightly sealed containers. If Ester based oil becomes contaminated with moisture or standard oils, dispose of properly — DO NOT USE!**

Installing and Removing Piercing Type Service Valves and a Gauge Manifold Set

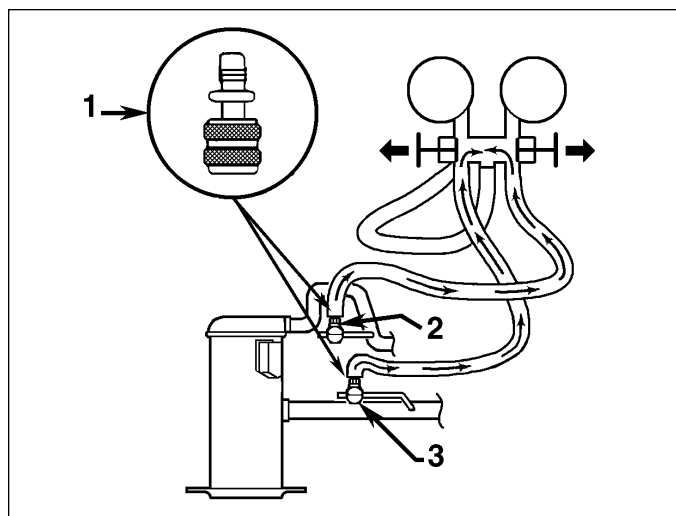
To service the refrigeration system on CSR hermetic units, special piercing type service access valves must be attached to the discharge and suction line process tubes. These process tubes are located in the compressor compartment.

When service or maintenance is complete, the hermetic refrigeration system must be returned to normal. The suction and discharge line process tubes must be carefully sealed and the service valves must be removed from the system.

Piercing Type Service Valve Installation

NOTE: *Before installing any piercing type service valve, carefully check to ensure that the valve and access port connection function properly.*

1. Stop the unit and allow compressor suction and discharge lines to cool to ambient temperature.
2. Inspect piercing type service valves for correct fittings for attachment of gauge manifold hoses, refrigerant recovery equipment, a vacuum pump and other service tools.
3. Remove the compressor compartment bracket.
4. Clean dirt and moisture from the unit's process tubes.
5. Position the piercing port of the service valve about 13 mm (0.5 in.) from the existing crimp (or end) of the process tube on the suction line.
6. Install and secure the piercing valve on process tube. Carefully check to ensure that the piercing valve connection on the process tube is secure.
7. Leak check the service valve connection with an electronic leak detector.
8. Repeat steps 5 through 7 to install a piercing type service valve on the discharge line process tube.



Balancing the Pressure

1. Quick Disconnect Access Valve
2. Discharge Service Valve (DSV)
3. Suction Service Valve (SSV)

Gauge Manifold Set Installation

NOTE: *As long as a slight positive pressure remains in the manifold set and hoses, the gauge manifold set may be reinstalled without additional purging. To purge a gauge manifold set and hoses, see "Gauge Manifold Valve Positions" in this chapter.*

1. Inspect gauge manifold for proper hose and fitting connections. Both the low side (suction) and high side (discharge) hand valves on the gauge manifold should be fully closed to center port.
2. Clean dirt and moisture from around ports on piercing valves. Remove service port caps (if required).
3. Attach the low side hose (compound gauge) to the piercing valve port on the suction process tube finger tight.
4. Attach high side hose (pressure gauge) to the piercing valve port on the discharge process tube finger tight.
5. The gauge manifold set is now ready to use to check system pressures and perform MOST service procedures.

Gauge Manifold Set Removal

NOTE: *To ensure minimum refrigerant release to the atmosphere, the compressor should be operating. While this is not possible in all cases, the same procedure should be followed.*

1. Operate the unit in a cool mode.
2. Close the refrigerant tank hand valve (if attached to the gauge manifold set).
3. Open both manifold hand valves.

4. Remove the discharge line from the piercing valve port.
5. Operate the unit in cool mode until the suction pressure decreases below 385 kPa, 3.85 bar, 50 psig.
6. Stop the unit.
7. Remove the suction line from the piercing valve port.

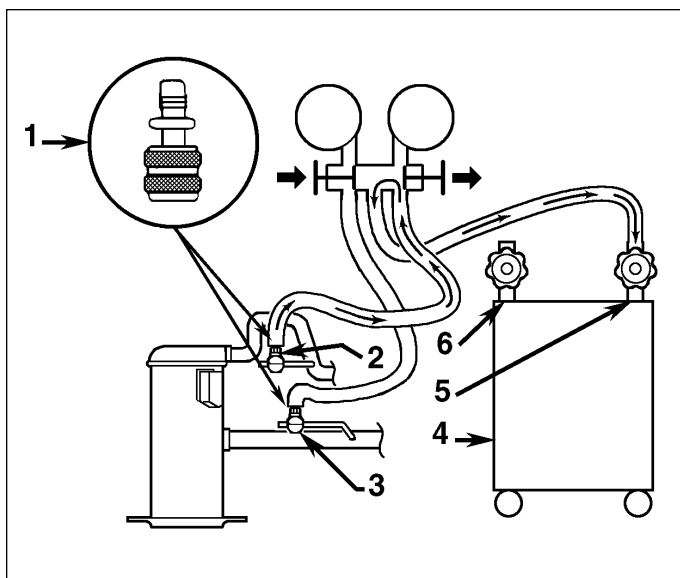
Piercing Type Service Valve Removal

NOTE: *Before removing a piercing type service valve, make sure the unit successfully completes a controller Pretrip Test to verify that the refrigerant charge and unit operation are correct.*

1. Carefully crimp the suction line process tube about 13 mm (0.5 in.) from the service access valve to seal and isolate suction line process tube from the service valve.

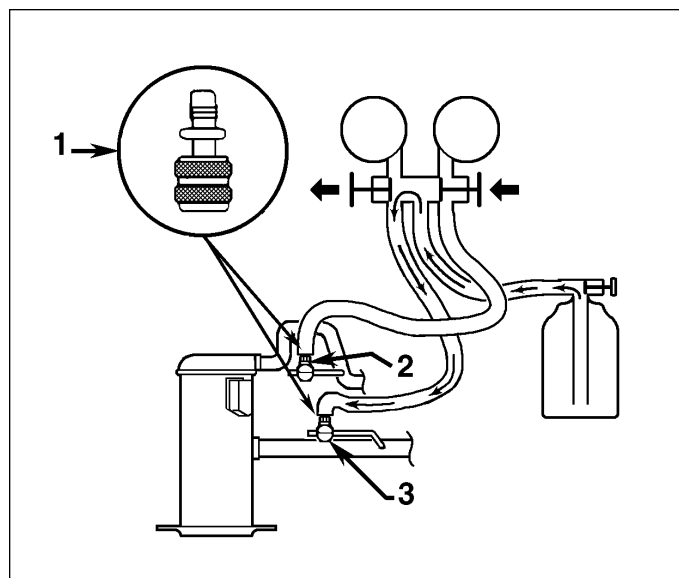
NOTE: *Perform the following three procedures as quickly as possible to prevent refrigerant loss.*

2. Remove the piercing type service valve from suction process tube.
3. Cut the end of process tube off where the tube was pierced by the service valve. This leaves about 13 mm (0.5 in.) of process tube open behind the crimp.
4. Fill the open end process tube with high temperature solder.
5. Repeat steps 1 through 4 to seal the process tube and remove the service valve on from the discharge line.
6. Leak check the process tubes with an electronic leak detector.



Removing Refrigerant

1. Quick Disconnect Access Valve
2. Discharge Service Valve (DSV)
3. Suction Service Valve (SSV)



Charging the System

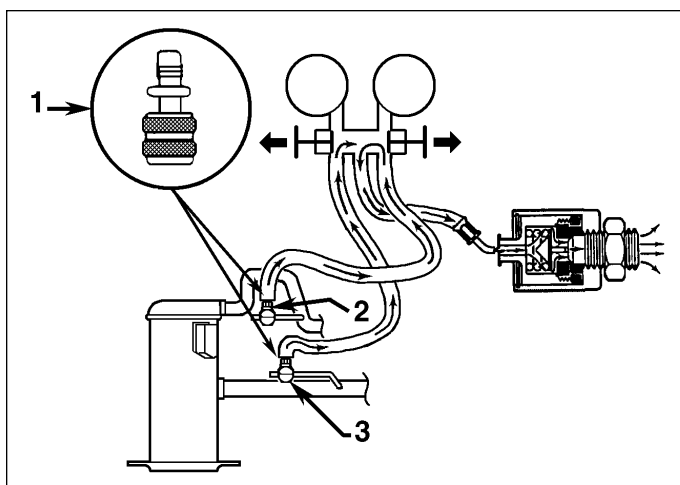
1. Quick Disconnect Access Valve
2. Discharge Service Valve (DSV)
3. Suction Service Valve (SSV)

Gauge Manifold Valve Positions

The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations shown below.

Purging a Gauge Manifold and Hoses

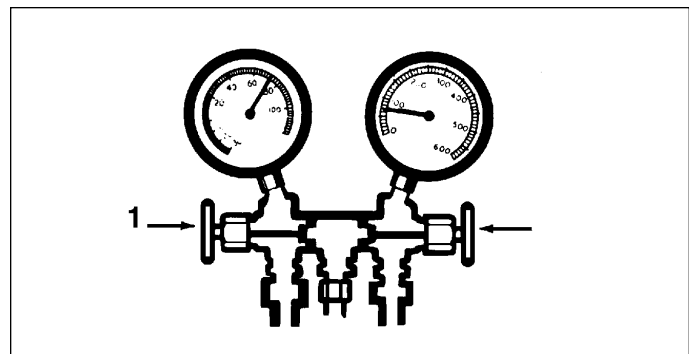
1. Inspect gauge manifold for proper hose and fitting connections.
2. Clean dirt and moisture from around service ports on service valves. Remove service port caps from service valves (if required).
3. Rotate both hose coupler hand wheels on the gauge manifold set counterclockwise to back the stem out of the high and low hose fittings.
4. Attach the low side hose (compound gauge) to the port on the suction line service valve. Purge the low side hose:
 - a. Open the low side (suction) hand valve on the gauge manifold fully to center port.
 - b. With 70 kPa, 0.70 bar, 10 psig or greater pressure in the low side, rotate the suction hose fitting hand wheel clockwise to open (depress) the suction line port valve to the low side hose.
 - c. Slowly screw a 1/2 inch ACME fitting into the low loss fitting on the manifold's service (center) line to purge the suction and service hoses.
 - d. Remove the ACME fitting after purging the suction hose.
 - e. Close the low side (suction) hand valve on the gauge manifold fully to center port.



Purging Gauge Manifold

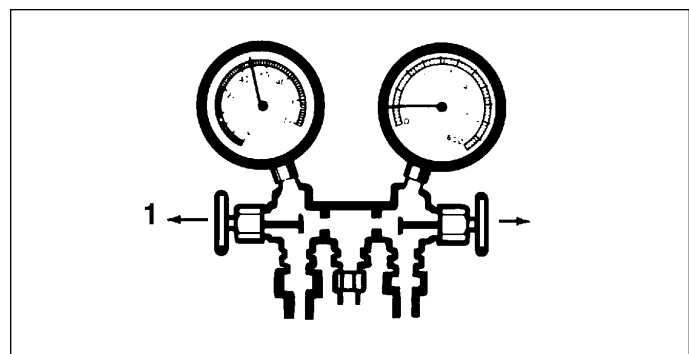
1. Quick Disconnect Access Valve
2. Discharge Connection
3. Suction Connection

5. Attach high side hose (pressure gauge) to the port on the discharge line service valve. Purge the high side hose:
 - a. Open the high side (discharge) hand valve on the gauge manifold fully to center port.
 - b. Rotate the discharge hose fitting hand wheel clockwise to open (depress) the discharge line port valve to the high side hose.
 - c. Slowly screw a 1/2 inch ACME fitting into the low loss fitting on the manifold's service (center) line to purge the discharge and service hoses.
 - d. Remove the ACME fitting after purging the discharge hose.
 - e. Close the high side (discharge) hand valve on the gauge manifold fully to center port.
6. The gauge manifold set is not ready to use to check system pressures and perform MOST service procedures.



Gauge Manifold Closed to Center Port

1. Close Hand Valves



Gauge Manifold Open to Center Port

1. Open Hand Valves

Refrigerant Leak Test Procedure

Use a reliable Halogen leak detector such as model H10G, P/N 204-712 or 204-756 (portable), to leak test the refrigeration system. Inspect carefully for signs of compressor oil leakage which is the first sign of a leak in the refrigeration system.

NOTE: Due to environmental concerns and personal safety, the use of a Halide torch is no longer recommended.

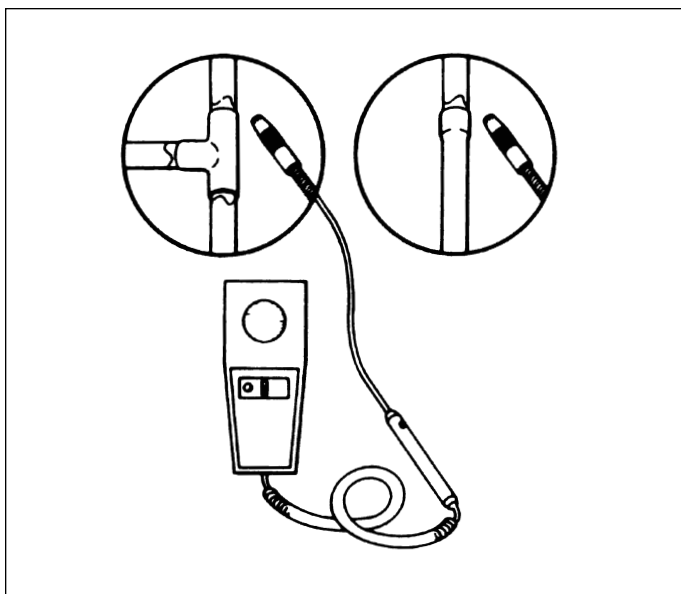
If refrigerant has leaked or been removed from the unit:

1. Check entire system for possible component damage and refrigerant oil loss.
2. Attach gauge manifold set (refer to "Gauge Manifold Set Attachment and Purging" for proper procedures).
3. Attach refrigerant bottle charging hose to center of gauge manifold and purge charging hose of air.
4. Pressurize the system with refrigerant (GAS ONLY) until 345 kPa, 3.45 bar, 50 psig vapor pressure is achieved.
5. Leak check the system with an electronic leak detector to inspect all joints and connections. (Use soap solution as an alternative test component.)

If no leaks are found but the system has lost its refrigerant charge, proceed to the next step.

6. Close both hand valves on gauge manifold (front seated).
7. Disconnect the refrigerant charging hose.
8. Connect the charging hose to a source of nitrogen. Adjust the pressure regulator to 1380 kPa, 13.80 bar, 200 psig. See "Using Pressurized Nitrogen" in this chapter.

CAUTION: Nitrogen (N_2) is under 15,170 kPa, 151.70 bar, 2200 psig pressure in a full cylinder



Testing for Refrigerant Leaks

at 21 C (70 F). DO NOT use oxygen, acetylene or any other type of pressurized gas in the system.

9. Pressurize the system with nitrogen to 1380 kPa, 13.80 bar, 200 psig.
10. Close the supply valve on the nitrogen bottle.
11. Use an electronic leak tester to inspect all joints and connections. (Use a soap solution as an alternative test component.)

NOTE: If system leakage is indicated, loosen supply line hose fittings to release pressure. Repair leakage condition.

12. If system repair is necessary, recheck system after repairs are completed.

Using Pressurized Nitrogen

The improper use of high pressure cylinders can cause physical damage to components, or personal injury, or cause stress that would lead to failure of components.

Safety Precautions

Observe the proper handling of cylinders:

1. Always keep protective cap on cylinder when not in use.
2. Secure cylinder in proper storage area or fastened to cart.
3. DO NOT expose to excessive heat or direct sun light.
4. DO NOT drop, dent, or damage cylinder.
5. Use a pressure regulator and a safety pressure relief valve as part of the pressure testing equipment. The safety pressure relief valve should be of the non-adjustable, non-tempering type. The valve should bypass any time the pressure exceeds its setting.
6. Open valve slowly; use regulators and safety valves that are in good working order.
7. The regulator should have two gauges; one to read tank pressure, the other to read line pressure. Properly maintained equipment will allow leak testing, purging, or dehydration to be done safely.

CAUTION: Nitrogen (N_2) is under 15,170 kPa, 151.70 bar, 2200 psig, or greater. Pressure is for full cylinder at 21 C (70 F). DO NOT use Oxygen (O_2), acetylene or any other types of pressurized gas on refrigeration systems or any component of a system.

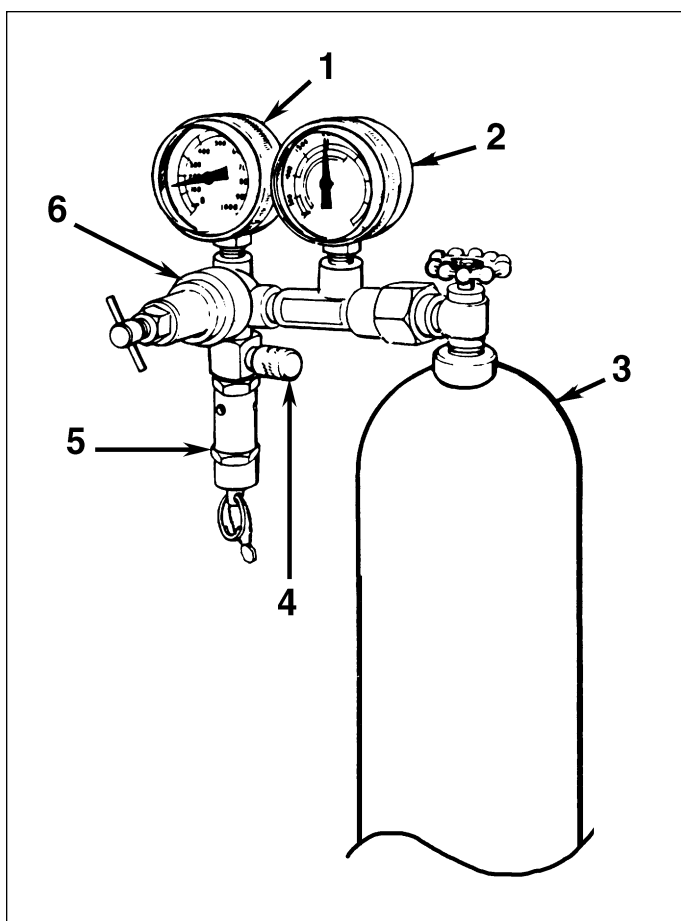
Dehydration, pressure testing, purging and soldering can be accomplished with the use of dry nitrogen (N_2). The proper equipment and application of equipment is of greatest importance.

Procedure

1. Attach gauge manifold set (refer to “Gauge Manifold Set Attachment and Purging” for proper procedure for connecting to the unit).
2. Close both hand valves on the gauge manifold (front seated).
3. Connect charging hose to a source of nitrogen. Adjust pressure regulator to the proper pressure for the required procedure.
4. Purge system high side to low side.

MAXIMUM Gas Pressure for Service Procedures

- Leak Testing: 1034 to 1200 kPa, 10.34 to 12.00 bar, 150-174 psig,
- Purging/Dehydration: 69 to 138 kPa, 0.69 to 1.38 bar, 10-20 psig,
- Soldering: 35 kPa, 0.35 bar, 5 psig.



Typical Pressurized Gas Bottle with Pressure Regulator and Gauges

1. Line Pressure
2. Tank Pressure
3. Tank
4. Pressure Test Line to System
5. Safety Valve
6. Pressure Regulator

Refrigerant Recovery from Hermetic Refrigeration Systems

Caution: Use only refrigerant recovery equipment approved for and dedicated to R-404A recovery.

When removing any refrigerant from a Thermo King refrigeration system, use a recovery process that prevents or absolutely minimizes the refrigerant that can escape to the atmosphere. Typical service procedures that require removal of refrigerant from the unit include:

- To empty the unit of refrigerant when an unknown amount of charge is in the system and a correct charge is required.
- To empty the unit of contaminated refrigerant when the system has become contaminated. Place this refrigerant gas in a contaminated refrigerant bottle to be reclaimed later.
- To remove a leak test charge from the refrigeration system. Because this refrigerant gas will contain some air, place it in a contaminated refrigerant bottle to be reclaimed later.

NOTE: Always refer to specific recovery equipment Operator and Service Manuals.

Vapor Recovery

1. Disconnect unit from 3-phase power supply.
2. Install piercing type service access valves on the process tubes located on the discharge and suction lines in the compressor compartment. Attach service lines to the service access valves and recovery machine and properly purge the lines.
3. Set the recovery machine for vapor recovery.

NOTE: CSR Hermetic units do not have service valves or fittings installed in the refrigeration system. Therefore, only vapor recovery of the refrigerant charge is possible.

4. Turn ON the recovery machine and open (back seat) both service access valves.
5. Continue to operate the recovery machine until unit pressures drop to 0 kPa, 0 bar, 0 psig pressure.

Evacuation and Cleanup of the Refrigeration System

Contamination

Whenever contaminants have entered the system, a thorough clean up is required to prevent damage or loss of compressor.

It is well known by the refrigeration service industry that the purpose of evacuation is to remove moisture and air from the refrigeration system before charging with new refrigerant after a system has been opened. The importance of thorough evacuation and system preparation cannot be over emphasized. Even infinitesimal quantities of air or moisture in a system can cause severe problems.

We know that the presence of moisture, oxygen, and heat under certain conditions can result in many forms of damage. Corrosion, sludge, copper plating, oil breakdown, carbon formation, and eventual compressor failure can be caused by these contaminants.

Things that will contaminate a system are (in order of importance):

- **AIR** — with oxygen as a contaminant. Oxygen in the air reacts with the oil. The oil begins to break down and can eventually lead to carbonization in the compressor and acid buildup. The longer this breakdown process goes on, the darker the compressor oil becomes until finally the color is BLACK indicating major system contamination.
- **MOISTURE**. Moisture in a system will cause metal corrosion and metal plating. It can freeze in the expansion valve and cause intermittent operational problems. It reacts in the oil to begin acid buildup.
- **DIRT, DUST, METAL PARTICLES, OTHER FOREIGN MATERIALS**. Particles of any kind left to float through the system will cause severe damage to all close tolerance items. Do not leave a system open to the infiltration of dirt. If you must open a system for any reason, seal off the open areas as soon as possible and DO NOT work in a dirty environment.
- **ACID**. Air and moisture cause a chemical breakdown of the oil and/or the refrigerant itself. The acid will accelerate the deterioration of the softer metals (i.e., copper) and cause metal plating as the softer material begins to cover the inside of the system. If this condition is not stopped, it can result in the total destruction of your equipment.

Compressor Oil Color Code

BLACK OIL — indicates carbonization caused by air in the system.

BROWN OIL — indicates copper plating caused by moisture in the system.

GRAY OR METALLIC OIL — indicates bearing wear or piston scoring.

NOTE: *If the compressor oil is discolored, perform a compressor oil acid test (oil test kit P/N 203-457). If the compressor oil shows an acid condition, change the oil, the in-line oil filter, the filter drier and perform a refrigeration system cleanup.*

Unit Preparation and Hookup

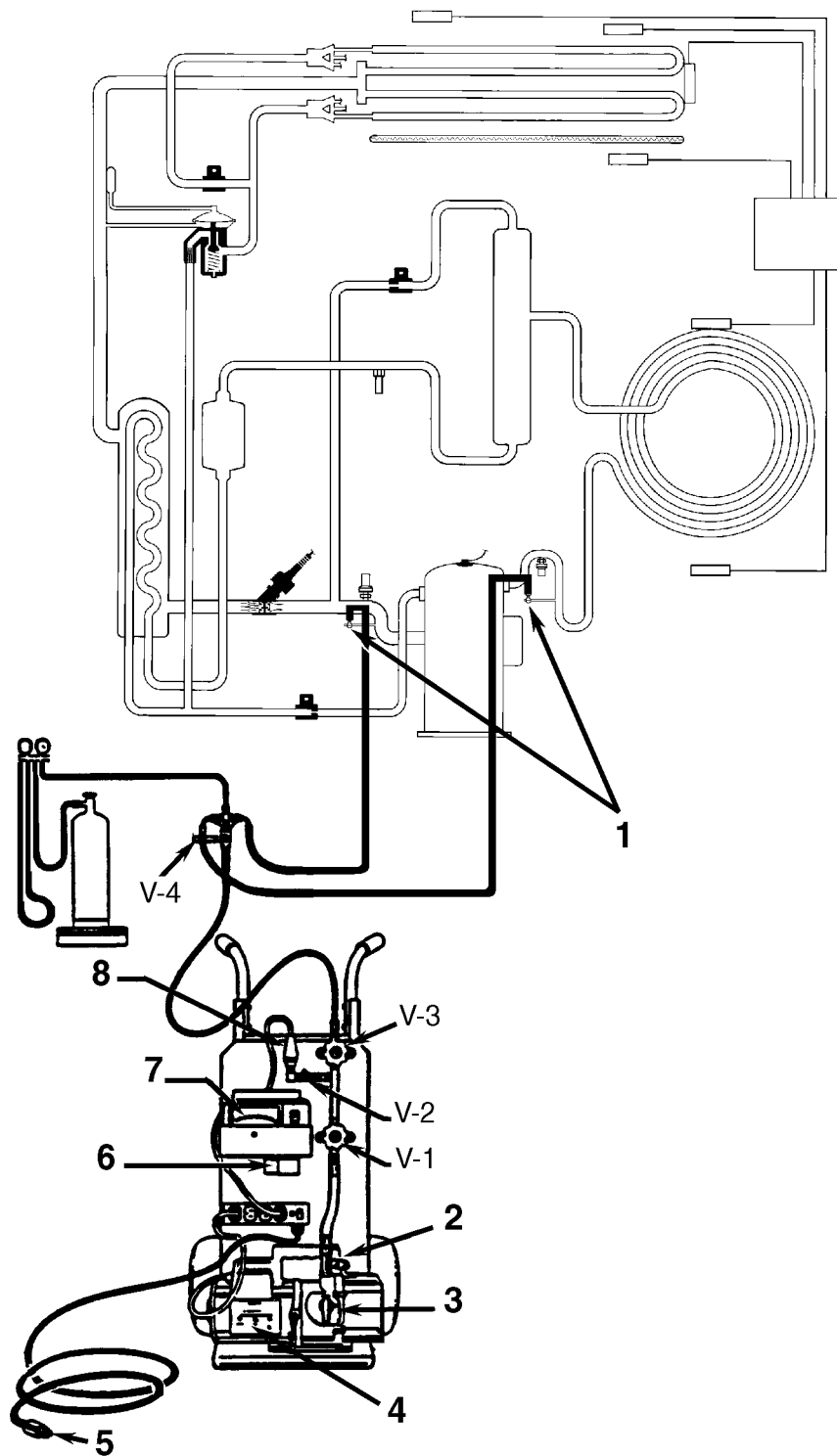
CAUTION: *Do not attempt to evacuate a unit until it is certain that the unit is leak free. A unit with less than a full charge of refrigerant should be thoroughly leak tested. Any leaks found must be repaired.*

1. Recover all refrigerants from the unit and reduce the unit pressure to the proper level (US Federal Law requires a -17 to -34 kPa, -0.17 to -0.34 bar, 5 to 10 in. vacuum that is dependent upon the recovery equipment used).
2. Break vacuum with refrigerant and equalize system pressure to 0 kPa, 0 bar, 0 psig. Replace the liquid line filter drier if necessary.

NOTE: *Hermetic units feature a large, one-piece filter drier/in-line filter. The filter drier should not require replacement unless major system contamination requires evacuation and cleanup of the refrigeration system.*

3. Confirm that the Evacuation Station functions properly and determine "Blank Off" Pressure. The Blank Off Pressure of the Vacuum Pump is the deepest vacuum that the vacuum pump can attain when isolated from the rest of the system.

If a vacuum pump (isolated from a system) is started and the Micron Meter responds quickly by going to a deep vacuum, the operator can be confident that the pump and oil are in good condition. If the vacuum pump fails to reach a deep vacuum within 5 minutes, the operator should suspect the condition of the oil or the pump. Thermo King recommends that the pump oil be changed first to see if the rate of reaching a deep vacuum is improved.



Evacuation Station and Unit Hook-up

1. Special, self-sealing quick disconnect couplers are required for R-404A units.
2. Gas Ballast Valve
3. Iso Valve
4. Two-stage Vacuum Pump
5. To 220/190 VAC Power
6. Calibration Standard
7. Micron Meter
8. Sensor

4. Connect the Evacuation Station and refrigerant tank with gauge manifold (optional) to the unit as indicated on the diagram on page 6-12. Connect evacuation hoses to the service access valves on the suction and discharge line process tubes.
 5. Open Evacuation Station valves (V1, V3, and V4). Open valve V2 only when a reading on the Micron Meter is desired. This is especially true when starting to evacuate a unit and large amounts of moisture and oil will be passing by the sensor.
 6. Open the vacuum pump Iso-Valve™ built into the pump housing below the handle. Keep the valve be kept open at all times.
 7. If connecting a refrigerant tank and gauge manifold to the evacuation station, close the gauge manifold and refrigerant tank valves to prevent refrigerant from being drawn from the tank.
2. If the vacuum level appears to stall above 500 microns, back seat the discharge service access valve and observe the Micron Meter.
 - A drop in pressure indicates that the compressor oil is out-gassing and further evacuation is necessary.
 - An increase in pressure indicates that a leak exists or there is moisture in the system. Perform a “Pressure Rise Test” and evaluate.
 3. Close valve V1 when the desired vacuum level has been reached.
 4. Wait five minutes and read the Micron Meter.
 - A system that is leak free and dry will remain below 2000 microns for five minutes.
 - A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
 - A system that continues to rise without stabilizing has a leak and must be repaired.
 5. If the vacuum level remained below 2000 microns for five minutes, the unit is ready to charge.

Unit Evacuation

1. Turn on the Vacuum Pump. Open the Gas Ballast Valve located on top of the pump housing behind the handle (the valve is fully open at two turns counterclockwise). Evacuate the system to 500 microns to achieve a final equilibrium pressure of 2000 microns or less. The final equilibrium pressure is determined with the Thermo King Evacuation Station using the following procedure (called a pressure-rise test):
 - a. Evacuate the system using the Evacuation Station until the vacuum level reaches 1000 microns. Then close the Gas Ballast Valve,
 - b. Continue evacuation to 500 microns or until vacuum stabilizes at its lowest level. Contamination may delay reaching the lowest level for a period of several or more hours.
 - c. Close valve V1 to isolate the vacuum pump from the system.
 - d. Observe the vacuum level on the Micron Meter.

When the Meter has stabilized, the value indicated on the Micron Meter is the equilibrium pressure. This reading must be 2000 microns or less.

NOTE: *The presence of refrigerant in the compressor oil may prevent a low vacuum reading from being achieved. Compressor oil can continue to outgas for long periods of time.*

Pressure Rise Test

Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the Micron Meter rises, one of the following conditions exist.

- **Leak:** Watch the movement of the Micron Meter needle. If the needle continues to rise until it reaches atmospheric pressure, it is an indication that a leak exists somewhere in the system. When a leak is in a system, the vacuum will eventually stabilize at atmospheric pressure (see graph, “Constant Pressure Rise After Evacuation Indicates System Leak”, on page 6-14).
- **Moisture:** When the needle indicates a rise and then stabilizes at a level below atmospheric pressure, it is an indication that the system is vacuum tight, but is still wet and requires additional dehydration and pumping time (see graph, “Pressure Rise Levels Off After Evacuation Indicates Moisture in System”, on page 6-14).

Factors Affecting the Speed of System Evacuation

It is almost impossible to state the exact amount of time required to evacuate any system. Some factors that can influence evacuation time are listed below.

- System size
- Amount of moisture contained in the system
- Ambient temperature
- Internal restrictions within the system
- External restrictions between the system and the vacuum pump

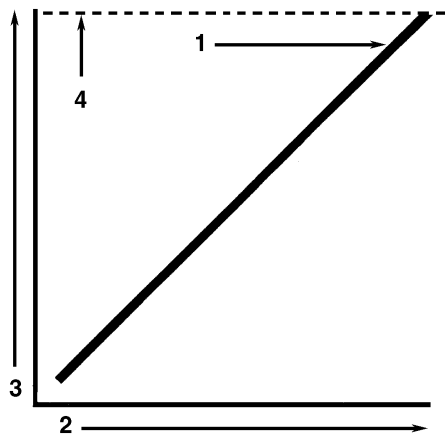
Hose size, both diameter and length, affect evacuation times. Laboratory tests show that the evacuation time can be significantly reduced by larger diameter hoses and shorter hoses. To obtain optimum pumping speed, keep hoses as short as possible and as large in diameter as possible. For example, it takes eight times as long to pull a given vacuum through a 6 mm (0.25 in.) diameter hose as it does through a 13 mm (0.5 in.) diameter hose. It takes twice as long to pull a vacuum through a 2 meter (6 ft) long hose as it does through a 1 meter (3 ft) long hose.

Heat Saves Time

A useful and practical time saver is the application of heat to the system. Increasing the temperature of the compressor oil and refrigerant will speed up the vaporization of any water present in the system.

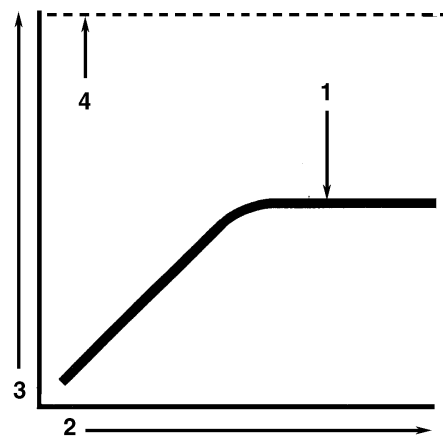
WARNING: Never use a torch or other concentrated heat source to heat the compressor or other refrigeration system component.

Heat lamps, electric heaters, or fans can be applied to the compressor crankcase and other parts of the system to increase the temperature of the refrigerant and compressor oil.



Constant Pressure Rise After Evacuation Indicates System Leak

1. Close the vacuum valve and watch the movement of vacuum gauge needle. If needle continues to rise, this is an indication that a leak exists in the unit or connecting line. The leak must then be located and eliminated.
2. Time
3. Pressure (Vacuum)
4. Atmospheric Pressure



Pressure Rise Levels Off After Evacuation Indicates Moisture in System

1. Close the vacuum valve and watch the movement of vacuum gauge needle. If needle shows a pressure rise but finally levels off to a constant pressure, the system still contains too much moisture. Dehydration and additional evacuation time are required.
2. Time
3. Pressure (Vacuum)
4. Atmospheric Pressure

Charging the System with Refrigerant

Unit Charging by Weight (from an Evacuated Condition)

1. Close valve V4.
2. Open the Gas Ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. The discharge valve and receiver outlet valves remain mid-seated.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (see “Evacuation Station and Unit Hookup” on page 6-12).
6. Weigh the tank of refrigerant.
7. Check unit data plate for the required weight of refrigerant charge. Then subtract the unit charge weight from the total weight of the refrigerant tank. This provides the final tank weight after the unit receives a full refrigerant charge.
8. Set the refrigerant tank for liquid removal. Open the hand valve on the tank.
9. With the unit OFF, open the gauge manifold hand valve and charge liquid refrigerant into the system.
10. Close the refrigerant tank hand valve when the correct amount (by weight) of refrigerant has been added or if the system will take no more liquid.

The unit is now ready to have the Evacuation Station removed.

Evacuation Station Removal

1. Close the high pressure hand valve on the gauge manifold.
2. Close the refrigerant tank hand valve.
3. Open the hand valve at the gauge manifold and read suction pressure.
4. Operate the unit in cool mode until the suction pressure decreases below 385 kPa, 3.85 bar, 50 psig.
5. Back seat the suction line access service valve.
6. Stop the unit.
7. Remove the hoses from the suction and discharge line access service valves.
8. Seal and solder the suction and discharge line process tubes to remove piercing type access service valves from unit (see “Installing and Removing Piercing Type Service Valves and a Gauge Manifold Set” in this chapter).
9. Leak check the process tubes with an electronic leak detector.
10. Start the unit and perform a controller Pretrip Test to verify correct refrigerant charge and unit operation.

Compressor Replacement

Removal

1. Remove the compressor compartment bracket.
2. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
3. Disconnect the unit from the three-phase power supply.
4. Remove the three-phase electric power connection from the compressor.
5. Unsolder the discharge line, suction line and liquid injection line from the compressor.
6. Remove the compressor mounting tray bolts and nuts.
7. Slide the compressor from the unit.
8. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.
9. Drain and measure the compressor oil that remains in the compressor.

NOTE: The compressor oil must be removed from the compressor and measured so that the same amount of oil can be added before placing the new compressor or repaired compressor in the unit.

Installation

1. Add new compressor oil to the new compressor. Add an amount equal to the amount removed from the old compressor.

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil, P/N 203-433. Keep Polyol Ester based compressor oil in tightly sealed containers. If Ester based oil becomes contaminated with moisture or standard oils, dispose of properly — DO NOT USE!

2. Clean the tubes for soldering.
3. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.
4. Solder the discharge line, suction line and liquid injection line to the compressor.

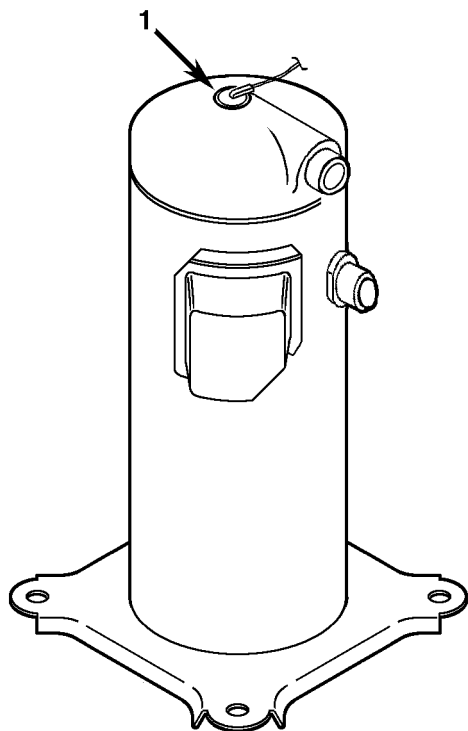
NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

5. Pressurize the refrigeration system and check for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see "Refrigerant Recovery" in this chapter).
7. Evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
8. Connect three-phase electric power to the compressor.
9. Recharge the unit with R-404A (see "Refrigerant Charge" in this chapter). Then perform a controller Pretrip Test to verify system operation.

Compressor Discharge Temperature Sensor Replacement

Removal

1. Disconnect the unit from the three-phase power supply.
2. Open control box door. Disconnect 2-pin, white molded connector of temperature sensor leads.
3. Remove sensor wires from main harness and control box.
4. Use a razor knife to cut the black RTV sealant between the compressor body and molded sensor cap.



Removing Compressor Discharge Temperature Sensor

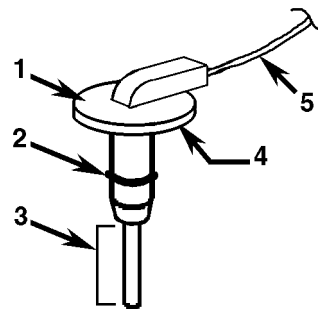
1. Loosen sensor cap from compressor body by cutting through RTV sealant with razor knife. Cut completely around the cap.

5. Remove sensor assembly from compressor.
6. Remove all RTV sealant from the compressor body.

Installation

1. Apply a heat conducting grease, P/N 203-454, on the sensing element.
2. Apply a 6 mm (0.25 in.) bead of black RTV silicone around the underside of the sensor cap (see sensor illustration below).
3. Insert sensor into compressor body.
4. Apply another bead of black RTV sealant around the outer edge of the sensor cap. Smooth and spread the sealant bead evenly around the edge of the sensor cap with a damp cloth.
5. Route sensor wires into control box. Connect new sensor leads (2-pin, white molded connector).

CAUTION: Do NOT splice or damage sensor leads or compressor damage will occur.



Preparing Compressor Discharge Temperature Sensor for Installation

1. Sensor Cap
2. O-ring
3. Apply heat conductive grease on this area of sensor
4. Apply a 6 mm (0.25 in.) bead of RTV silicone around top of the sensor before inserting sensor into compressor pocket.
5. Route sensor leads into control box.

CAUTION: Do NOT splice or damage sensor leads or compressor damage will occur.

Stepper Motor Valve Replacement

The stepper motor valve is used to control the flow of refrigerant to the compressor when the unit is operating in the Modulation mode. As the supply air temperature approaches setpoint, the controller sends an electrical signal to the stepper motor to close the valve a precise amount. This throttles the suction gas returning to the compressor and reduces cooling capacity.

Service of the stepper motor valve includes replacement of the complete valve.
refrigerant Leak Test Procedure” in this chapter).

Replacement

1. Remove the compressor compartment bracket.
2. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
3. Disconnect the unit from the three-phase power supply.
4. Unplug the motor wire harness.
5. Unsolder the compressor side stepper motor valve joints from the suction line. Unsolder and remove modulation valve.
6. Clean the tubes for soldering. Position the new valve in position in the suction line.
7. Solder both valve connections.

CAUTION: Use a heat sink or wrap the valve with wet rags to prevent damage to the new valve.

8. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
9. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
10. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
11. Plug the motor wire harness into the unit wire harness.
12. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
13. Perform a controller Pretrip Test to verify system operation.

Condenser Coil Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Remove the condenser fan grille, condenser fan blade and condenser fan shroud.
3. Remove the condenser coil support brackets from the coil.
4. Unsolder the liquid inlet and outlet connections.
5. Support the coil and unbolt the condenser coil mounting brackets. Slide the coil from the unit.
6. Drain and measure any compressor oil that may be trapped in the condenser coil.

Installation

1. If compressor oil was drained from the condenser coil, add a equal amount of new compressor oil to the new coil.

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil, P/N 203-433. Keep Polyol Ester based compressor oil in tightly sealed containers. If Ester based oil becomes contaminated with moisture or standard oils, dispose of properly — DO NOT USE!

2. Clean the tubes for soldering.
3. Slide the coil into the unit and install the bolts in the mounting brackets.
4. Solder the inlet line and liquid line connections.

NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

5. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
7. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
8. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
9. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter). Then perform a controller Pretrip Test to verify system operation.

Filter Drier/In-line Filter Replacement

NOTE: CSR Hermetic units use a one-piece, combination filter drier/in-line filter, P/N 66-9306.

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Unsolder the filter drier inlet and outlet connections.
3. Remove the filter bracket clamping nuts and bolts.
4. Remove the old filter drier from the unit.

Installation

1. Clean the liquid line tubes for soldering.
2. Remove the sealing caps from the new filter drier/in-line filter.
3. Place new filter drier in position.

NOTE: To prevent incorrect installation of the dehydrator (or in-line filter), the inlet and outlet fittings are different sizes.

4. Solder inlet and outlet connections.
5. Reinstall clamping brackets, nut and bolts. Tighten the bolts.
6. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
7. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
8. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
9. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter). Then perform a controller Pretrip Test to verify system operation.

Expansion Valve Replacement

NOTE: CSR hermetic units use a non-adjustable, factory sealed expansion valve. Do NOT attempt to remove the seal or adjust the valve.

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Remove insulating tape and unclamp feeler bulb from the suction line in the condenser section. Note the position of the feeler bulb on the side of the suction line.
3. Remove insulating tape from expansion valve outlet line.
4. Heat and unsolder the equalizer line from expansion valve.
5. Heat and unsolder the liquid line inlet and outlet connections to expansion valve in condenser section.
6. Remove expansion valve from unit.

Installation

1. Clean the liquid lines and equalizer lines for soldering.
2. Place new expansion valve in position in liquid line.
3. Solder liquid line inlet and outlet line connections to valve.

NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

4. Solder equalizer line to expansion valve.
5. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
7. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
8. Clean the suction line to a bright polished condition. Install the feeler bulb of new power head in the feeler bulb clamp on the suction line. Locate bulb on the suction line in former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Cover with insulating tape.
9. Cover expansion valve outlet line with insulating tape.
10. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter). Then perform a controller Pretrip Test to verify system operation and correct feeler bulb installation.

Heat Exchanger Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Remove the “U” mounting clamps that hold the heat exchanger assembly to the wall of the condenser section.
3. Unsolder the liquid inlet and outlet line connections.
4. Note position of feeler bulb on the side of the suction line. Un-tape and remove the feeler bulb from the suction line.
5. Unsolder the suction inlet and outlet line connections.
6. Lift the heat exchanger assembly from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the unit and install the mounting hardware.
3. Solder the suction inlet and outlet line connections.

NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

4. Solder the liquid inlet and outlet line connections.
5. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
7. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
8. Clean suction line to a bright polished condition. Install feeler bulb in the feeler bulb clamps on the suction line. Locate bulb on the suction line in former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Cover with insulating tape.
9. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter). Then perform a controller Pretrip Test to verify system operation and correct feeler bulb installation.

Receiver Tank Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Unsolder the liquid inlet, liquid outlet and warm gas bypass valve line connections.
3. Loosen the mounting nuts and remove the tank.
4. Remove the water fittings (option) and water pressure switch (option) from the receiver tank for installation in new tank.

Installation

1. Install a new tank in the unit and tighten the mounting bolts.
2. Solder the inlet line, outlet line and warm gas bypass line connections.

NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

3. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
4. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
6. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter). Then perform a controller Pretrip Test to verify system operation.

Low or High Pressure Cutout Switch Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Turn the unit On-Off switch OFF. Disconnect electrical connections to the switch.
3. Unsolder the switch:
 - High pressure cutout switch: Unsolder from the liquid line.
 - Low pressure cutout switch: Unsolder from the suction line.

Installation

1. Clean the tube for soldering.
2. Place the new switch in position and solder the connection.

CAUTION: Use a heat sink or wrap the switch with wet rags to prevent damage to the new switch.

3. Check for refrigerant leaks (see “Refrigerant Leak Test Procedure” in this chapter).
 - High pressure cutout switch: Pressurize the high side with refrigerant and check for leaks.
 - Low pressure cutout switch: Pressurize the low side with refrigerant and check for leaks.
4. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
6. Reconnect the electrical wires to the switch.
7. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter).
8. Perform a controller Pretrip Test to verify system operation.

Warm Gas Bypass Solenoid Valve, Liquid Injection Valve or Dehumidify Valve (Option) Replacement

NOTE: In most cases, only the coil requires replacement. No other repair is possible on solenoid valves.

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Turn the unit On-Off switch OFF. Disconnect electrical connections to valve coil.
3. Dehumidify valve: Remove insulating tape from liquid line.
4. Unsolder the liquid line connections to the valve.
5. Remove the valve from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the new valve in position and solder the liquid line connections.

CAUTION: Use a heat sink or wrap the valve with wet rags to prevent damage to the new valve.

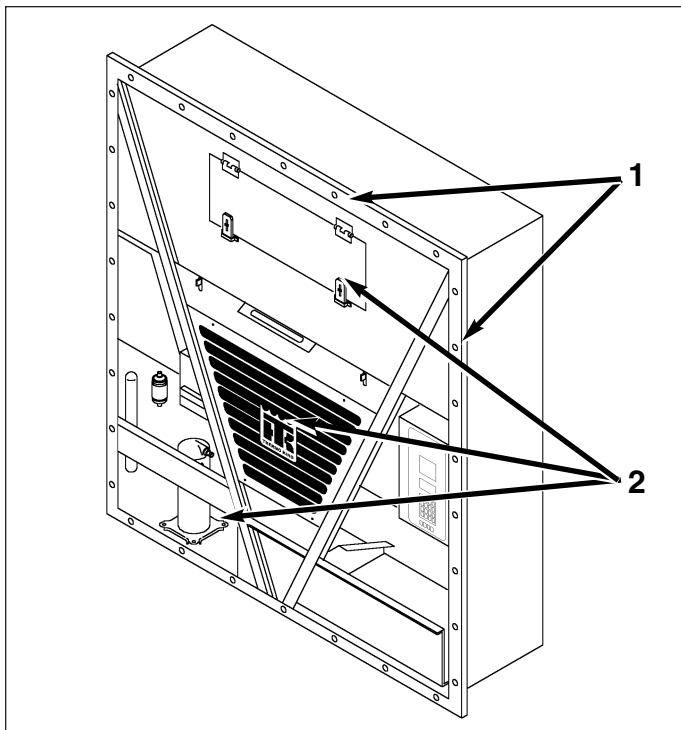
3. Pressurize the low side with refrigerant and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
4. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
6. Reconnect the electrical wires to the valve.
7. Recharge the unit with R-404A (see “Refrigerant Charge” in this chapter). Then perform a controller Pretrip Test to verify system operation.

Mounting Bolts

Check and tighten all unit, compressor, and fan motor mounting bolts during pretrip inspections and every 1,000 operating hours. Unit mounting bolts should be tightened to a torque value of 204 N.m (150 ft-lb). Compressor and fan motor mounting bolts should be tightened to a torque value of 20 to 21 N.m (15 to 20 ft-lb).

Unit Inspection

Inspect the unit during unit pretrip inspection and every 1,000 operating hours for loose or broken wires or hardware, compressor oil leaks, or other physical damage which can affect unit performance and require repair or replacement of parts.



Mounting Bolts

1. Tighten Unit Mounting Bolts
2. Tighten Compressor, Condenser Fan and Evaporator Fan Mounting Bolts

Condenser Coil

Clean the condenser coil by blowing low pressure compressed air or a medium pressure warm water spray from the inside of the coil outward (opposite direction of normal airflow). Inspect coil and fins for damage and repair if necessary.

CAUTION: Air pressure or water spray must not be high enough to damage coil fins.

If a build up of salt or debris is present on the condenser coil, the coil should be cleaned using a mild alkaline cleaner with a pH of 9.5 to 10.5. For example, a 2-3% solution of SIMPLE GREEN® would make a suitable cleaning solution. Apply the solution using a pressure spray/wash type apparatus. Spray the condenser coil thoroughly from both the inside and outside of the coil. Always thoroughly rinse the coil with a fresh water spray.

Also inspect the directional airflow condenser grille for damage. This grille directs the condenser airflow out and away from the unit to increase the efficiency of the condenser coil by preventing the recirculation (short cycling) of warm air through the coil. Abnormally high head pressures may result if this special condenser grille is damaged or missing.

Evaporator Coil

Clean the evaporator coil by blowing low pressure compressed air from the bottom side of the coil upward (opposite direction of normal airflow). Inspect coil and fins for damage and repair if necessary.

CAUTION: Air pressure must not be high enough to damage coil fins.

Defrost Drains

Clean the defrost drains every 1,000 operating hours to be sure the lines remain open.

Fresh Air Exchange System

The fresh air exchange system has an adjustable vent door for ventilation. The evaporator fans draw in outside air through an air intake and discharge an equal amount of container air through an air outlet.

NOTE: Set the disk or door position to the ventilation rate indicated on the shipping manifest.

Disk Adjustment: Low Ventilation Rates

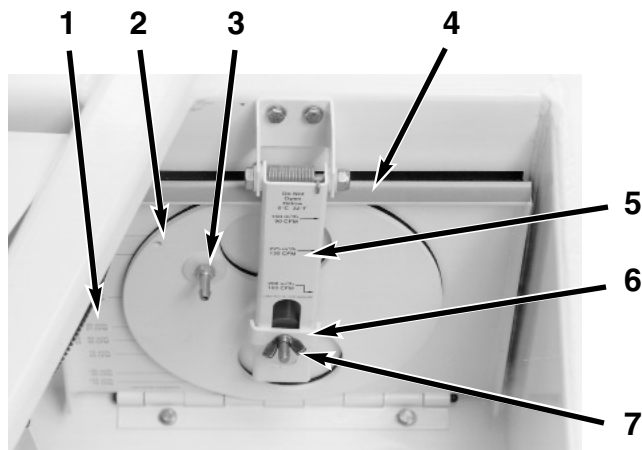
1. Loosen wing nut on handle assembly.
2. Rotate the disk to set the Indicator at the air exchange rate shown on the ventilation scale on the door:
- CSR40 and CSR40SL Models: 0 to 125 m³/hr (0 and 75 ft³/min.)
3. Tighten the wing nut.

Handle Adjustment: High Ventilation Rates

1. Loosen wing nut on handle assembly until handle bracket will rotate over handle.
2. Align handle bracket and wing nut over hole in handle assembly and push through handle.
3. Pull handle down to lower ventilation door. Insert edge of ventilation door in a notch on handle. Spring loaded handle holds ventilation door in position. Air exchange rate is shown on the handle scale:
- CSR40 and CSR40SL Models: 150 to 280 m³/hr (90 to 165 ft³/min.)

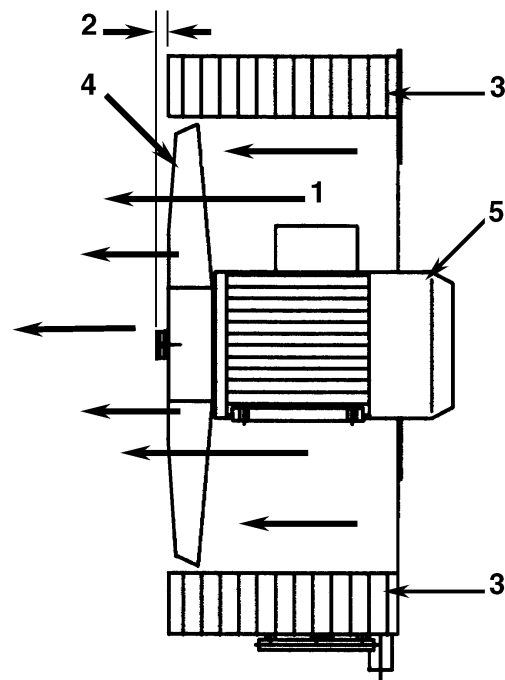
Condenser Fan Location

Place fan blade on motor shaft with hub located on the outside of the blade for proper airflow direction. When mounting the fan blade and hub assembly on the fanshaft, center the assembly in the orifice. Position the front of the fan blade 10 mm (0.4 in.) in from the outer edge of the fan orifice.



Air Exchange System

1. Disk Scale: Low Ventilation Rates
2. Disk Assembly with Rate Indicator
3. CO2 Port
4. Ventilation Door
5. Handle Assembly with Scale: High Ventilation Rates
6. Handle Bracket
7. Wing Nut



Condenser Fan Blade Placement

1. Airflow Direction
2. 10 mm (0.4 in.)
3. Condenser Coil
4. Condenser Fan Blade
5. Condenser Motor

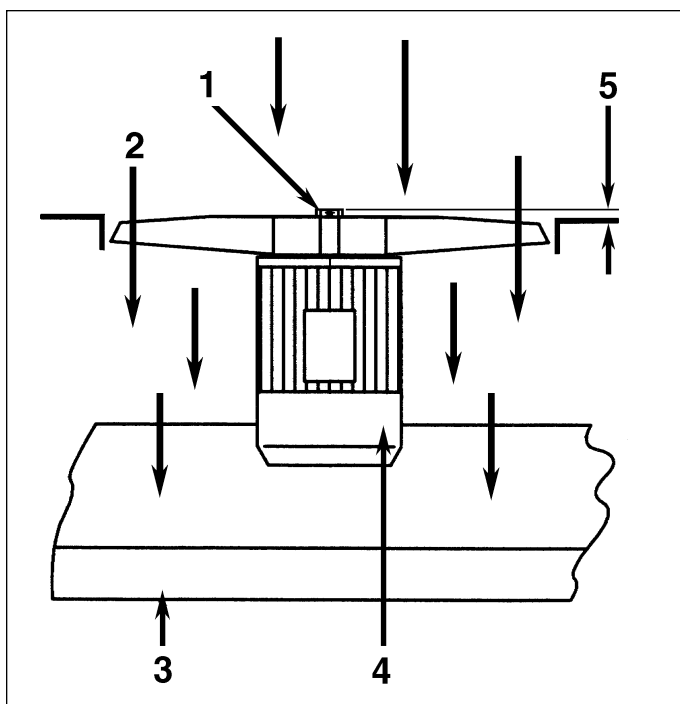
Evaporator Fan Location

Place fan blade on motor shaft with hub located on the outside of the blade for proper airflow direction. When mounting the fan blade and hub assembly on the fanshaft, center the assembly in the orifice. Position the front (top) of the fan blade hub 13 mm (0.5 in.) in from the outer edge of the fan orifice.

Humidify System (Option)

The Humidify Mode increases the humidity level in the container by injecting atomized water directly into the evaporator supply air stream. The use of the Humidify Mode should be established by the shipper. The Humidify Mode option is turned on from the CONTROL line in the Setpoint menu of the controller. See "Changing the Humidity Mode Setting" under "Setpoint Menu" on page 4-15 to set the Humidify system to ON. The HUMIDITY LED turns ON when the Humidify Mode is set to ON.

The controller energizes (operates) the air compressor when the humidity level in the container is more than 2% below the humidity setpoint. The air compressor atomizes and injects water into the evaporator supply air stream to add moisture to the container air.

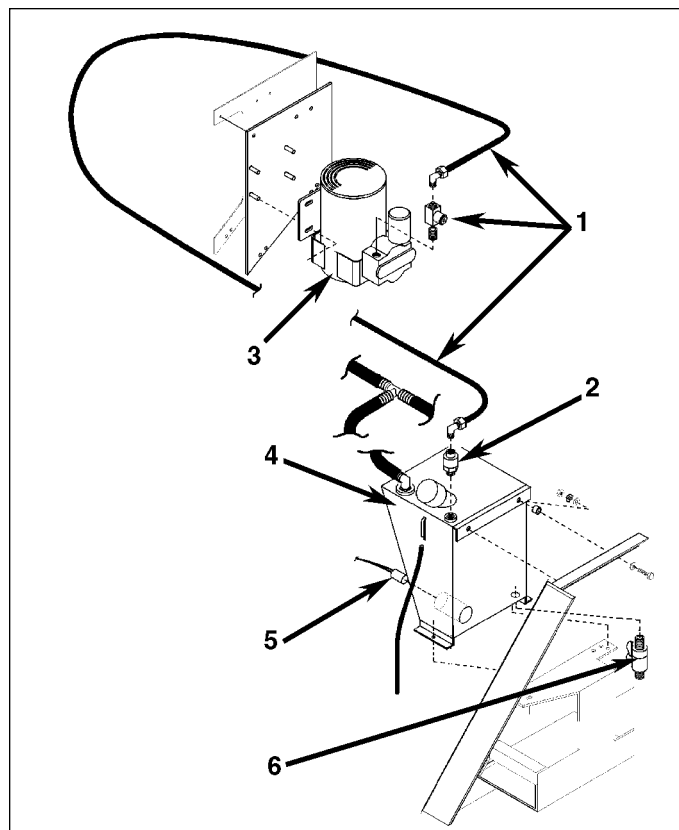


Evaporator Fan Blade Placement

1. Evaporator Fan Blade
2. Airflow Direction
3. Evaporator Coil
4. Evaporator Motor
5. 13 mm (0.5 in.)

The evaporator drain hoses are routed to the water tank to replenish the water level during unit operation. However, water usage will vary depending upon the load and ambient conditions. An overflow hose on the water tank removes excess water when particularly wet loads are transported or when the humidify system is not operating.

NOTE: Only demineralized or distilled water should be used to prevent plugging of the atomizing nozzle.



Humidify System (Option)

1. Water Supply Hose and Atomizing Nozzle: Inspect every 1,000 hours and clean if necessary.
2. Filter: Inspect every 1,000 hours and clean if necessary.
3. Air Compressor: Inspect once a year.
4. Water Tank:
 - Pretrip Inspection: Check the water level.
 - Every 1,000 Hours: Inspect the water tank and clean if necessary.
5. Water Tank Heater: Check for correct operation in ambient temperatures below 4 C (40 F).
6. Drain Cock

Pretrip Inspection

The following items should be inspected before loading the container:

- Check the water level in the water tank to maintain an adequate water supply.
- Check humidify system operation by starting the unit, setting the Humidify mode to ON and adjusting the humidify setpoint (HUMSP) more than 2% above the current humidity level in the container. Verify that the air compressor operates and that water is drawn into the atomizing nozzle and injected into the return air stream.

Inspection and Cleaning

The following items should be periodically serviced:

- Clean and inspect the filter in the water supply hose on the water tank every 1,000 operating hours. Clean the filter screen with fresh water and a soft brush.
- Inspect the water tank, water supply line and atomizing nozzle every 1,000 hours and clean if necessary. Use fresh water, a soft brush and compressed air to clean and blow clear components.
- Inspect the air compressor for signs of overheating once a year.

8

Mechanical Diagnosis

Mechanical Diagnosis

Condition	Possible Cause	Remedy
Compressor does not operate — no amperage draw	Controller ON; unit start sequence still timing	Wait up to 2 minutes for compressor start-up
	No power to unit (condenser and evaporator fans do not operate)	Locate fault and repair: power source, power plug, main circuit breaker, motor contactor, motor terminals, motor
	Open in 29 Vac control circuit	Check fuses and On/Off switch. Replace or repair as required
	Container temperature does not demand compressor operation	Adjust controller setpoint
	Compressor contactor inoperative	Replace compressor contactor
	No output signal from controller	Diagnose and replace main relay board or controller
	Unit on defrost	Turn unit On/Off switch OFF and then ON again
	Defective high or low pressure cutout switch	Replace defective switch
	High condenser head pressure causing high pressure cutout	Check refrigeration system and correct fault
	Defective compressor	Replace compressor
	Controller shut unit down on Compressor Over Temperature (fault code 56)	Let compressor cool and controller will reset automatically. Check liquid injection valve and compressor temperature sensor
	Compressor motor internal thermal overload protection open	If compressor contactor is energized, wait 60 minutes for protector to cool and reset

Condition	Possible Cause	Remedy
Compressor does not operate; excessive amperage draw or intermittent cycling on overload	Rotating scroll stuck Seized or frozen compressor bearings Improperly wired Low line voltage Contacts in compressor contactor not closing completely Open circuit in compressor motor winding Defective compressor motor internal thermal overload protector Refrigerant overcharge or high side restriction causing cycling on high pressure cutout Inefficient condenser operation causing cycling on high pressure cutout	Replace compressor Replace compressor Check/correct wiring against wiring diagram Check line voltage — determine location of voltage drop Check by operating manually. Repair or replace Check motor stator connections. Check stator winding for continuity. If open, replace compressor Replace thermal overload protector or compressor Check for restricted filter drier, in-line filter or high side; or refrigerant overcharge Check condenser airflow, condenser fan motor, fan blade, condenser grille and condenser coil temperature sensor
Compressor contactor burned out	Low line voltage Excessive line voltage Short cycling	Increase line voltage to at least 90% of compressor motor rating Reduce line voltage to at least 110% of compressor motor rating Eliminate cause of short cycling
Unit short cycles	Refrigerant overcharge causing cycling on high pressure cutout Inefficient condenser operation causing cycling on high pressure cutout	Purge system Check condenser airflow, condenser fan motor, fan blade, condenser grille and condenser coil temperature sensor

Condition	Possible Cause	Remedy
Noisy compressor	<p>Loose mounting bolts</p> <p>Oil slugging or refrigerant flooding back</p> <p>Scroll rotating backwards</p> <p>Defective compressor</p>	<p>Tighten mounting bolts</p> <p>Perform controller Pretrip Test to check refrigerant charge. Check expansion valve adjustment. Check compressor for compressor oil.</p> <p>Check phase correction system and check unit wiring</p> <p>Repair or replace compressor</p>
Condenser fan motor does not operate	<p>Unit in Heat or Defrost</p> <p>Unit in Cool with Low condenser temperature</p> <p>Loose line connection</p> <p>Open motor internal thermal overload protector</p> <p>Defective motor</p> <p>Defective condenser fan contactor</p> <p>No condenser fan output signal from controller</p>	<p>Check indicator lights. If unit is in Heat or Defrost, unit operation is normal (no remedy required)</p> <p>Check indicator lights, condenser temperature and discharge pressure. Condenser temperature may not require condenser fan operation (no remedy required; condenser fan also pulses On and Off on a 30 second cycle to control condenser temperature)</p> <p>Tighten connections</p> <p>Check for seized bearings or defective thermal overload protector. Repair or replace as necessary</p> <p>Replace motor</p> <p>Replace defective contactor</p> <p>Diagnose and replace condenser fan relay, main relay board, or controller</p>

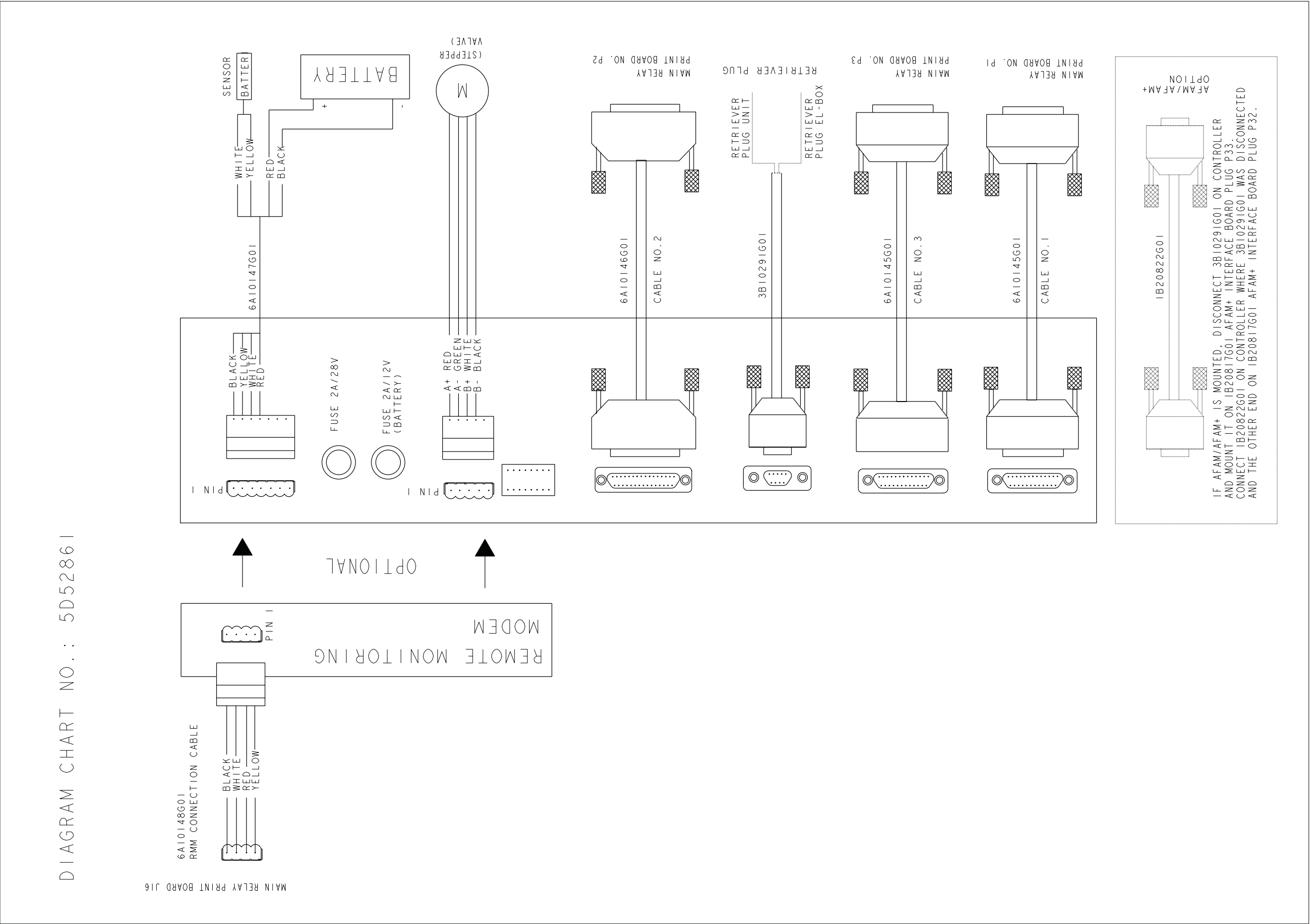
Condition	Possible Cause	Remedy
Evaporator fan motor(s) does not operate	Unit on defrost	Check operating mode indicator LEDs
	Unit in Economy Mode (Frozen Load; Null mode ONLY)	Check setpoint, indicator lights and Setpoint menu of the controller to verify that Economy Mode is set to ON
	Loose line connection	Tighten connections
	Open motor internal thermal overload protector	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary
	Defective motor	Replace motor
	Defective low or high speed evaporator fan contactor	Replace defective contactor
	No low or high speed evaporator fan output signal from controller	Diagnose and replace evaporator fan relay, main relay board or controller

9

Electrical, Refrigeration and MP-3000 Menu Flow Diagrams

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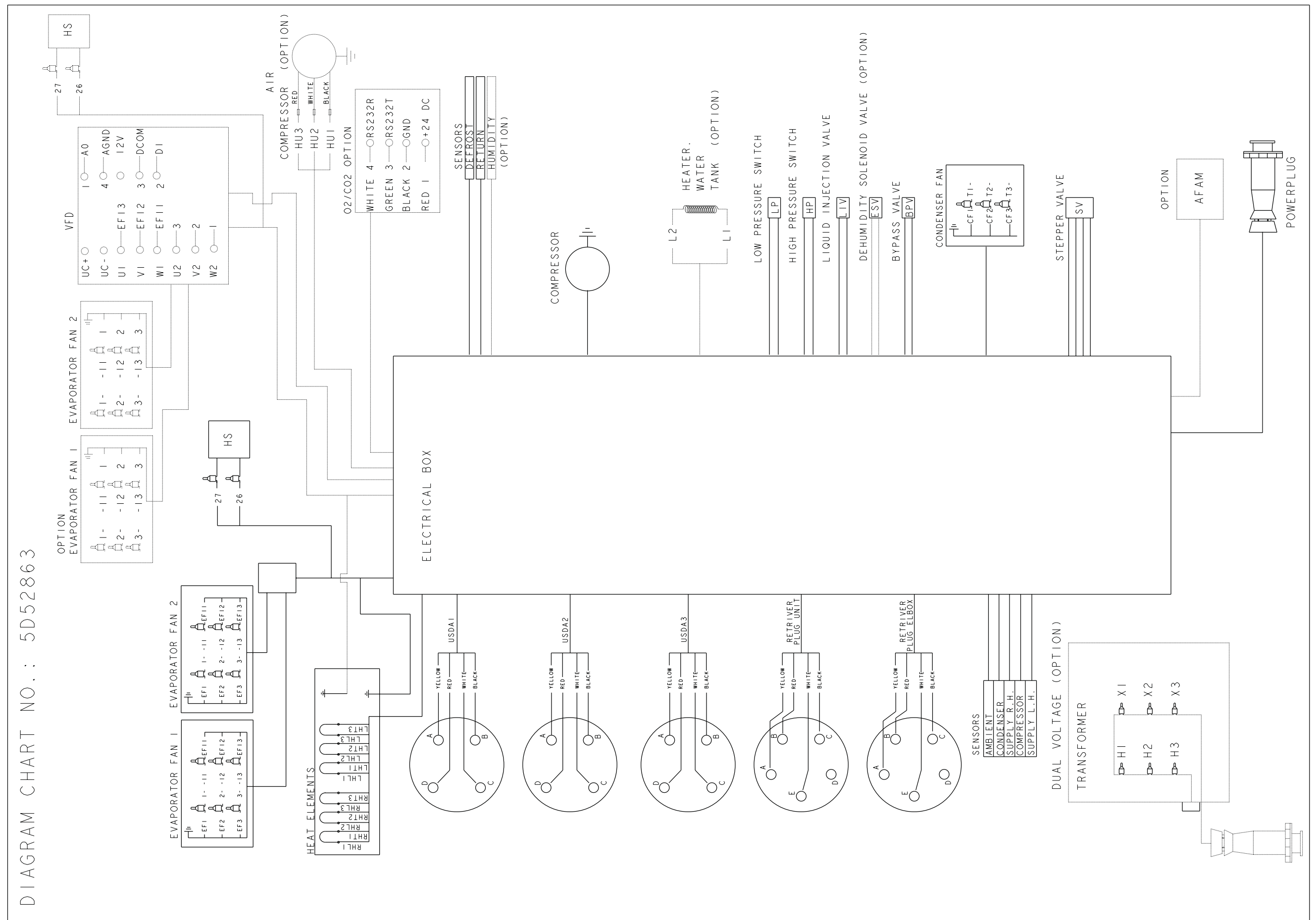


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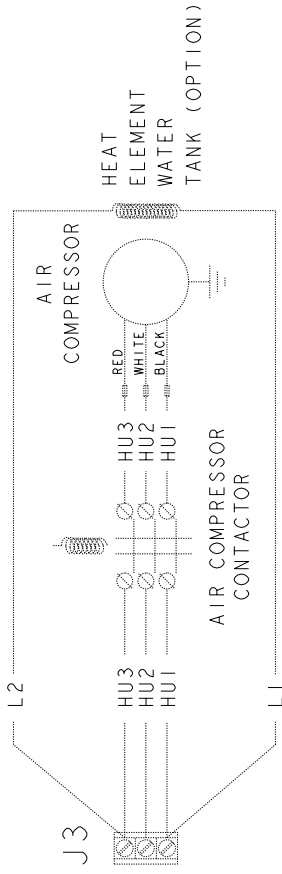
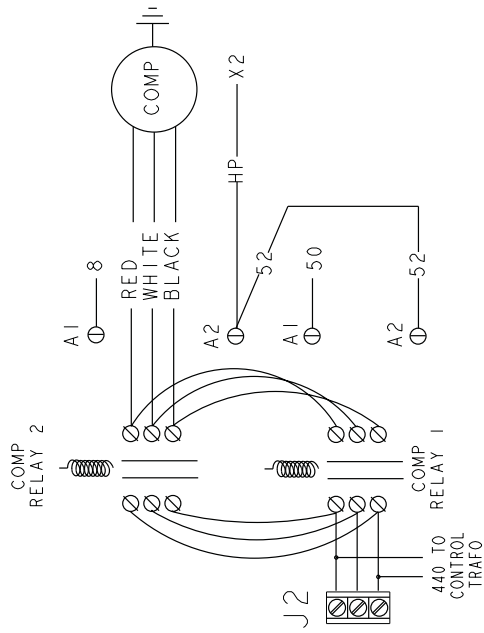
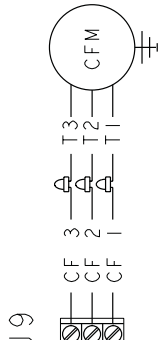
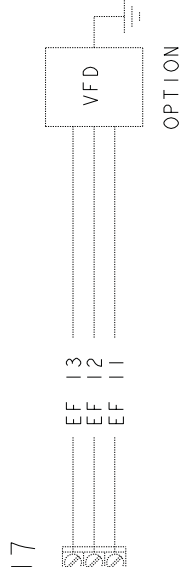
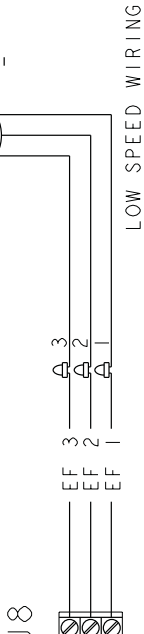
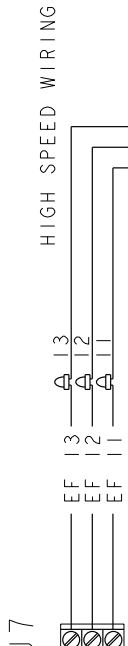
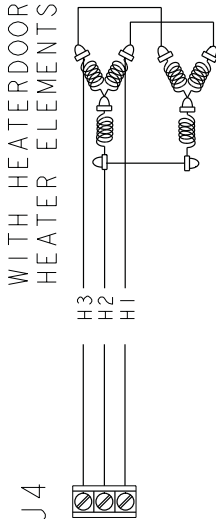
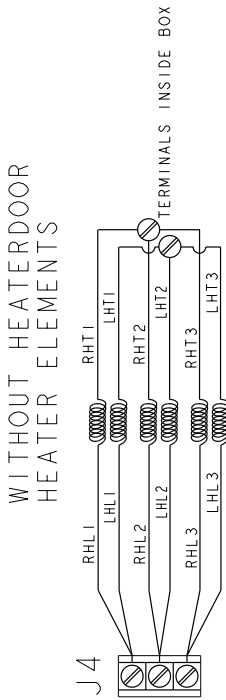
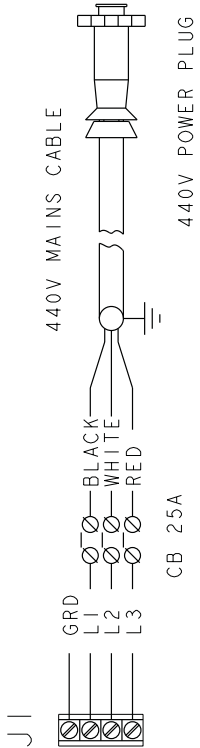
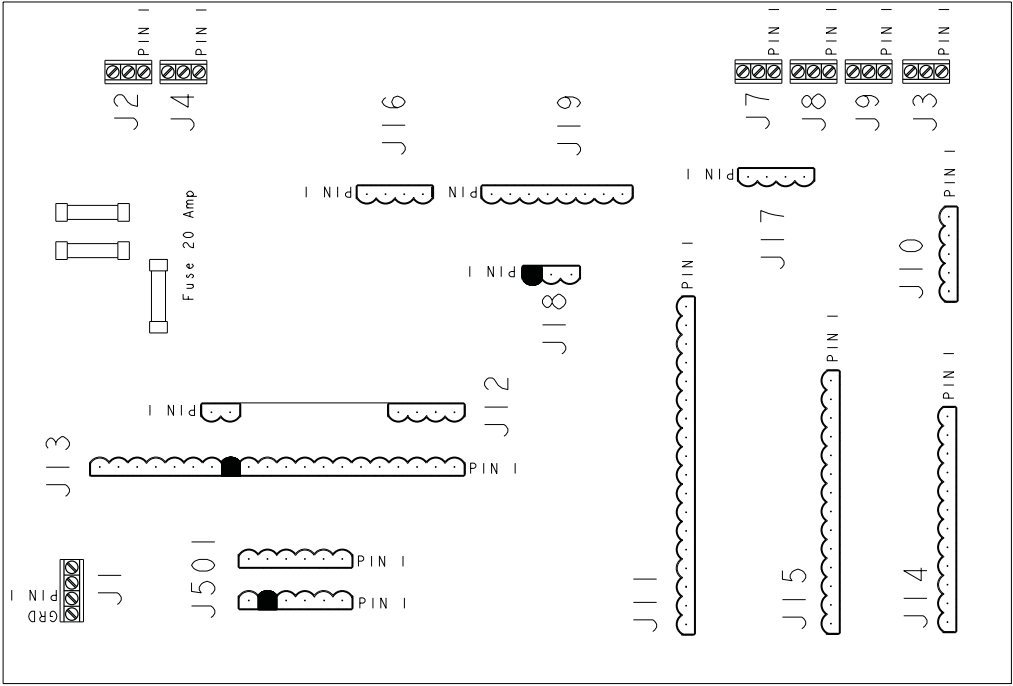


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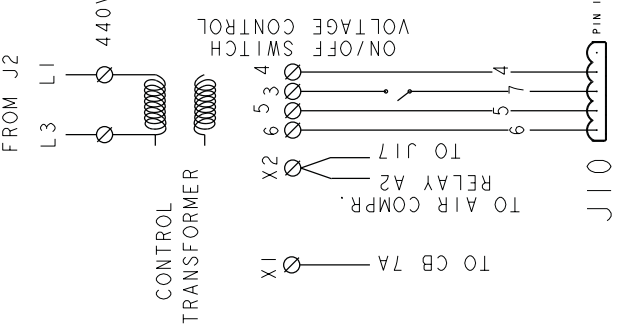
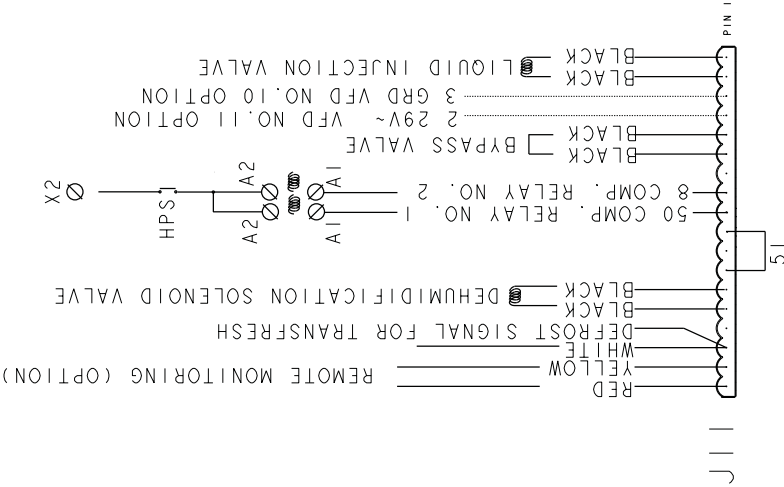
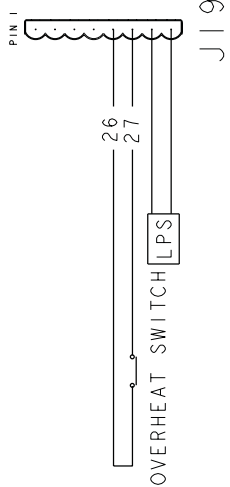
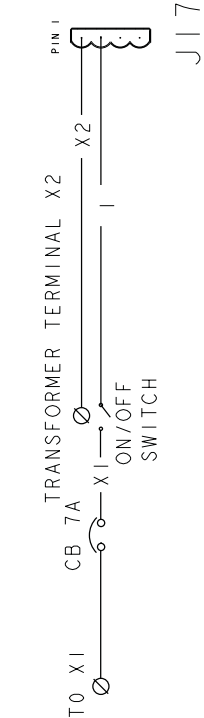
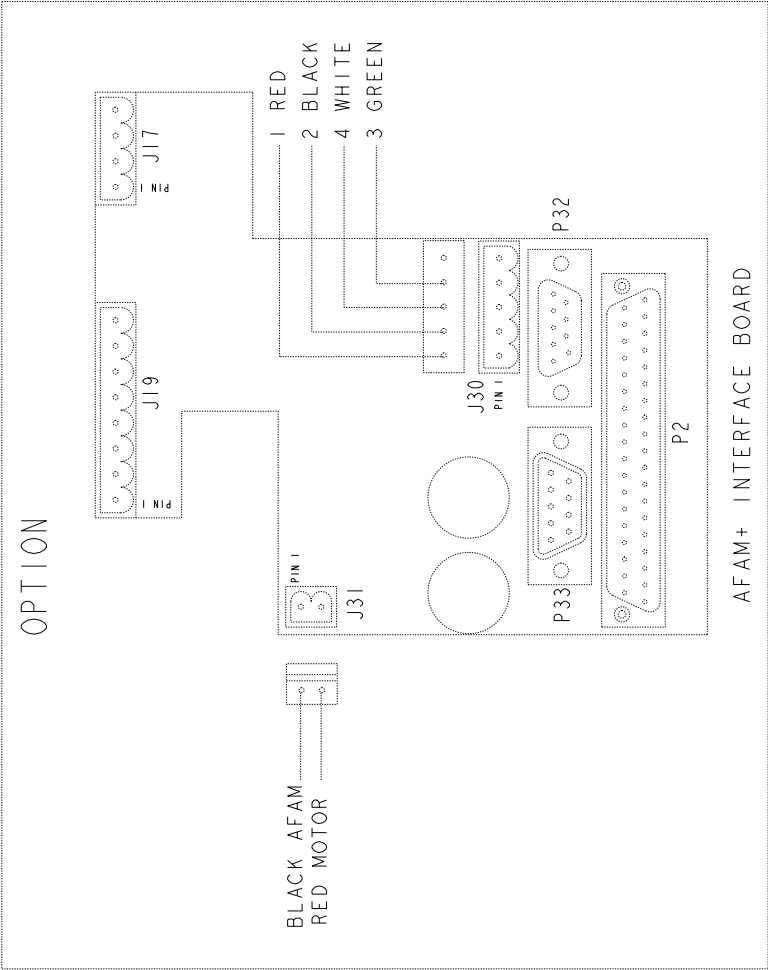
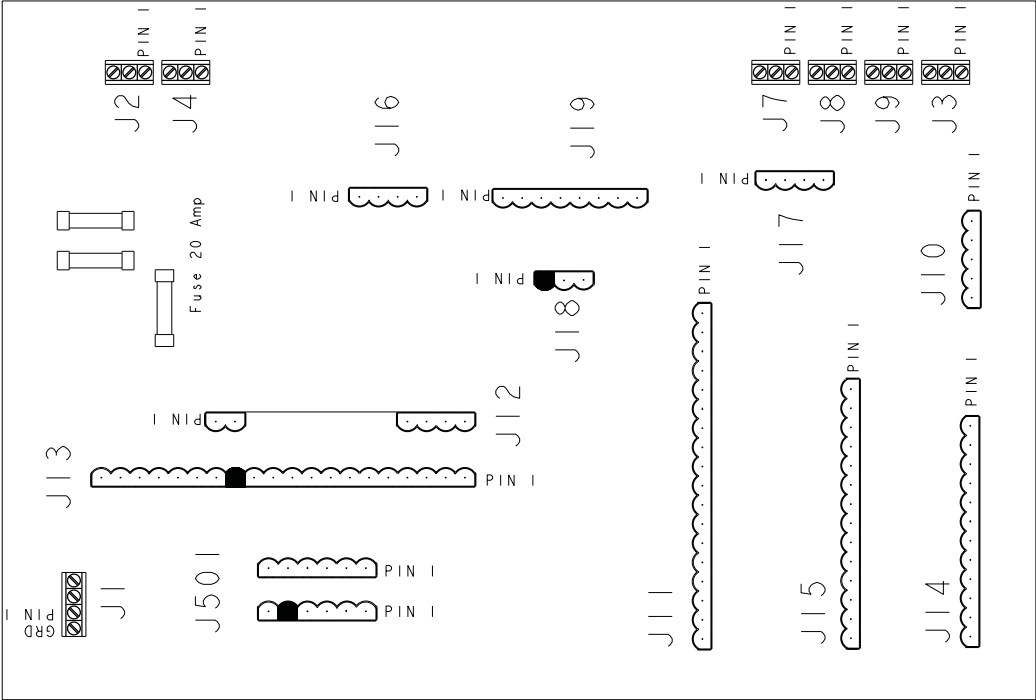
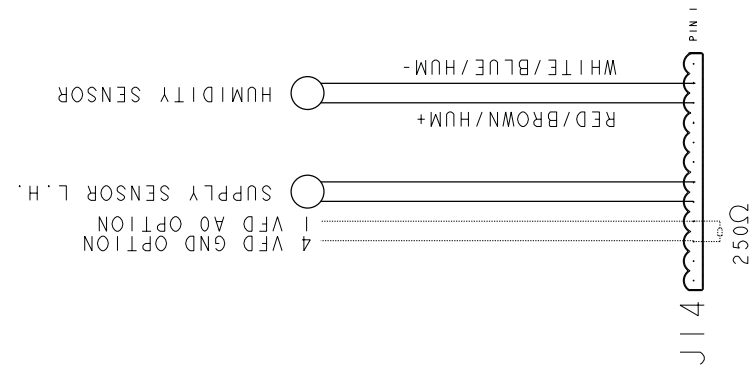
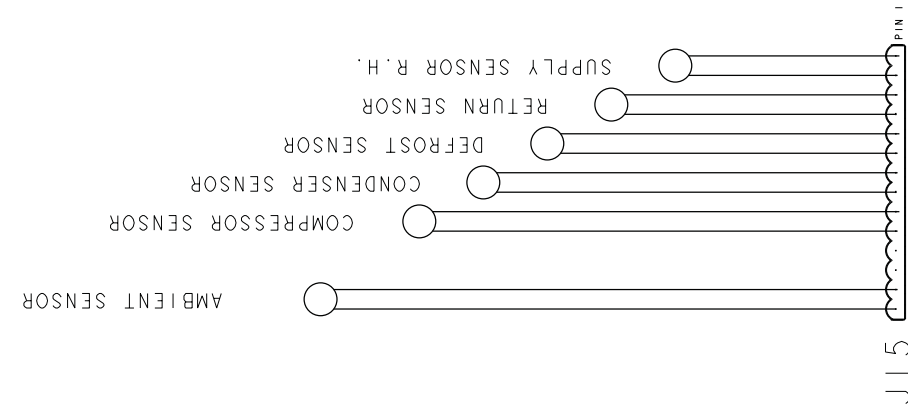
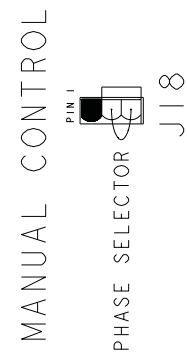
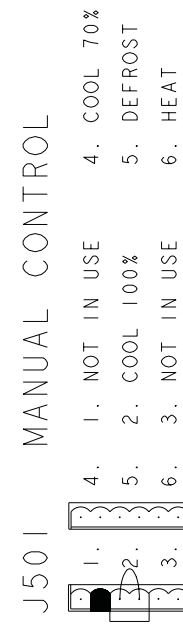
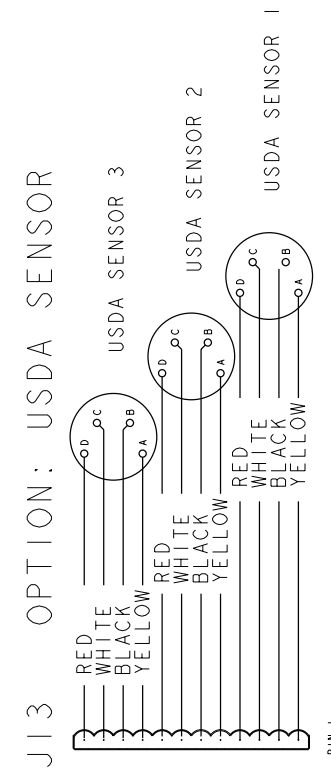
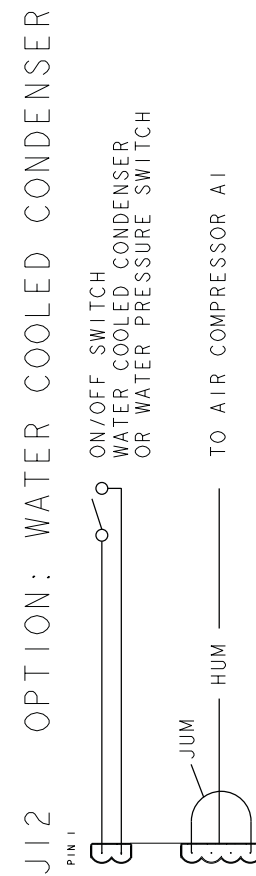
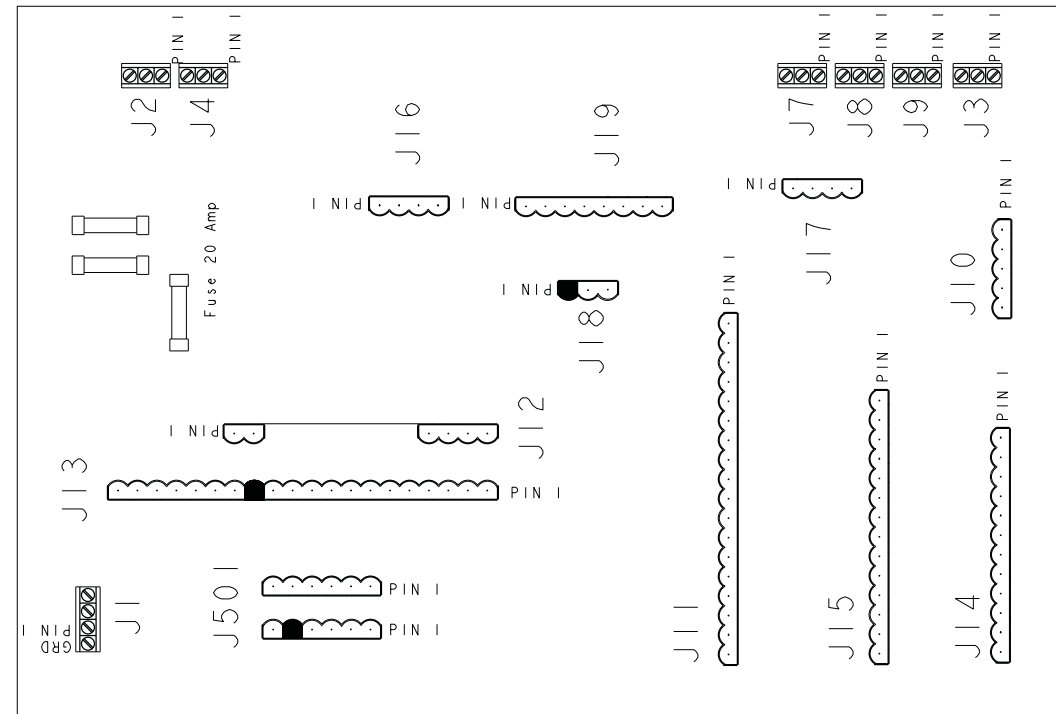


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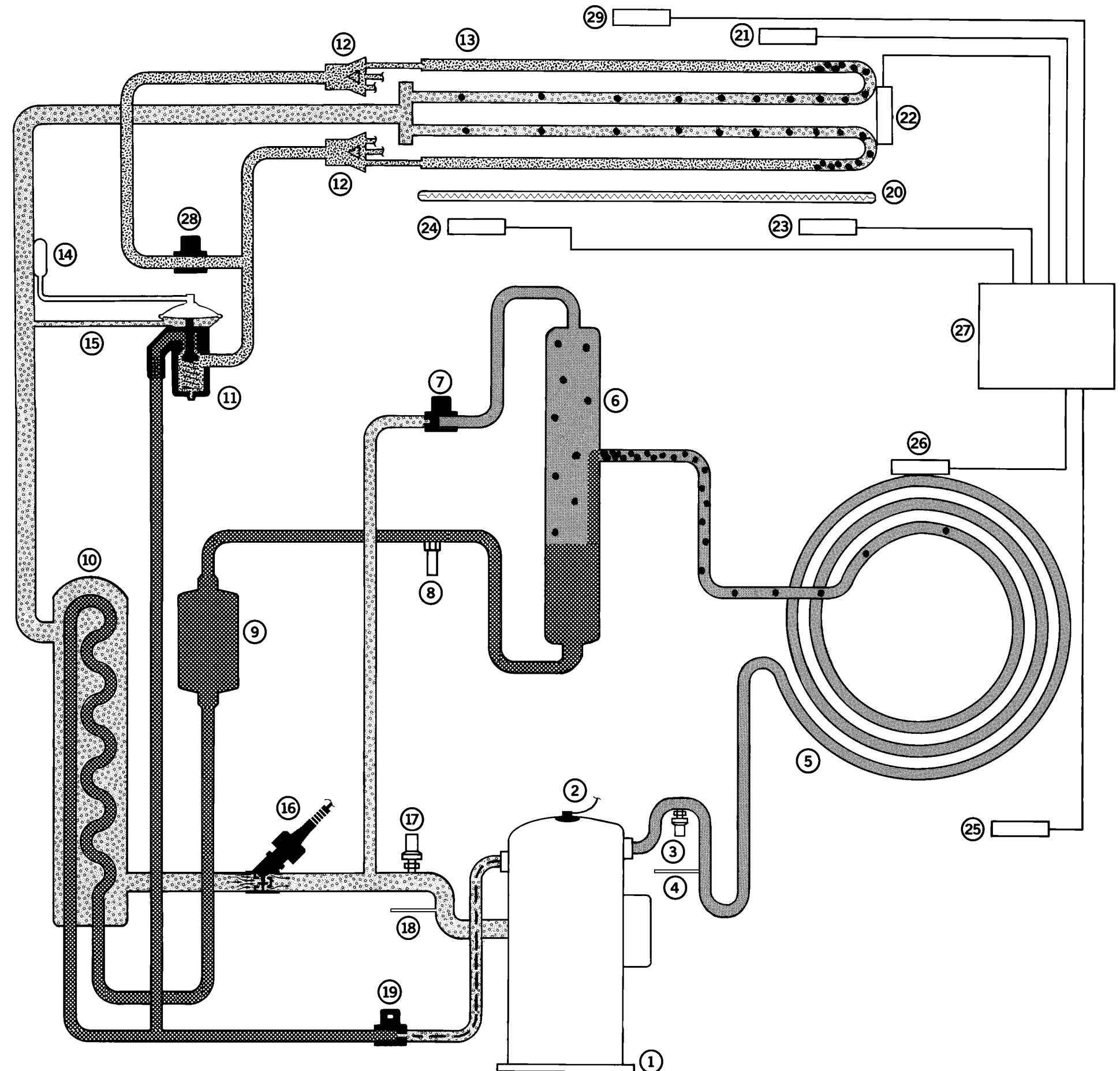
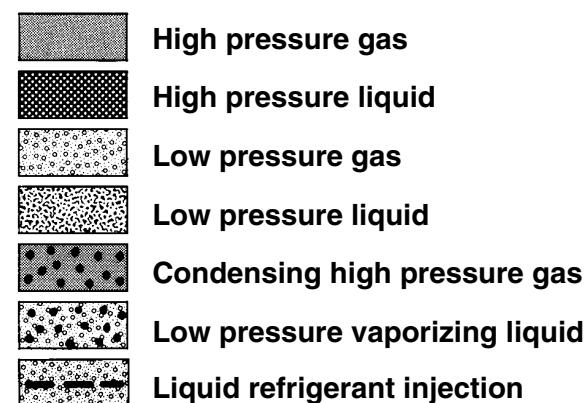


Flow and Pressure Diagram

CSR PS

Full Cool

- 1. Scroll Compressor**
Compressor operation has a delay on initial start-up and when the unit shifts to a cooling mode requiring the compressor to start.
- 2. Compressor Discharge (Head) Temperature Sensor**
Controller cycles condenser fan ON typically when the compressor discharge temperature is above 50 C (122 F) and increasing.
- 3. High Pressure Cutout Switch (HPCO)**
Is a normally CLOSED switch.
It OPENS at 3240 +/- 50 kPa, 32.4 +/- 0.5 bar, 470 +/- 7 psig.
It CLOSSES at 2590 +/- 260 kPa, 25.9 +/- 2.6 bar, 375 +/- 38 psig.
- 8. High Pressure Relief Valve**
OPENS at 3450 +520/-105 kPa, 34.5 +5.20/-1.05 bar, 500 +75/-15 psig.
CLOSSES at 2760 kPa, 27.6 bar, 400 psig.
- 17. Low Pressure Cutout Switch (LPCO)**
Is a normally OPEN switch.
It OPENS at +21 to -20 kPa, +0.21 to -0.20 bar, 3 psig to 6" Hg vacuum.
It CLOSSES at 48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig
- 20. Electric Heaters**
During the DEFROST and HEAT mode, the electric heaters are pulsed ON and OFF.
- 26. Condenser Coil Temperature Sensor**
Controller cycles condenser fan ON typically when the condenser coil temperature is above 35 C (95 F).
- 27. Controller**
MP-3000 with digital thermostat, thermometer and fault indicator monitor.



Flow and Pressure Diagram

CSR PS

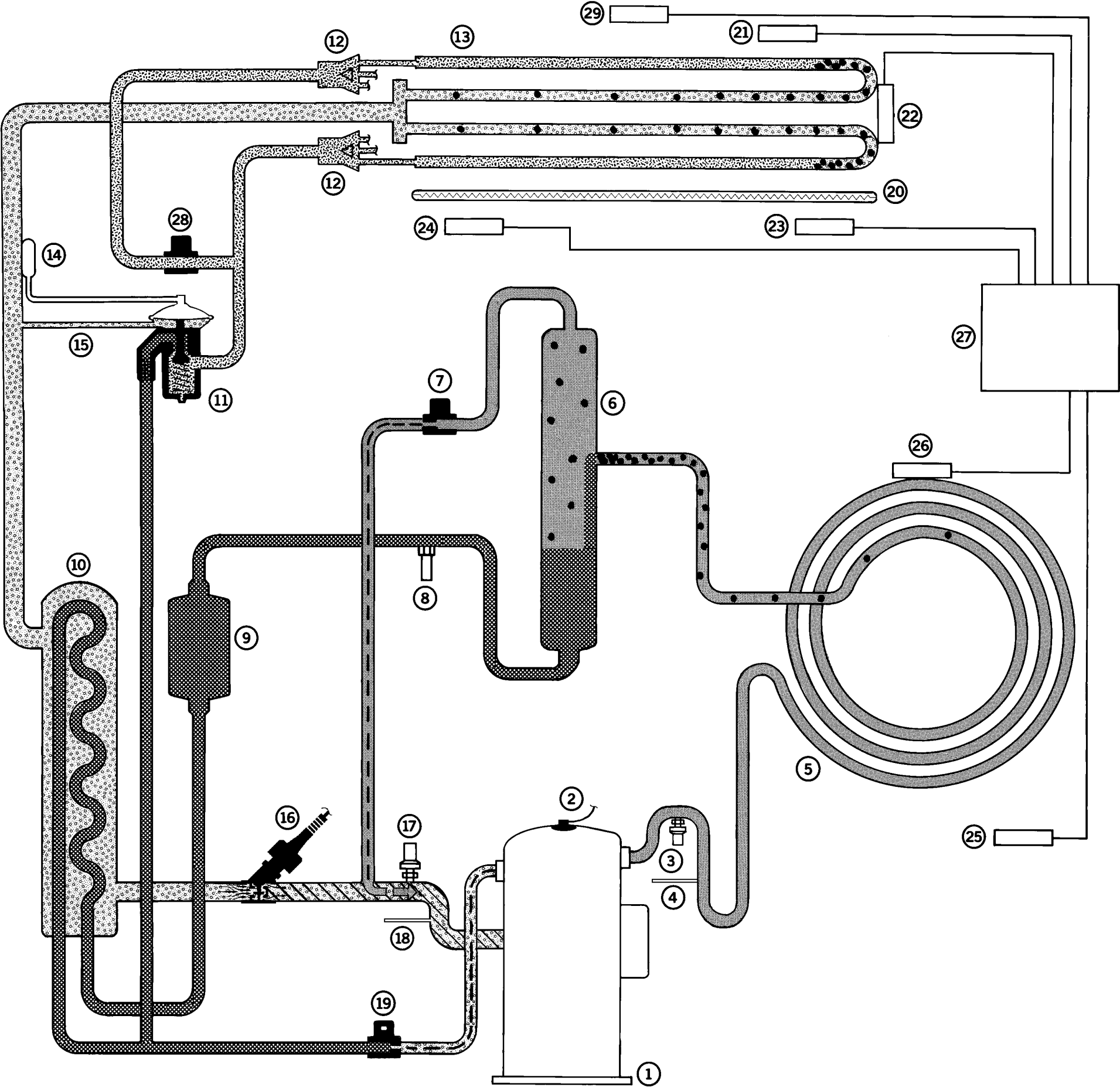
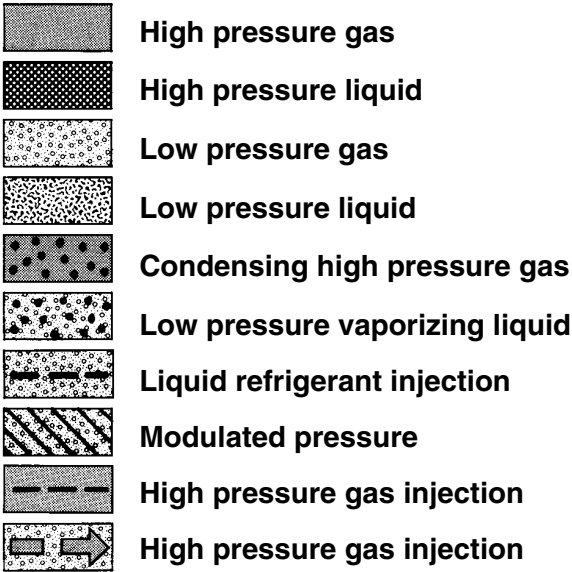
Cool with Modulation (or Power Limit)

7.

Warm Gas Bypass Valve
Is a normally CLOSED solenoid.
It OPENS when energized to reduce cooling capacity when the temperature is close to setpoint.
16.

Stepper Motor Valve
Is a normally OPEN valve.
It CLOSSES when energized. As the signal strength is increased, the valve closes more. The controller regulates the signal to the valve based on sensor temperatures and power limit requirements.
19.

Liquid Injection Valve
Is a normally CLOSED valve.
It OPENS when energized. When liquid injection is required, the valve is pulsed open and closed on a 60 second cycle. Liquid injection is controlled by the compressor discharge temperature and the temperature control algorithm.



Flow and Pressure Diagram

CSR PS

Dehumidification

NOTE: At setpoints below 5 C (41F), the dehumidification is not energized.

28. **Dehumidify Solenoid Valve (DSV)**
Is a normally OPEN valve.
If the container humidity is 2% or more above the humidity setpoint and the temperature is in-range, the controller will energize (CLOSE) the normally open solenoid. This closes refrigerant distribution to 50% of the evaporator coil, thereby lowering the temperature of the active part of the coil and condensing more moisture from the container air.
20. **Electric Heaters**
If the container humidity is 5% or more above the humidity setpoint, and the temperature is in-range, the controller will pulse the electric heaters ON and OFF in addition to energizing (closing) the dehumidify solenoid valve. This increases the cooling load on the evaporator coil, thereby lowering the temperature of the entire coil and condensing more moisture from the container air.
29. **Humidity Sensor (rH) (Option)**
The humidity sensor is located at the top right hand side of the evaporator fan deck and measures the humidity of the return air from the cargo space.

