CRR-40 119, 172 & 800 for Maersk Sealand

TK 50743-4-MM (Rev. 5, 11/03)

For further information, refer to:	
CRR-40 119, 800 MPC2000ID Parts Manual for Maersk	TK 50680
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

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.

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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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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 Polyester 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 microprocessor, controller 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 (Refer to Tool Catalog) with the lead end connected to the microprocessor'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 a Remote Monitor Module or Modem (RMM) or Integrated Remote Monitor Unit (IRMU), disconnect all wire harnesses from the RMM/IRMU circuit board.
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, wire harnesses 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.
- Controller: Nameplate on back of controller.

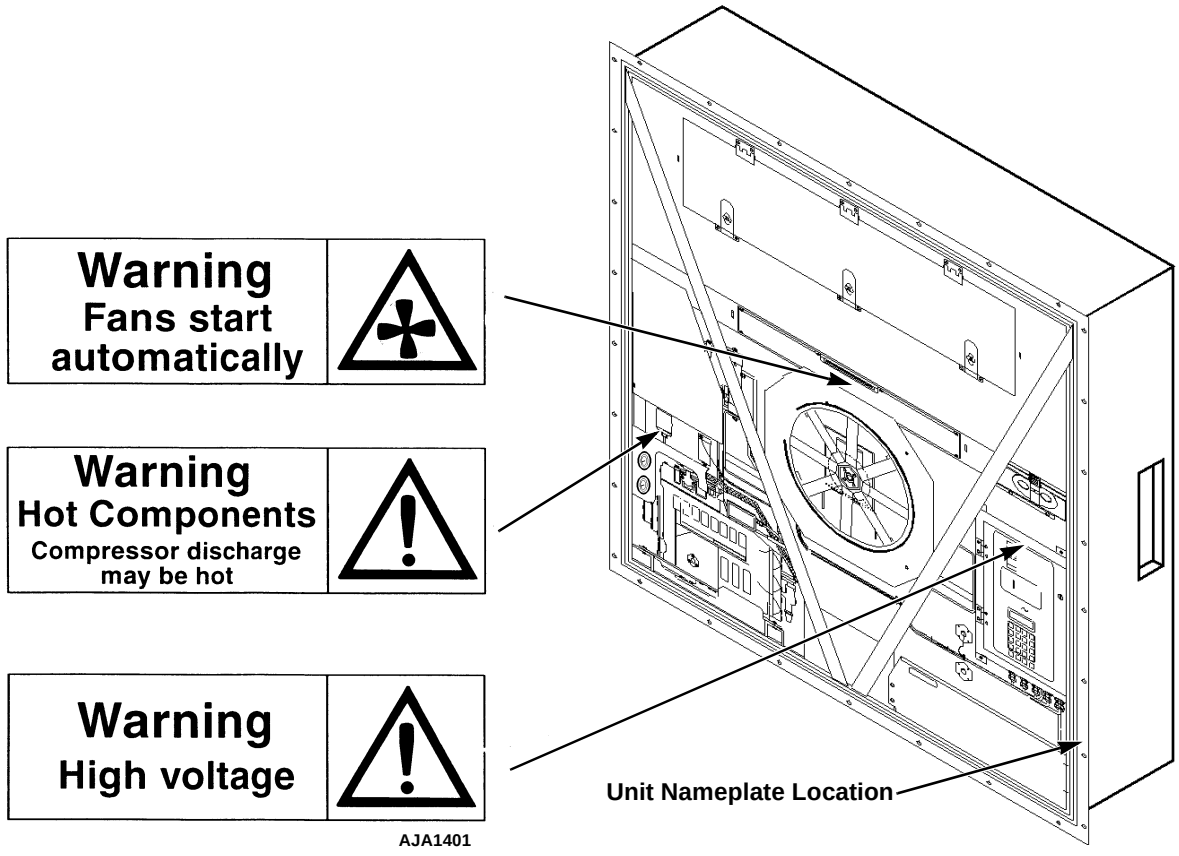


Figure 1: Nameplate and Warning Locations

Service Guide

Pre-Trip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Electrical
•			Perform a controller Pre-trip Inspection (PTI) check.
•	•	•	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.
			Refrigeration
•	•	•	Check refrigerant charge.
•	•	•	Check for proper suction pressure.
•	•	•	Check compressor oil level.
		•	Check compressor efficiency and pump down the refrigeration system.
		•	Check discharge and suction pressures.
		•	Check dehydrator for restriction or corrosion.
			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.

Model Features

CRR-40 Model Features

CRR-40-119	CRR-40-119A	CRR-40-172	CRR-40-800	CRR-40-800A thru D	CRR-40-800E	Model Features X=Included
X	X	X	X	X	X	460-380V/3Ph 60-50 Hz, 18.3 m (60 ft) Power Cable and Plug
X	X	X	X	X	X	25 Amp Main Power Circuit Breaker
X	X	X	X	X	X	Automatic Phase Selection Control
X	X	X	X	X	X	D3DS Copeland Discus Compressor w/5.60 kW (7.5 Hp) Motor
X	X	X	X	X	X	Suction and Discharge Line Service Valves
X	X	X	X	X	X	Compressor Liquid Injection System
X	X	X	X	X	X	KVQ Valve (Evaporator Pressure Regulator)
X	X	X	X	X	X	Refrigerant R-134a w/Polyol Ester Compressor Oil (P/N 203-433)
X	X	-	X	-	-	MPC2000ID Microprocessor Controller with Integral Datalogger
-	-	X	-	X	X	MP-3000a Microprocessor Controller with Integral Datalogger
X	X	X	X	X	X	Refcon Remote Monitoring Modem (RMM)
X	X	-	-	-	-	Three Evaporator Fans with 2-Speed Motors
-	-	X	X	X	X	Two Evaporator Fans with 2-Speed Motors
X	X	X	X	X	X	Fresh Air Exchange System
X	X	X	X	X	X	One Condenser Fan with 1-Speed Motor
-	-	-	-	-	-	Receiver Tank with Moisture Indicating Sight Glass
X	X	X	X	X	X	Water-Cooled Condenser-Receiver Tank with Moisture Indicating Sight Glass
X	X	X	X	X	-	Dehumidify Valve
X*	-	-	-	-	-	Humidity System
X	X	X	X	X	X	Pressure Gauge, Discharge
X	X	X	X	X	X	Pressure Gauge, Suction
X	X	X	X	X	X	USDA Cold Treatment Temperature Recording
-	-	-	-	-	X	Expansion Valve in Evaporator Section

* Humidity System option installed on model CRR-40 129 (10 units only)

Specifications

System Net Cooling Capacity — Full Cool

CRR-40 Models with Three Evaporator Fans — 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@ 460V
1.7 C (35 F)	10,900	9,375	37,200	9900 W	8,720	7,500	29,760	8.74
-17.8 C (0 F)	5,605	4,820	19,125	5300 W	4,484	3,857	15,304	4.69

*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-134a.

CRR-40 Models with Two Evaporator Fans — 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@ 460V
1.7 C (35 F)	10,700	9,202	36,519	10.4	8,560	7,362	29,215	8.42
-17.8 C (0 F)	5,600	4,816	19,113	5.7	4,480	3,853	15,290	4.61

*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-134a.

CRR-40 Models with Three Evaporator Fans — Water Cooled Condensing Option with 37.8 C (100 F) Water Temperature*

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@460V
1.7 C (35 F)	10,900	9,375	37,200	10.2	8,720	7,500	29,760	8.26
-17.8 C (0 F)	5,600	4,816	19,115	5.3	4,480	3,853	15,290	4.29

*System net cooling capacity with a 37.8 C (100 F) water temperature, 30 liter/min. (8 gal./min.) water flow and R-134a.

CRR-40 Models with Three Evaporator Fans — Water Cooled Condensing Option with 30 C(86 F) Water Temperature*

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@460V
1.7 C (35 F)	12,900	11,095	44,030	9.8	10,320	8,876	35,222	7.93
-17.8 C (0 F)	6,300	5,418	21,500	5.1	5,040	4,335	17,200	4.13

*System net cooling capacity with a 30 C (86 F) water temperature, 30 liter/min. (8 gal./min.) water flow and R-134a.

CRR-40 Models with Two Evaporator Fans — Water Cooled Condensing Option with 37.8 C (100 F) Water Temperature*

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@460V
1.7 C (35 F)	10,900	9,375	37,200	9.9	8,720	7,500	29,760	8.01
-17.8 C (0 F)	5,600	4,730	18,770	5.3	4,400	3,784	15,015	4.29

*System net cooling capacity with a 37.8 C (100 F) water temperature, 30 liter/min. (8 gal./min.) water flow and R-134a.

CRR-40 Models with Two Evaporator Fans — Water Cooled Condensing Option with 30 C(86 F) Water Temperature*

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@460V
1.7 C (35 F)	12,900	11,095	44,028	9.6	10,320	8,876	35,222	7.77
-17.8 C (0 F)	6,100	5,246	20,820	5.1	4,880	4,197	16,655	4.13

*System net cooling capacity with a 30 C (86 F) water temperature, 30 liter/min. (8 gal./min.) water flow and R-134a.

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
CRR-40 w/2 Evap Fans*	5,780	4,971	19,727	4,800	4,128	16,382
CRR-40 w/3 Evap Fans*	6,080	5,230	20,750	5,046	4,340	17,225

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

Evaporator Airflow

CRR-40 Models with Three Evaporator Fans

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	
	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min
0 mm (0 in.)	7,250	4,270	3,760	2,160	6,000	3,530	2,900	1,700
10 mm (0.4 in.)	6,960	4,100	2,570	1510	5,500	3,240	1,400	825
20 mm (0.8 in.)	6,400	3,770	—	—	5,000	2,940	—	—
30 mm (1.2 in.)	5,850	3,440	—	—	4,250	2,500	—	—
40 mm (1.6 in.)	5,100	3,000	—	—	3500	2060	—	—

CRR-40 Models with Two Evaporator Fans

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	
	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min
0 mm (0 in.)	6,580	3,875	3,170	1,865	5,500	3,240	2,730	1,608
10 mm (0.4 in.)	5,870	3,458	1,770	1,040	4,630	2,727	950	560
20 mm (0.8 in.)	5,000	2,940	—	—	3,760	2,215	—	—
30 mm (1.2 in.)	4,430	2,610	—	—	2,980	1,755	—	—
40 mm (1.6 in.)	3,640	2,144	—	—	1,880	1,108	—	—

Refrigeration System

Compressor Model No.:	D3DST-075E-TFD, Semi-hermetic Reciprocating with Copeland Discus® Valve Design
Refrigerant Charge:	
Standard Receiver Tank	4.7 Kg (10.35 lb) R-134a
Water-Cooled Condenser-Receiver Tank	5.2 Kg (11.5 lb) R-134a
Compressor Oil Capacity*	4.6 liter, 1.22 gal. (155.5 oz.)
Compressor Oil Type	Polyol Ester Based Type** (required) Refer to Tool Catalog
High Pressure Cutout Switch:	
Cutout	2240 ± 70 kPa, 22.40 ± 0.70 bar, 325 ± 10 psig
Cutin	1590 ± 70 kPa, 15.90 ± 0.70 bar, 230 ± 10 psig
Liquid Injection Control:	
KVQ Setting Less Than 5 C (8.9 F) Below the Return Air Temperature.	Liquid injection turns ON 6 seconds every minute regardless of compressor discharge temperature. Liquid injection activated at compressor discharge temperatures between 115 C and 125 C (239 F and 257 F), depending on KVQ valve setting.
Compressor Discharge Temperature Control ***	Liquid injection valve opens continuously during Power Limit and Modulation Cool modes
Liquid Injection Valve (Compressor):	
Voltage	24 Vac
Cold Resistance	5.6 ohms
Evaporator Pressure Regulator (KVQ Valve):	
EPR Circuit Voltage	24 Vdc
EPR Circuit Resistance	22 ohms
EPRTH (Thermistor) Circuit Resistance	22,000 ohms at 20 C (68 F)

*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!

***Active during Chill Mode only (setpoints at -9.9 C [10.1 F] and above). Controller pulses the liquid injection valve open and closed on a 1 minute duty cycle. For example, the valve may be energized for 15 seconds and de-energized for 45 seconds. Number of seconds valve is open (energized) is based on the compressor discharge temperature and the temperature control algorithm.

Normal R-134a System Suction Pressures (D3DS Copeland Reciprocating Compressor)*

Container Temp.	Operating Mode	Ambient Temp.	Suction Pressure
21 C (70 F)	Cool	27 to 38 C, 80 to 100 F	110 to 140 kPa, 1.10 to 1.40 bar, 16 to 20 psig
	Cool	16 to 27 C, 60 to 80 F	95 to 125 kPa, 0.95 to 1.25 bar, 14 to 18 psig
	Modulation Cool	27 to 38 C, 80 to 100 F	*
	Modulation Cool	16 to 27 C, 60 to 80 F	*
2 C (35 F)	Cool	27 to 38 C, 80 to 100 F	110 to 140 kPa, 1.10 to 1.40 bar, 16 to 20 psig
	Cool	16 to 27 C, 60 to 80 F	95 to 125 kPa, 0.95 to 1.25 bar, 14 to 18 psig
	Modulation Cool	27 to 38 C, 80 to 100 F	*
	Modulation Cool	16 to 27 C, 60 to 80 F	*
-18 C (0 F)	Cool	27 to 38 C, 80 to 100 F	-30 to -15 kPa, -0.30 to -0.15 bar, 9” to 5” Hg vacuum
	Cool	16 to 27 C, 60 to 80 F	-35 to -25 kPa, -0.35 to -0.25 bar, 11” to 7” Hg vacuum
-29 C(-20F)C	Cool	27 to 38 C, 80 to 100 F	-45 to -35 kPa, -0.45 to -0.30 bar, 14” to 11” Hg vacuum
	Cool	16 to 27 C, 60 to 80 F	-50 to -35 kPa, -0.40 to -0.20 bar, 15” to 11” Hg vacuum

*Suction pressure in Modulation Cool will vary between 140 and -35 kPa, 1.40 and -0.35 bar, 20 psig and 10” Hg vacuum depending on the value of the control temperature differential.

Controller

Temperature Controller: Type	MPC2000ID or MP-3000a microprocessor with programming key-pad, 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	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	Demand defrost function initiates defrost when: -Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large for 90 minutes. -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: Chill Mode*	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.

Controller (Continued)

Defrost Termination:	
Evaporator Coil Sensor*	Chill Mode: Terminates defrost when coil sensor temperature rises to 30 C (86 F); or exceeds 18 C (65 F) for 25 minutes
	Frozen Mode: Terminates defrost when coil sensor temperature rises to 18 C (65 F); or exceeds 8 C (46 F) for 25 minutes
Interval Timer**	Terminates defrost after 90 minutes at 60 Hz operation if coil sensor has not terminated defrost (120 minutes at 50 Hz operation)
Compressor Shutdown (Auto Reset):	
Stops Compressor	130C (266 F)
Allows Compressor Start	90 C (194 F)
Power Off	Turning unit On/Off switch OFF terminates defrost

Electrical System

Compressor Motor:	
Type	460/380V, 60/50 Hz, 3 Phase
Kilowatts	5.60 kW @ 460V,60 Hz
Horsepower	7.5 hp @ 460V,60 Hz
RPM	1750 rpm @ 60 Hz
Full Load Amps	15.5 amps @ 460V,60 Hz; 15.5 amps @ 380V, 50 Hz
Locked Rotor Amps	83 amps — 460V; 82 to 91 amps @ 380V, 50 Hz
Condenser Fan Motor:	
Red Color Finish: Type	460/380V, 60/50 Hz, 3 Phase
Kilowatts (60 Hz)	0.56 kW @ 460V,60 Hz
Horsepower (60 Hz)	0.75 hp @ 460V,60 Hz
RPM (60 Hz)	1140 rpm @ 60 Hz
Full Load Amps (60 Hz)	1.3 amps@ 460V,60 Hz
Black Color Finish: Type	460/380V, 60/50 Hz, 3 Phase
Kilowatts (60 Hz)	0.37 kW @ 460V,60 Hz
Horsepower (60 Hz)	0.50 hp @ 460V,60 Hz
RPM (60 Hz)	1145 rpm @ 60 Hz
Full Load Amps	0.9 amps @ 460V; 1.0 amps @ 380V, 50 Hz
Locked Rotor Amps	4.0 amps @ 460V; 4.4 amps @ 380V, 50 Hz
Evaporator Fan Motors:	
Type	460/380V, 60/50 Hz, 3 Phase
Number	3 or 2
Kilowatts (Each)	0.75 kW @ 460V,60 Hz
Horsepower (Each)	1.0 hp @ 460V,60 Hz
RPM (Each)	3450 rpm, High Speed @ 60 Hz 1725 rpm, Low Speed @ 60 Hz
Full Load Amps (60 Hz) (Each)	1.2 amps @ 460V, High Speed @ 460V,60 Hz 0.5 amps @ 460V, Low Speed @ 460V,60 Hz
Locked Rotor Amps (60 Hz)	10.3 amps @ 460V, High Speed @ 460V,60 Hz 2.9 amps @ 460V, Low Speed @ 460V,60 Hz
Electric Resistance Heater Rods:	
Type	460/380V, 60/50 Hz, 3 Phase
Number	6
Watts (60 Hz) (Each)	680 Watts
Current Draw (Amps)	5 amps nominal (total) across each phase at the heater contactor
Control Circuit Voltage	29 Vac@ 60 Hz; 24 Vac@ 60 Hz
Evaporator Overheat Switch:	Opens: 54 C (130 F) Closes: 32 C (90 F)

Dehumidify and Humidify Systems (Options)

Dehumidify System:	
Turn Mode On and Off	Set from CONTROL line of the Setpoint menu of the controller
Control Range (HUMSP) Setting	Setpoint adjustable from 60% 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	60% to 99% Relative Humidity
Air Compressor Output	2.5 m^3/hr @ o kPa (1.5 CFM @ 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

Fresh Air Exchange Venting System (Adjustable):	
CRR-40	0 to 285 m^3/hr (0 to 168 ft^3/min.) @ 60 Hz
	0 to 236 m^3/hr (0 to 139 ft^3/min.) @ 50 Hz
Evaporator Fan Blade Specifications:	
CRR-40 with Three Evaporator Fans Diameter:	355 mm (14.0 in.)
Pitch	22^o
CRR-40 with Two Evaporator Fans Diameter:	355 mm (14.0 in.)
Pitch	25^o
Weight (net):	
CRR-40 Unit	526 Kg (1159 lb)
Water-cooled Condenser-Receiver Option	13.6 Kg (30 lb)

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: CRR-40	420.0 mm (16.54 in.) from back of flange

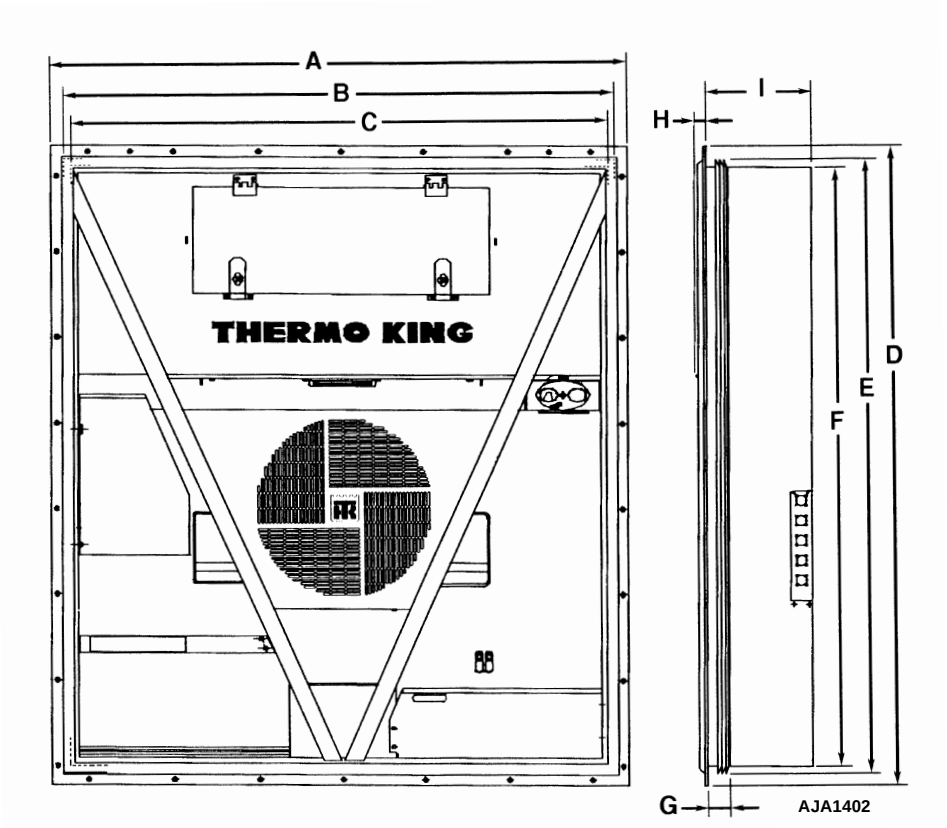


Figure 2: Physical Specifications

Metric Hardware Torque Chart

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.

Compressor Torque — D3D Copeland Compressor Bolt Torque

Bolt Usage	N.m	In.-lb.
Bottom Plate:		
Grade 5	45.2	400
Grade 8	59.3	525
Housing Cover	45.2	400
Oil Pump to Housing Cover	33.9	300
Bearing Cover to Housing Cover	33.9	300
Stator Cover:		
Grade 5	45.2	400
Grade 8	59.3	525
Cylinder Head	59.3	525
Oil Screen Cover	31.1	275
Crankcase Heater Plug	45.2	400
Discharge and Suction Valve:		
18 (5/16 in.)	25.4	225
13 (1/2 in.)	56.5	500
Pipe Plug:		
6.35 mm (0.25 in.)	33.9	300
3.175 mm (0.125 in.)	22.6	200
Oil Sight Glass:		
Grade 5	4.5	40
Grade 8	8.5	75
Terminal Plate	33.9	300
Nut on Top of Terminal Plate	5.1	45
Nut on Top of Jumper Bar	9.0	80

Unit Description

General Description

Model CRR-40 units are all-electric, single-piece, refrigeration units with bottom air supply. Each unit is designed to cool and heat containers for shipboard or overland transit of deep frozen, frozen, chilled or heated cargoes. Each unit mounts in the front wall of the container. 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.

The 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.

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 and evaporator fan motor operation. Unit power cable is stored below the control box in the condenser section.

Unit features include a semi-hermetic reciprocating compressor with a liquid injection system; 2-speed evaporator fans; a fresh air exchange system; and a microprocessor controller with integral data logger. For additional unit feature information, see the Model Features Section.

Semi-Hermetic Reciprocating Compressor with Liquid Injection Cooling System

The refrigeration unit includes a semi-hermetic reciprocating compressor with forced feed lubrication system, ambient compensated internal overload and high temperature protectors, and a refrigerant injection system.

Dual Speed Evaporator Fans

CRR 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:
Chill 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.

Microprocessor Controller

A microprocessor 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 set-point 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 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 on MPC2000ID controller (680 days on MP-3000a controller). 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; plus humidity and ambient sensors on MP-3000a. 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 or SmartSponge handheld data retriever, or a REFCON power line remote monitoring system.

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 System

A dehumidification system lowers the relative humidity in the container to the humidity setpoint. The setpoint is adjustable between 60% and 99%.

Humidification Control System Option

An optional humidification system increases the relative humidity in the container to the humidity setpoint. The control range is between 60% and 99%.

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.

Pressure Gauge Options

A high pressure gauge is available to indicate condenser (high side) pressure. A low pressure gauge is available to indicate compressor suction (low side) pressure.

Water-Cooled Condenser-Receiver Tank

A water-cooled condenser-receiver provides the unit with above deck and below deck operating capabilities. A Condenser Fan On/Off switch is provided on the control box with the water-cooled condenser option. Place the Condenser Fan On/Off switch OFF for water-cooled condenser operation.

Operating Modes

NOTE: See 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:

With a Setpoint of -9.9 C (14.1 F) and above the Supply Air Temperature is the controlling sensor.

With a setpoint of -10 C (14 F) and below the Return Air Temperature is the controlling sensor.

The controller uses a complex 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).

NOTE: If the compressor has been OFF for more than 8 hours, or the unit has been on heat or defrost; the controller performs a compressor sequence start.

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.

- 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)

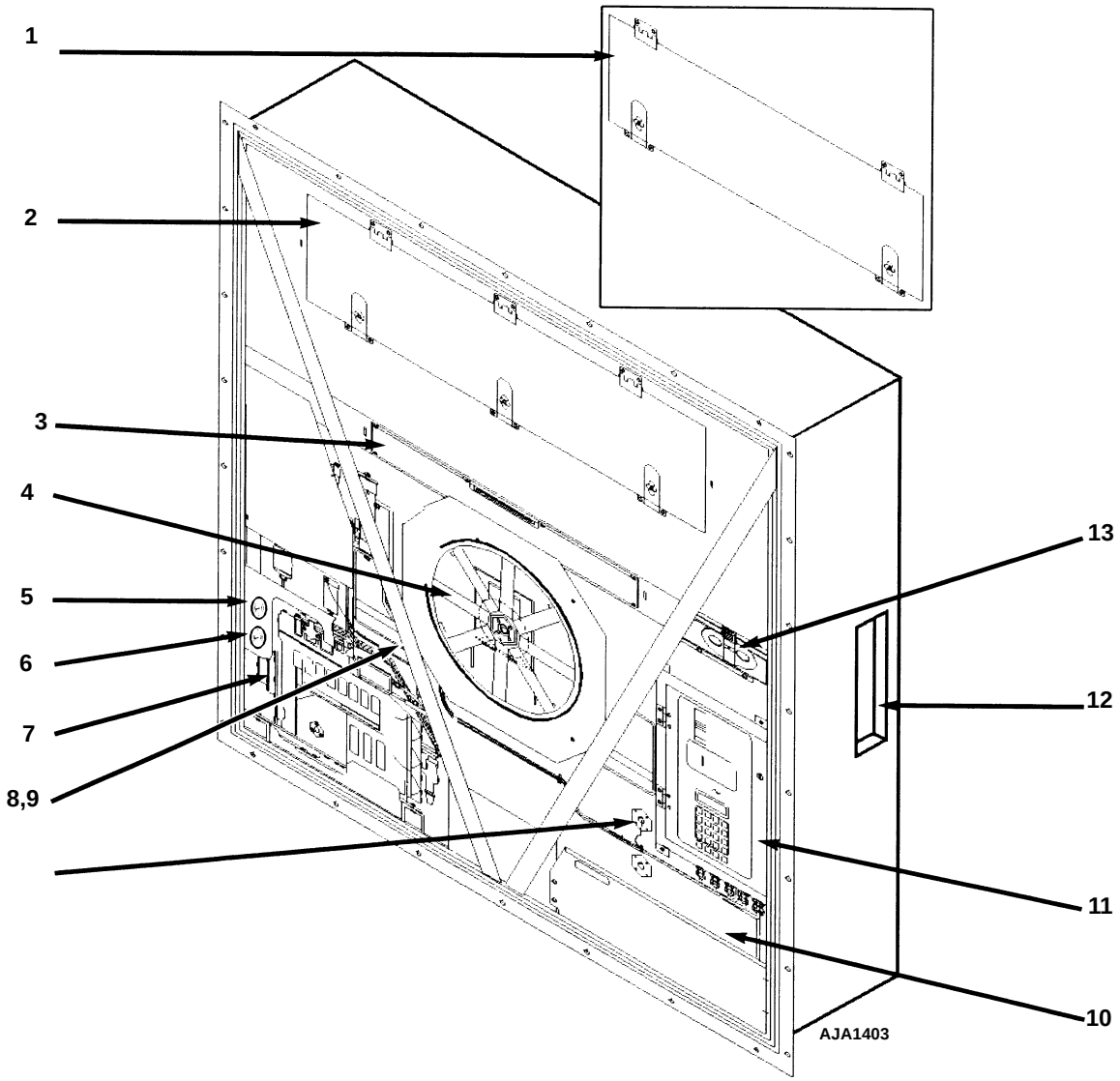
  NOTE: If the Economy Mode is set to ON, the evaporator fans operate on low speed at set-points of -9.9 C (14.1 F) and above whenever the container temperature is In-range.

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).

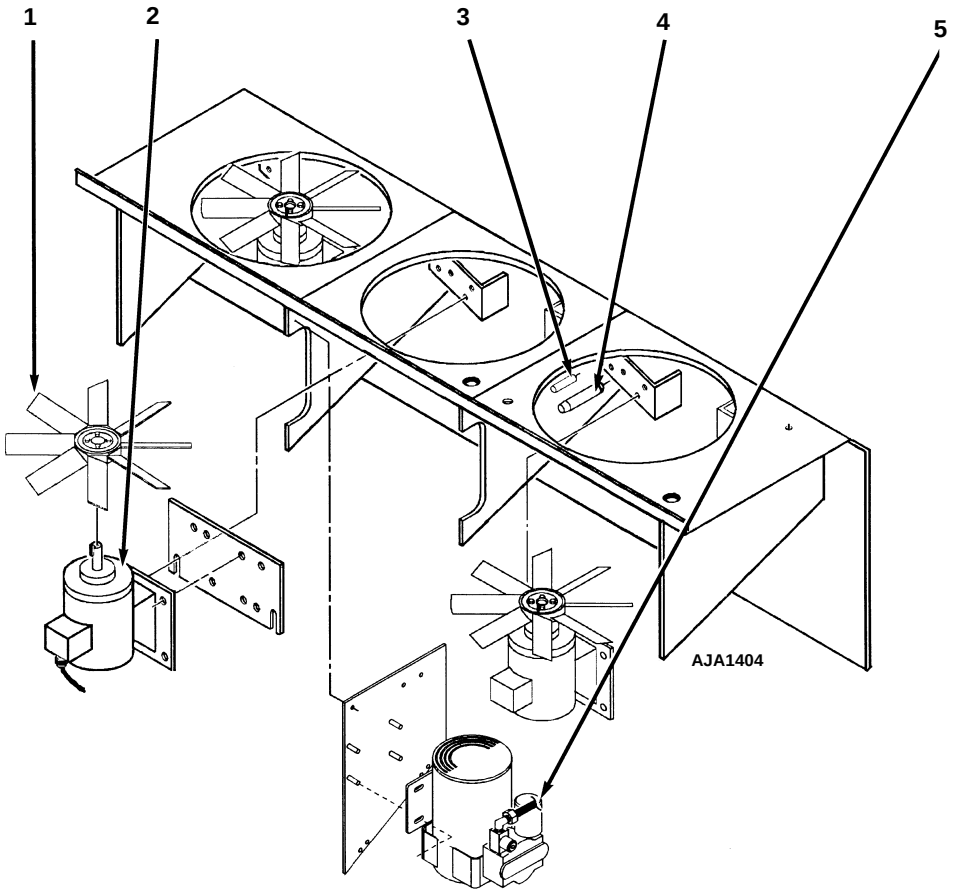
- Cool (down to 1 C [1.8 F] below setpoint)
- Null (compressor and condenser fan stops, evaporator fans operate)
- Defrost (resistance heaters on, evaporator fans stop)

  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.



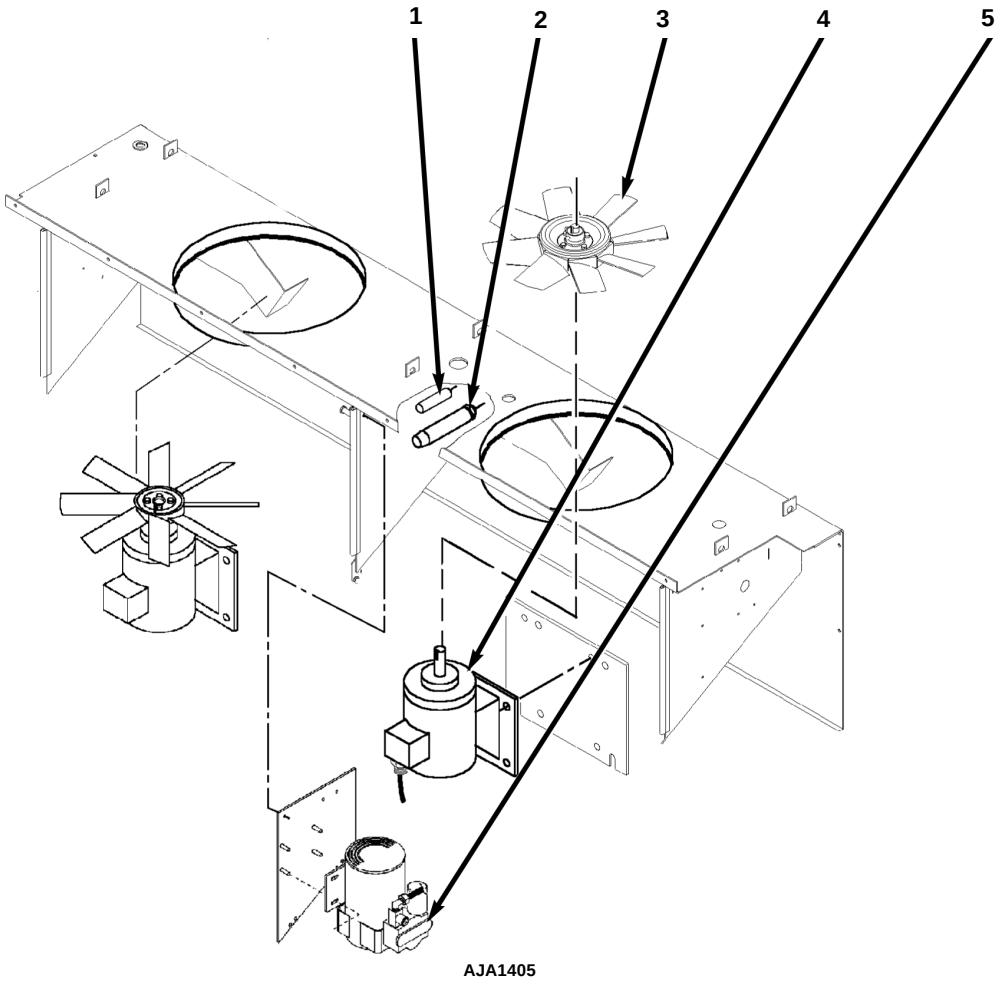
1.	Evaporator Access Door, 1018 mm (40.08 in.) Wide with Two Latches — Models with Two Evaporator Fans	8.	Supply Air Sensor Probe Holder Left Hand (behind compressor)
2.	Evaporator Access Door, 1399 mm (55.04 in.) Wide with Three Latches — Models with Three Evaporator Fans	9.	Supply Air Sensor Probe Holder Right Hand (behind compressor)
3.	Heater Access Panel Location	10.	Power Cord Storage Compartment
4.	Condenser Fan	11.	Control Box
5.	Suction Pressure Gauge	12.	USDA Receptacle Panel (Access from Inside Container)
6.	Discharge Pressure Gauge	13.	Fresh Air Exchange Vent
7.	Compressor Compartment		

Figure 3: Unit Front View



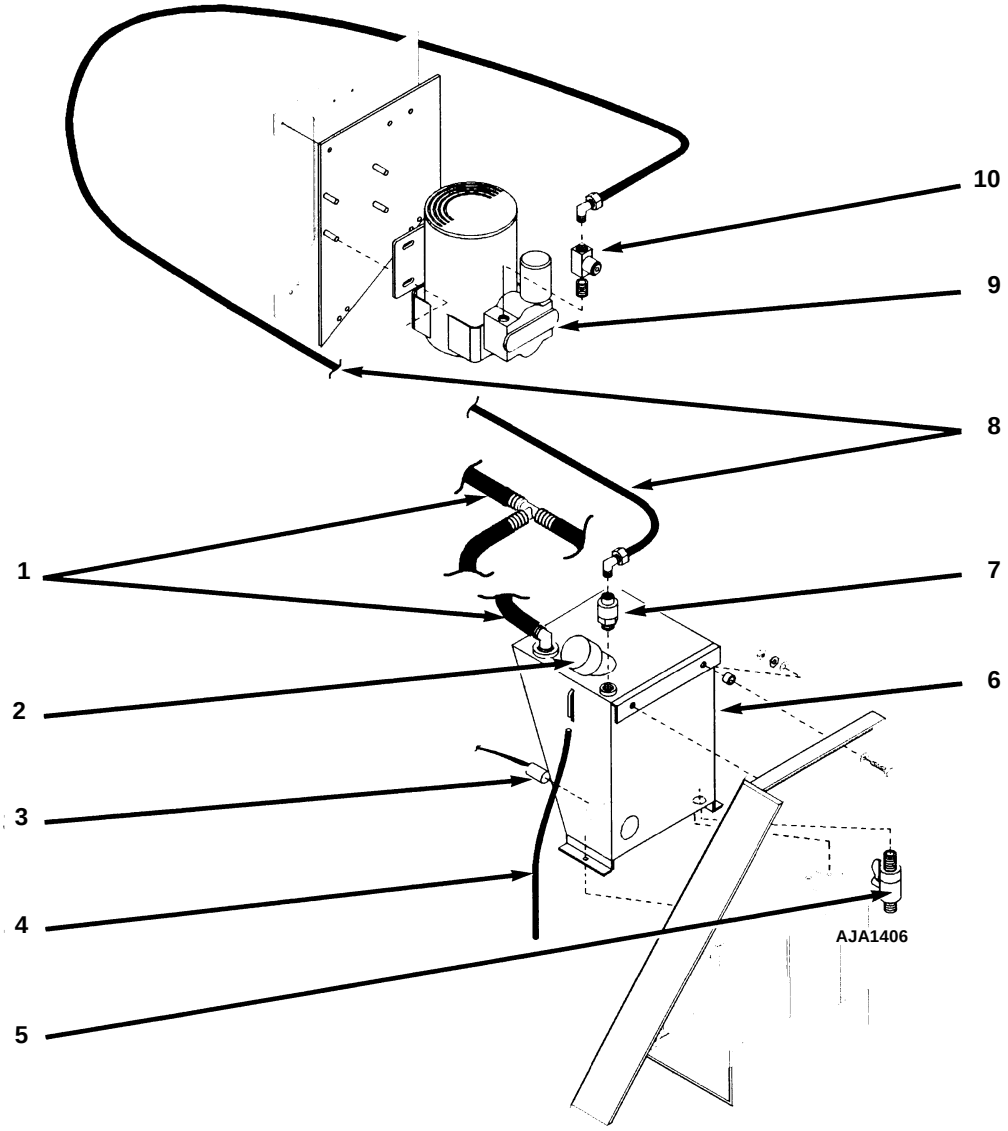
1.	Evaporator Fan Blade
2.	Evaporator Fan Motor
3.	Return Air Sensor
4.	Humidity Sensor (Option)
5.	Humidity System Compressor (Option)

Figure 4: Evaporator Section for Models with Three Evaporator Fans—Front View



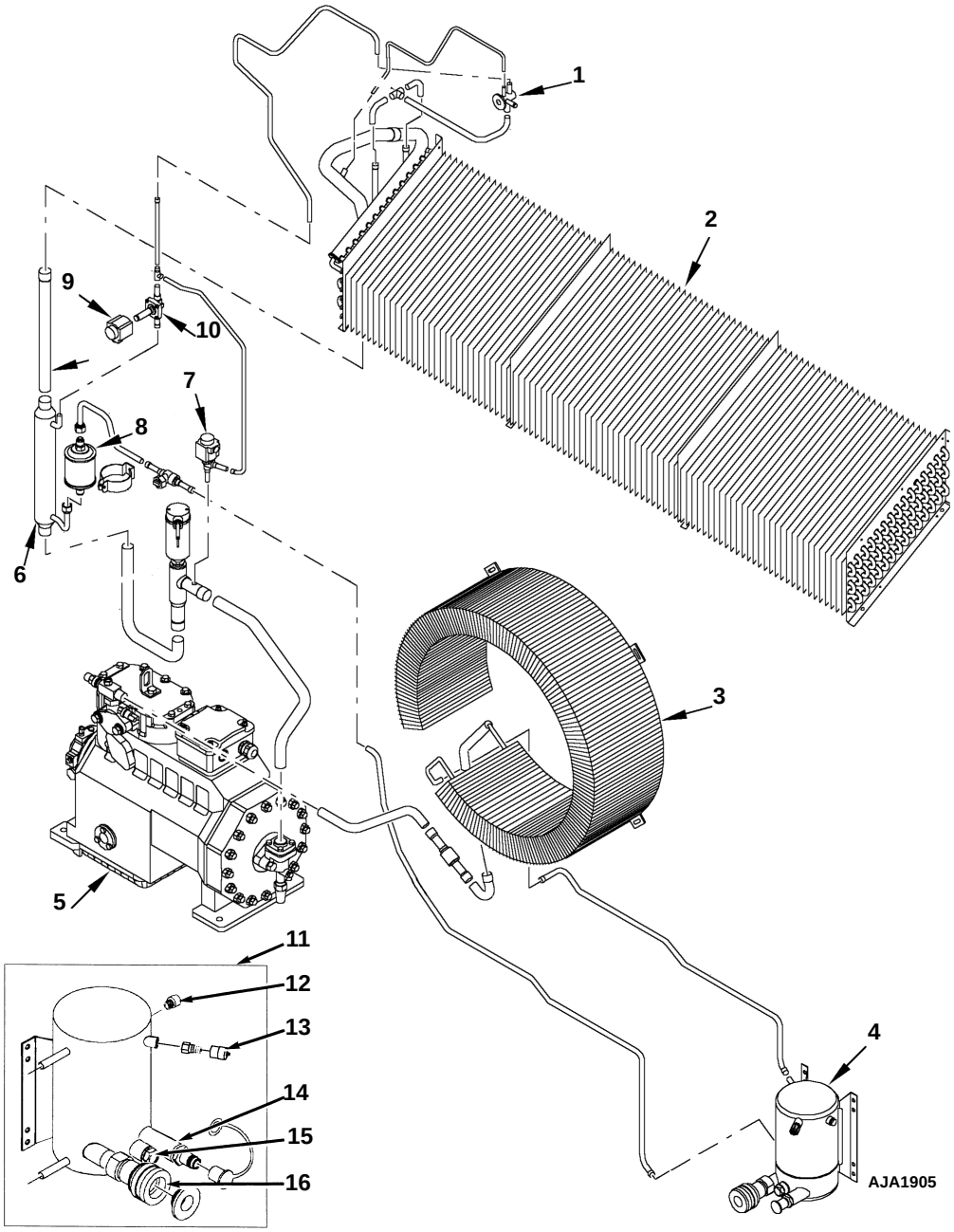
1.	Return Air Sensor
2.	Humidity Sensor (Option)
3.	Evaporator Fan Blade
4.	Evaporator Fan Motor
5.	Humidity System Compressor (Option)

Figure 5: Evaporator Section for Models with Two Evaporator Fans — Front View



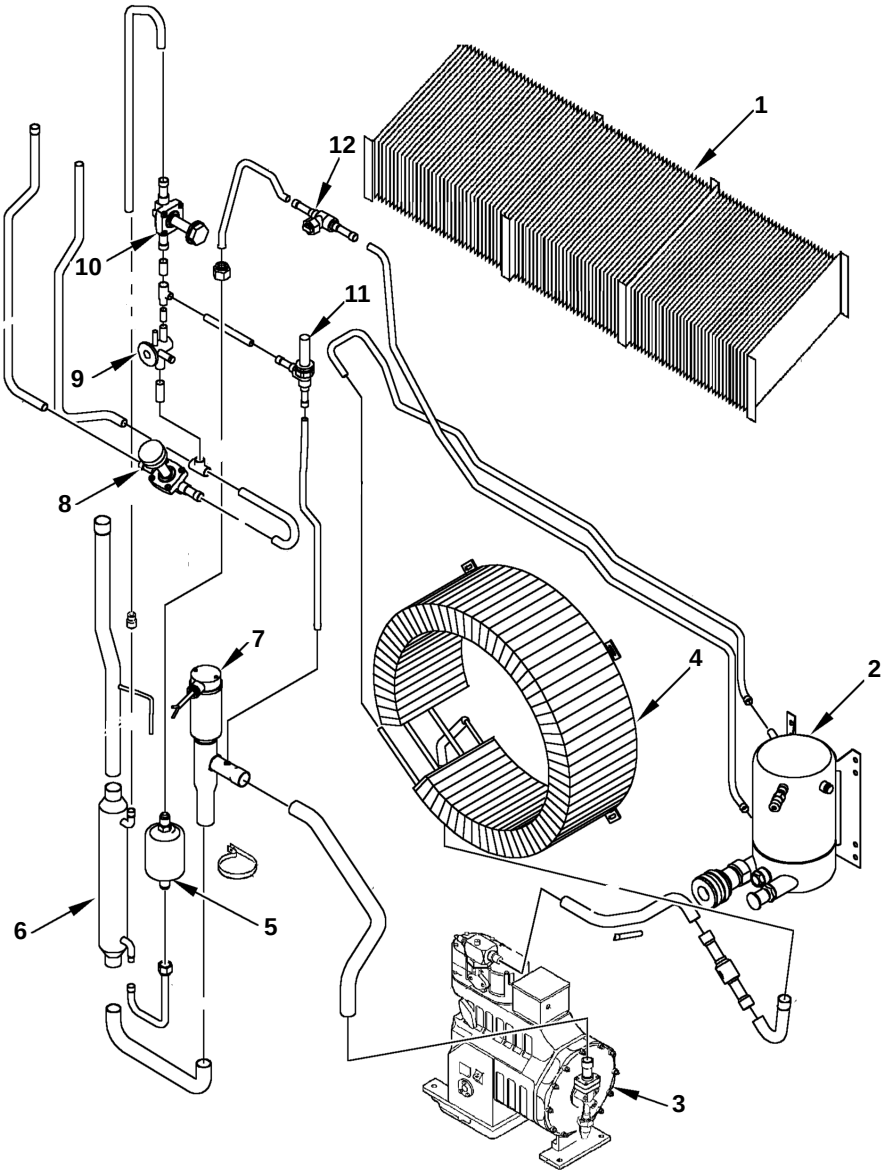
1.	Evaporator Drain Hose
2.	Fill Cap
3.	Water Tank Heater
4.	Tank Overflow Hose
5.	Drain Cock
6.	Water Tank
7.	Water Filter
8.	Water Supply Hose
9.	Air Compressor
10.	Liquid Spray Nozzle

Figure 6: Humidity System Option



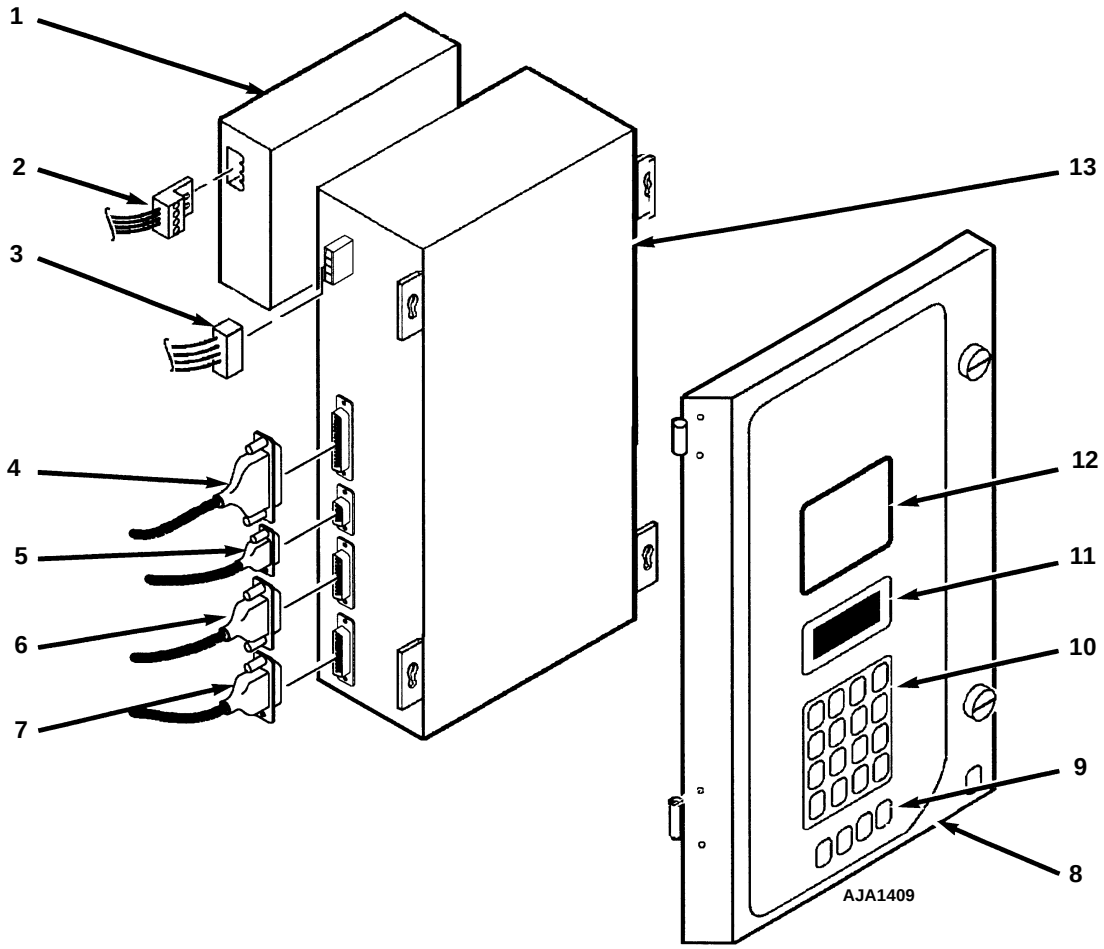
1.	Expansion Valve	9.	Coil Valve
2.	Evaporator Coil	10.	Solenoid Valve
3.	Condenser Coil	11.	Water-Cooled Condenser-Receiver Tank (CRR-40 119A & CRR-40 800)
4.	Condenser Tank	12.	Fusible Plug
5.	Compressor	13.	Service Port Fitting and Cap
6.	Heat Exchanger	14.	Water Outlet Coupling
7.	Solenoid Liquid Injection Valve	15.	Sight Glass
8.	Dehydrator with O-Rings	16.	Water Inlet Coupling

Figure 7: Refrigeration System



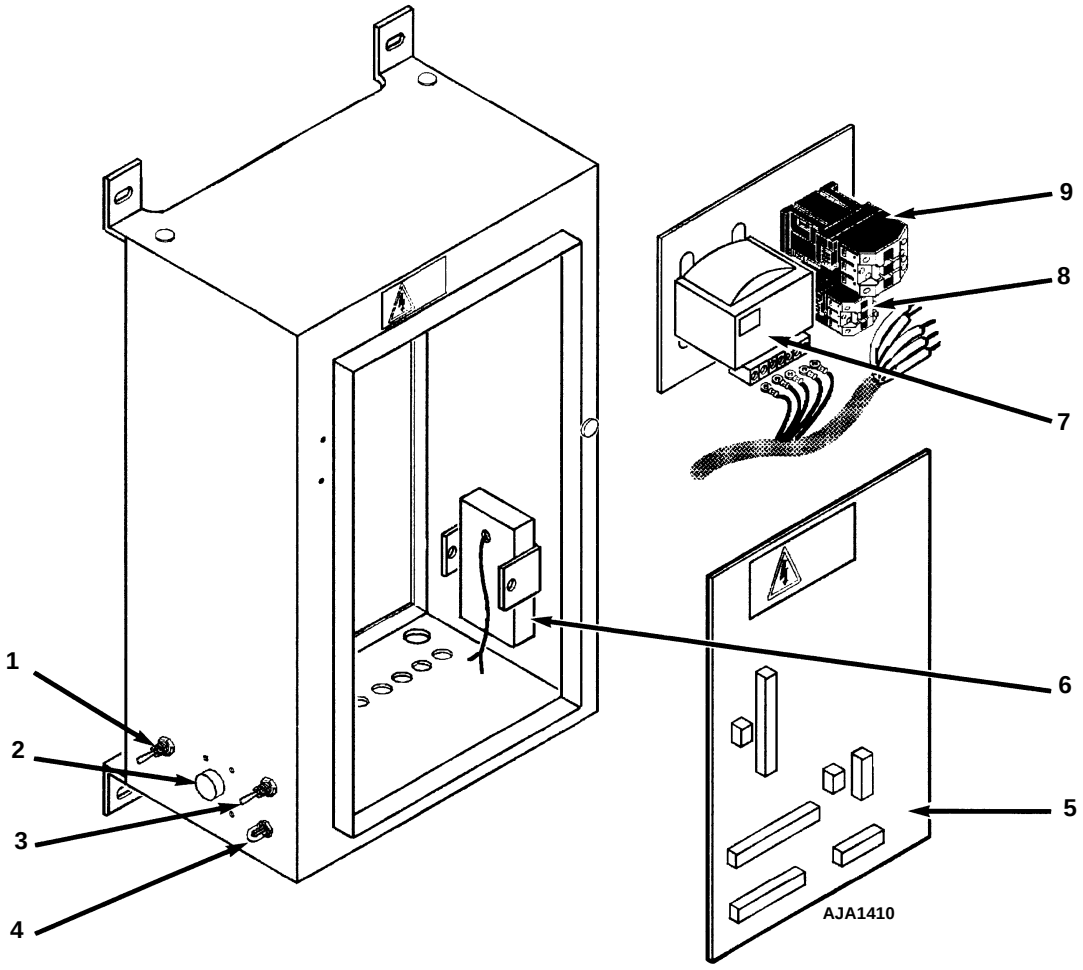
1.	Evaporator Coil (units w/3 evap fans)	7.	KVQ Valve
2.	Condenser Tank (800, 800A/B/C/D)	8.	Solenoid Valve (humidity control, normally open, Danfass valve)
3.	Compressor	9.	Expansion Valve (or use Kit 60-253 for replacement of brass valves)
4.	Condenser Coil (800, 800A/B/C)	10.	Solenoid Valve (liquid, normally closed)
5.	Dehydrator	11.	Solenoid Valve (pulse)
6.	Heat Exchanger (800B/C/D)	12.	Shutoff Valve

Figure 8: Water-Cooled Condenser-Receiver Tanks



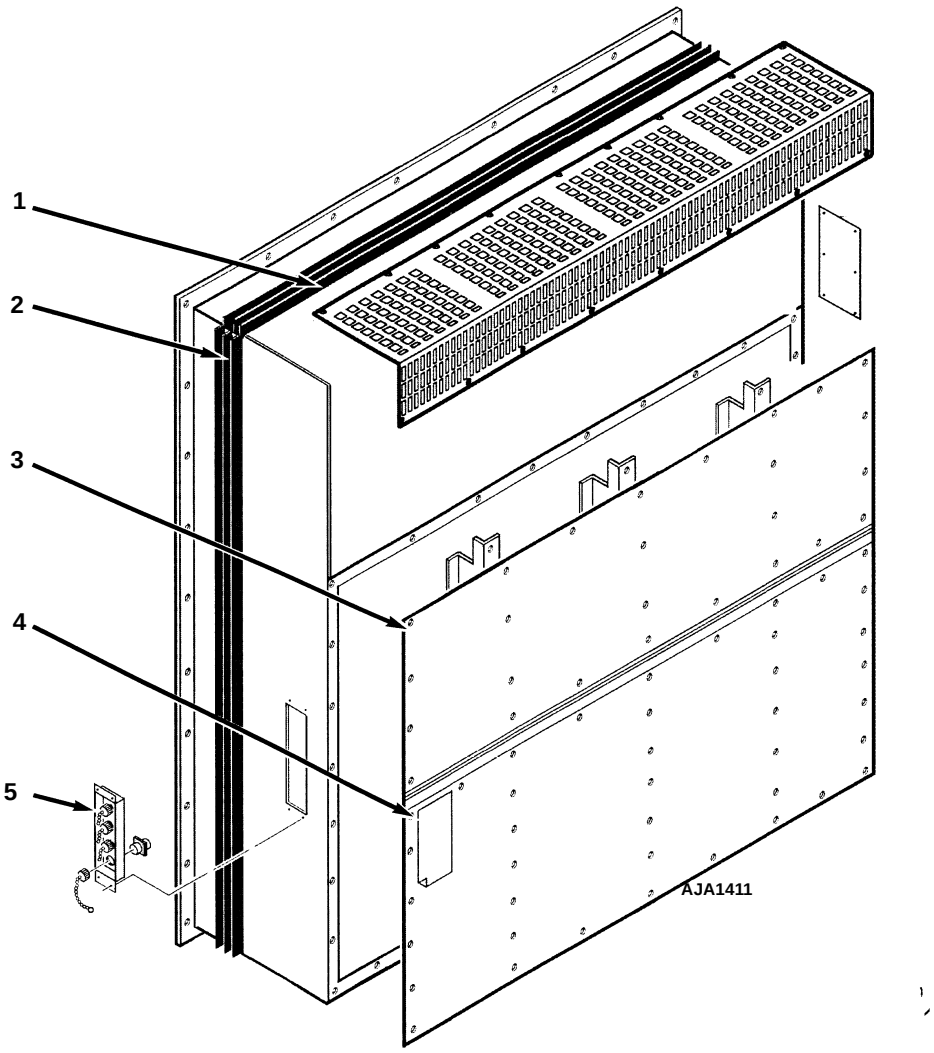
1.	Remote Monitoring Modem	8.	Control Box Cover and Controller Keyboard Decal
2.	RMM Communication Cable	9.	Special Function Keypad
3.	Battery Cable Connection to Controller	10.	General Purpose Keypad
4.	Cable No. 2 Connection to Controller	11.	LCD Display (Setpoint Temperature, Message and Controller Main Menu Tree Display)
5.	Download Cable Connection to Controller	12.	LED Display (Return or Supply Air Temperature Display and Status Indicator LEDs)
6.	Cable No. 3 Connection to Controller	13.	Controller: MPC2000ID or MP-3000a
7.	Cable No. 1 Connection to Controller		

Figure 9: Controller and Remote Monitoring Modem



1.	Condenser Fan On/Off Switch (OFF=Water-cooled Condenser Operation) (Option)
2.	Communications Connector for Data Retrieval
3.	Unit On/Off Switch
4.	Circuit Breaker
5.	Main Relay Board
6.	12 Vdc Battery
7.	Control Power Transformer
8.	Compressor Contactor
9.	25 Ampere Main Power Circuit Breaker

Figure 10: Unit Control Box



1.	Evaporator Grille
2.	Unit Gasket
3.	Top Rear Plate
4.	Bottom Rear Plate
5.	Sensor Connector Assembly Controller Communications and Data Retrieval Connection USDA1 Sensor Connection USDA2 Sensor Connection USDA3 Sensor Connection USDA4 Sensor Connection

Figure 11: Unit Back View

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.
2. CONDENSER FAN SWITCH (Water-Cooled Condenser Option).
   a. FAN AIR position. Condenser fan operates as required during cooling to provide air-cooled condensing.
   b. WATER position. Condenser fan does NOT operate so refrigerant condensing can be provided by the water-cooled condenser.

   NOTE: Water-cooled condenser requires a water flow of 19 to 38 l/min. (5 to 10 gal./min.) when Condenser Fan On/Off switch is OFF.

MPC2000ID or MP-3000a Controller

The MPC2000ID or MP-3000a 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 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 set-point (standard). The controller maintains the in-range signal during defrost and after defrost for 60 minutes. If the controlling air sensor temperature goes out-of-range, the controller maintains the in-range signal for 5 more 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

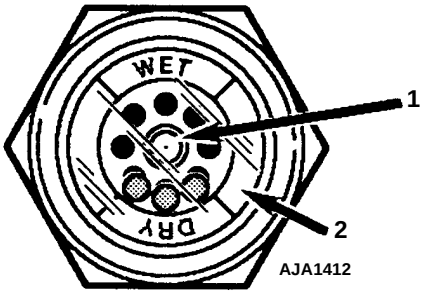
1. EVAPORATOR OVERHEAT SWITCH. A temperature switch near the evaporator coil opens to de-energize the heater contactor if the evaporator temperature reaches 54 C (130 F). The switch closes (resets) when the evaporator temperature decreases to 32 C (90 F).

Unit Instruments

1. RECEIVER TANK SIGHT GLASS. A sight glass on the receiver tank contains three small balls that indicate the level of refrigerant in the tank for checking the refrigerant charge. A moisture indicator in the sight glass changes color to indicate the level of moisture in the system. Check the color of the indicator against the color decal in the sight glass. The dry eye in the sight glass is LIGHT GREEN when the system is dry and YELLOW when the system is wet (contains excessive moisture).
2. COMPRESSOR OIL SIGHT GLASS. A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.
3. SUCTION PRESSURE GAUGE. A suction pressure gauge indicates the refrigerant pressure in the suction line returning to the compressor.
4. DISCHARGE PRESSURE GAUGE. A discharge pressure gauge indicates the refrigerant pressure in the discharge line leaving the compressor.

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.



1.	Moisture Indicator: Light Green = Dry or Yellow = Wet
2.	Outer ring is color coded. Compare to indicator

Figure 12: Receiver Tank Sight Glass

2. CONTROL SYSTEM CIRCUIT BREAKER. A 7 ampere manual reset circuit breaker or a 7 ampere ATO fuse protects the 29 Vac control circuit. This circuit breaker is located in the control box beside the On/Off switch. The ATO Fuse is located inside the control box on the right side wall.
3. FUSES. A number of fuses are located on the main relay board and controller 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 LINE TEMPERATURE SENSOR. The controller uses the compressor discharge line temperature sensor to protect the compressor from excessively high operating temperatures and activate liquid injection during Chill mode (setpoints at -9.9 C [10.1 F] and above).
   - High Temperature Protection: If the discharge gas temperature rises above 130 C (266 F), the unit stops immediately. The controller turns ON the Alarm LED and records Alarm 56, Compressor Temperature Too High. The controller will restart the unit when the sensor temperature is below 90 C (194 F).

- Compressor Discharge Temperature Control (Chill Mode Only):

A. Liquid injection is activated at compressor discharge temperatures between 115 C and 125 C (239 F and 257 F). The controller pulses the liquid injection valve open and closed on a 1 minute duty cycle. For example, the valve may be energized for 15 seconds and de-energized for 45 seconds. Number of seconds the valve is energized is based on the discharge temperature and the KVQ valve setting.

B. Liquid injection is activated when the KVQ Setting less than 5 C (8.9 F) below the return air temperature. The controller energizes liquid injection valve for 6 seconds every 60 seconds regardless of the discharge temperature.

5. HIGH PRESSURE CUTOUT (HPCO) SWITCH. If the compressor discharge pressure rises above 2240 +/- 70 kPa, 22.4 +/- 0.7 bar, 325 +/- 10 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 in the Misc. Functions Status Menu: “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 over-load 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. FUSIBLE PLUG FOR HIGH PRESSURE RELIEF. A fusible plug is installed in the water-cooled condenser-receiver tank to avoid excessive pressure build-up within the refrigeration system from extraordinary and unforeseen circumstances. The plug blows when the plug temperature reaches 100 C (212 F). The plug is located so that refrigerant pressure expelled from the valve would be directed away from anyone servicing the unit. The plug is non-repairable and requires no adjustment. If the plug blows, recover the remaining refrigerant charge and replace the fusible plug.

7. OVERLOAD PROTECTION. The condenser fan motor, evaporator fan motors and compressor motors include internal overload protection with automatic reset.

8. 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 proper condenser and evaporator fan rotation.

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. Inspect water-cooled condenser-receiver tank, water lines and fittings for water leaks. When water lines are disconnected, also check to be sure that the water drains completely from the condenser-receiver tank. Report defective fittings and tanks that do not drain to a technician.
9. Optional: Check water level in humidity system tank. Add only demineralized or distilled water to prevent plugging of the atomizing nozzle.
10. Observe the unit for proper operation and functions during Pre-load Operation.
11. 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 MPC2000ID or MP-3000a 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.
   - Evaporator fan motors start.
2. If the controller calls for cooling, the compressor motor starts and the liquid line solenoid energizes (opens). If the unit starts in Modulation Cool, compressor start-up can be delayed up to 3 minutes while the KVQ valve opens or closes to the required setting.
   - On cooling, the condenser fan starts as required when the unit is on air-cooled condensing operation.
3. 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 Controller chapter of this manual. Be sure to wait up to 3 minutes for the compressor to start.
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 enter new setpoint. Enter Arrow appears in the menu line and the current setpoint disappears.
   - Enter minus sign 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 set-point 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 F4 key is not pressed within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat step 4.

5. Check the direction of the condenser airflow (see "Condenser Fan and Evaporator Fan Rotation" in the Electrical Maintenance chapter of this manual).
6. Check direction of evaporator airflow (see "Condenser Fan and Evaporator Fan Rotation" in Electrical Maintenance chapter of this manual).
7. Allow the unit to operate one-half hour before loading. This will remove residual container heat and moisture, and pre-cool the container interior.
8. Perform a Pretrip (PTI) Test and check unit modes while the unit pre-cools:

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.

- 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 Smart Sponge handheld data retriever.

9. Set the fresh air vent to the desired air exchange rate.
10. Optional: Operate the humidity system (see "Changing the Humidity Mode Setting" under "Setpoint Menu" 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.
11. 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. 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.
2. Turn the Condenser Fan On/Off switch to FAN AIR position.

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 enter new setpoint. Enter Arrow appears in the menu line and the current setpoint disappears.
   - Enter minus sign 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 set-point 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 F4 key is not pressed within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat step 4.

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 the 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 MPC2000ID or MP-3000a datalogger may be down loaded via the communications port on the control box using a DRU-II or SmartSponge handheld data retriever; or via the REFCON remote monitor system.

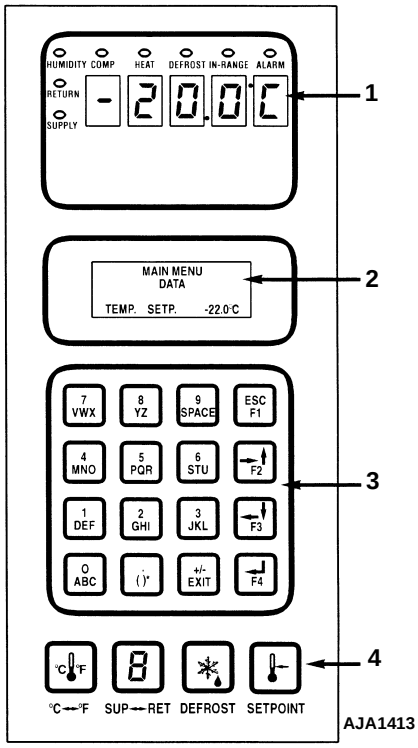
MP-3000a Controller

Controller Description

The MPC2000ID and MP-3000a are both advanced micro-processor controllers that have been specially developed for the control and monitoring of refrigeration units. Each 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.



1.	LED display for TEMPERATURE. Status indicator LEDS identify controlling sensor temperature (return or supply) that appears in display.
2.	LCD display for SETPOINT, EMSSAGES 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.

Figure 13: Controller

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 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 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 a 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 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 custom airflow, set bulb mode, set AFAM operation, set AFAM delay, set AFAM rate, set O_2 Minimum and set CO_2 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 cur-rent 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 1Alarm) occurs. Less serious Log Alarms (Level 3 Alarm) are recorded but do not activate the Alarm LED (see Alarms Menu in this chapter for more information).

Data Recording and Downloading Data

The controller's 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.

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 not 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 reconnected 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, downloading 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 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
- KVQ 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 KVQ valve to provide accurate control of the container temperature in direct response to load demand.

The KVQ 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 pulse 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 con-troller 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 protections is provided by pulsing the electric heaters ON and OFF 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.

KVQ Setting Value in Data Menu

The KVQ Setting value displayed in the Data menu indicates the evaporating temperature the KVQ valve uses to control refrigerant return to the compressor. During maximum cooling capacity operation, the KVQ Setting value may range between -40 C and -60 C (-40 F and -76 F).

The temperature difference between the KVQ valve setting and the return air temperature determines the cooling capacity available. A temperature difference of 5 C (8.9 F) or less indicates very low cooling capacity.

Compressor Sequence Start

The controller performs a compressor sequence start when the compressor has not operated for more than 60 seconds within the last 18 hours. A compressor sequence start cycles the compressor ON 3 seconds, OFF 10 seconds, ON 5 seconds, OFF 10 seconds, ON 7 seconds, OFF 10 seconds and then ON continuously.

Compressor Liquid Injection

During compressor operation, a liquid injection system injects refrigerant into the suction line to protect the compressor for excessively high operating temperatures.

Compressor Discharge Temperature Control (Chill Mode Only)

- Liquid injection is activated at compressor discharge temperatures between 115 C and 125 C (239 F and 257 F). The controller pulses the liquid injection valve open for 2 to 60 seconds every 60 seconds. The number of seconds the valve is energized depends on the discharge temperature and the KVQ valve setting.
- Liquid injection is activated when the KVQ Setting is less than 5 C (8.9 F) below the return air temperature. The controller energizes liquid injection valve for 6 seconds every 60 seconds regardless of the discharge temperature.

High Temperature Protection

- If the discharge gas temperature rises above 130 C (266 F), the unit stops immediately. The controller turns ON the Alarm LED and records Alarm 56, Compressor Temperature Too High. The controller will restart the unit when the sensor temperature is below 90 C (194 F).

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 during the compressor start-up in both the Chill and Frozen modes. During start-up, the controller partially closes the KVQ valve to reduce the cooling capacity load on the compressor. The actual KVQ Setting depends on the condenser temperature, but ranges between 10 C and 30 C (5.6 and 16.8 F) below the return air temperature. The KVQ valve then gradually opens to increase cooling capacity during initial pull-down as required.

When the total current or the condenser temperature exceeds a predetermined threshold, the controller limits unit power consumption by sending a voltage pulse to the KVQ valve. The KVQ valve closes to restrict the flow of refrigerant to the compressor to limit the compressor motor current draw and the condenser temperature to the 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.

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 60 to 95% from the Setpoint menu too.

The use of the Dehumidify Mode should be established by the shipper. When the Dehumidify Mode is ON, the controller:

a. Energizes (closes) the dehumidify valve when the humidity level is 2% or more above setpoint; and the KVQ valve has reduced the unit cooling capacity by about 25%. 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. Pulses the electric heaters ON and OFF when the humidity level is 5% or more above setpoint; and the KVQ valve has reduced the unit cooling capacity by about 50% (40% at setpoint temperatures below 5 C [41 F]). This increases the cooling load on the evaporator coil, thereby causing the coil to become even colder and condensing 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.
- The evaporator fan motors start about 40 seconds after the unit was turned ON.
- - 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 and the liquid line solenoid energizes (opens) if the controller calls for cooling.
- The condenser fan then starts if the Condenser Fan switch is in the FAN AIR position and 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 con-trolling sensor temperature is within 1.5 C (2.7 F) of the setpoint.

NOTE: If the compressor has been off for more than 18 hours, the controller performs a compressor sequence start. See "Compressor Sequence Start" in this chapter for further details).

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, KVQ 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.

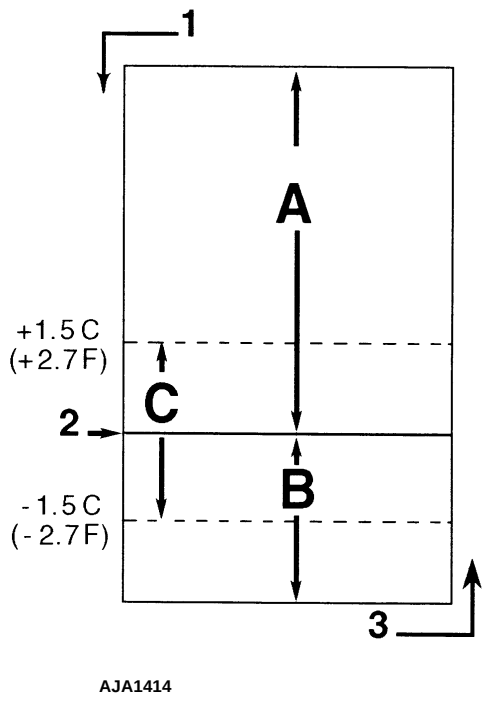
At setpoints of -9.9 C (14.1 F) and above, the controller operates the unit on:

- Cool mode with Modulation
- 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 cycles a single-speed condenser fan ON for 2 to 30 seconds every 30 seconds when the Condenser Fan switch is in the FAN AIR position. The amount of ON time depends on the condenser coil, ambient and compressor discharge temperatures.
- Power limit is active when the unit is operating in the Cool mode.

NOTE: When the Condenser Fan switch is in the WATER position, the condenser fan does not operate.

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 KVQ valve to regulate the flow of refrigerant to the compressor. The position of the 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.



A.	Cool with Modulation* (control temperature differential is above setpoint)
B.	Heat (electric heaters pulse ON and OFF on a 60 second duty cycle if the return air temperature decreases to 0.3 C [0.5 F] above setpoint; or the supply air temperature is too low)
C.	In-Range (bases on supply air temperature)
1.	Decreasing Temperature
2.	Setpoint
3.	Increasing Temperature
* If the compressor stops, it must remain OFF for a minimum of 5 minutes.	

Figure 14: Chill Load Sequence (Setpoints at -9.9C [14.1 F] and Above)

- 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 (see “Chill Loads” under General Theory of Operation in this chapter).
- Controller turns ON the Heat LED whenever the heaters are pulsed ON and OFF.

Heat

- If the supply air temperature is too low and the calculated KVQ valve setting is above the setpoint, the controller stops the compressor, de-energizes the liquid line solenoid and pulses the electric heaters ON for 2 to 60 seconds every 60 seconds to provide heat. The amount of ON time depends on the amount of heat required to gradually increase the supply air temperature to setpoint.

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 cycles a single-speed condenser fan ON for 2 to 30 seconds every 30 seconds when the Condenser Fan switch is in the FAN AIR position. The amount of ON time depends on the condenser coil, ambient and compressor discharge temperatures.
- 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).

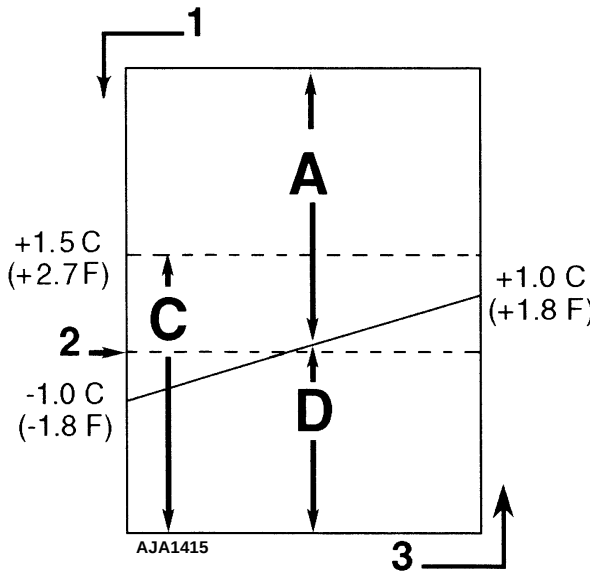
  NOTE: When the Condenser Fan switch is in the WATER position, the condenser fan does not operate.

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 the Return air temperature increases more than 1.0 C (1.8 F) above setpoint.
- Compressor must operate for a minimum of 5 minutes after startup.
- Controller turns ON the Compressor LED when the compressor is operating.
- 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 controller also de-energizes (closes) the liquid line solenoid valve.
- The evaporator fans continue to operate (except when Economy mode is ON).
- Compressor remains OFF for a minimum of 5 minutes.



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.

Figure 15: Frozen Load Control Sequence (Setpoints at -10C [14 F] and below)

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			
Cool w/Mod	**Heat**	**Defrost**	**Cool**	**Null**	**Defrost**	**Unit Function**
•	•					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
•			•			Liquid Line Solenoid Valve OPEN (energized)
•			•			Compressor Liquid Injection ON (valve energized)[2]
•			•			Condenser Fan ON [3]
•			•[4]			KVQ Valve MODULATING (energized)[4]
•	•	•			•	Electric Heaters PULSING or ON (energized)[5]

[1] Setpoint 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.

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

- Chill Mode: When the KVQ valve setting is less than 5 C (8.9 F) below the return air temperature, the controller energizes liquid injection valve for 6 seconds every 60 seconds regardless of the compressor discharge temperature.
- When the compressor discharge temperature is between 115 C and 125 C (239 F and 257 F): The controller pulses the valve open for 2 to 60 seconds every 60 seconds. The number of seconds the valve is energized depends on the discharge temperature and the KVQ valve setting.

[3]Condenser fan operation is determined by a control algorithm so ON/OFF operation cannot 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: Condenser fan operates continuously if the compressor or condenser temperature sensor is defective. When the Condenser Fan switch is in the WATER position, the condenser fan does not operate.

[4] KVQ valve MODULATES:

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

[5] Controller 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 60 second duty cycle.
- Heat mode (compressor OFF): If supply air temperature is tool low, the controller PULSES heaters ON and OFF on a 60 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.

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)[2]

[1] Economy 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.

[2] Dehumidification Option:

- When the humidity is more than 2% above humidity setpoint and the KVQ valve has reduced the unit cooling capacity by about 25%, the controller CLOSES (energizes) the dehumidify valve.
- When the humidity is more than 5% above humidity setpoint and the KVQ valve has reduced the unit cooling capacity by about 50% (40% at setpoint temperatures below 5 C [41 F], the controller also pulses the electric heaters ON and OFF.

[3] Humidification 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).

  - 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 and de-energizes the liquid line solenoid valve.
- 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 35 minutes.

  - Frozen mode: Evaporator coil sensor temperature reaches 18 C (65 F); or exceeds 8 C (46 F) for 35 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 and energizes the liquid line solenoid 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 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 Main Menu is divided into eight major menus:

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

Moving through these eight 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.

or

F2 or F3 key: Press the F3 key to enter the Main Menu. Then pressure 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 sub-menu; 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 min-utes. 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*
- CO_2 Maximum*

**** Denotes MP-3000a feature only. 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.***

Changing the Setpoint Temperature

See “Changing the Setpoint” in this chapter.

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 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.

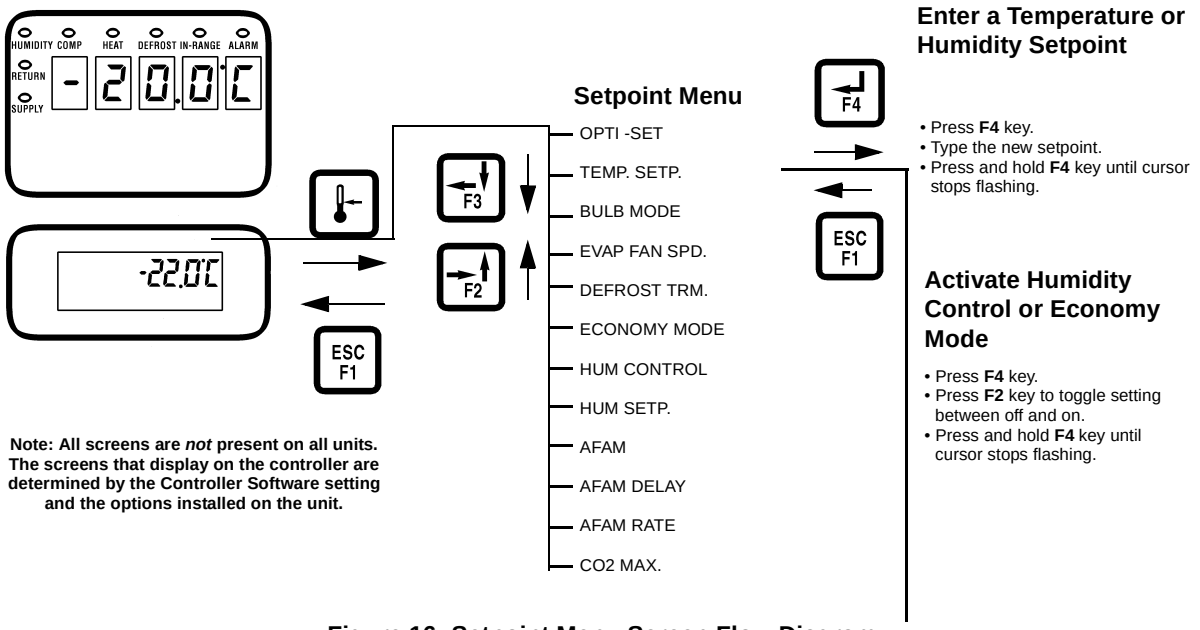


Figure 16: Setpoint Menu Screen Flow Diagram

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.

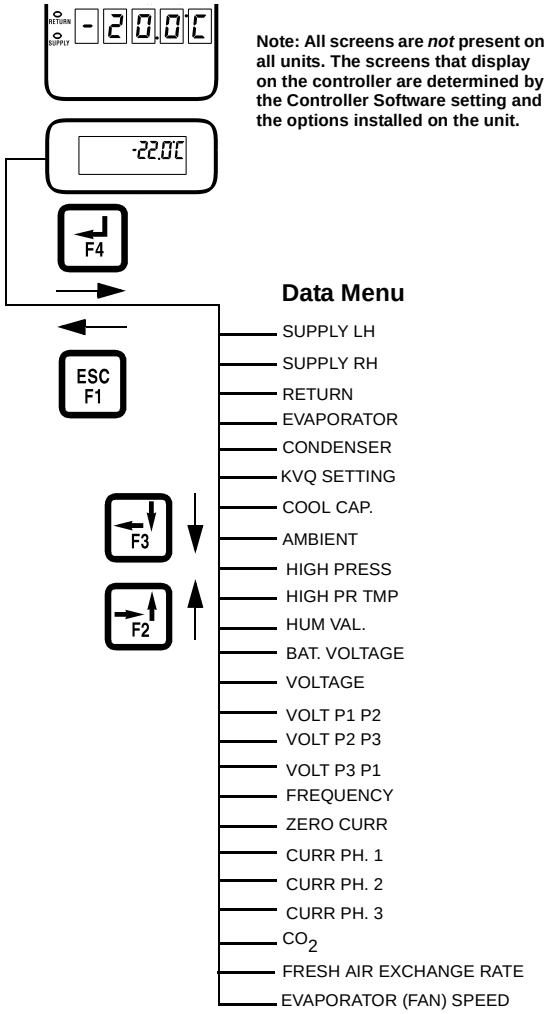
2. Press F3 to scroll the cursor down through the menu list. The Data menu displays the following functions:

- Supply Air Temperature, Left Hand
- Supply Air Temperature, Right Hand
- Return Air Temperature
- Evaporator Coil (Defrost) Temperature
- Condenser Coil Temperature
- KVQ Valve Setting
- Ambient Temperature
- High Pressure
- High Pressure Temperature (Compressor Discharge Line Temperature)
- Relative Humidity
- Battery Voltage
- Voltage Average (380/460V Power Supply)
- Voltage 1 (Main Power Supply) (P1-P2)
- Voltage 2 (Main Power Supply) (P2-P3)
- Voltage 3 (Main Power Supply) (P3-P1)
- Frequency (Main Power Supply)
- Zero Current
- Current Phase 1 (Main Power Supply)
- Current Phase 2 (Main Power Supply)
- Current Phase 3 (Main Power Supply)
- CO_2 *
- Fresh Air Exchange Rate*
- Evaporator Fan Speed*

**** Denotes MP-3000a feature only. 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.***

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.



Note: All screens are *not* present on all units. The screens that display on the controller are determined by the Controller Software setting and the options installed on the unit.

Figure 17: Data Menu Screen Flow Diagram

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 two 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.

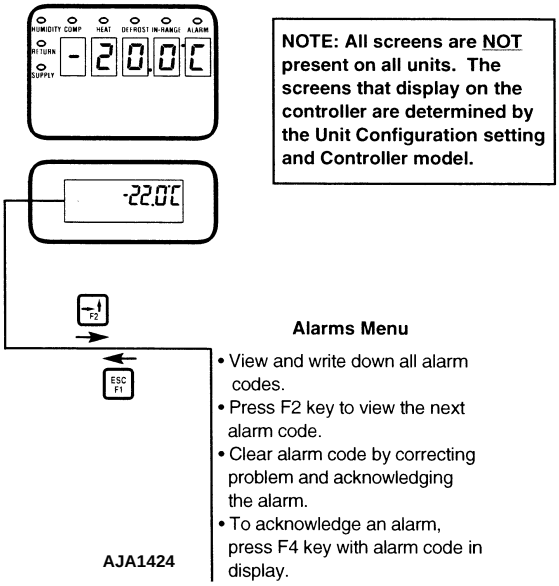


Figure 18: Alarms Menu Screen Flow Diagram

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 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 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 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 previous menu level or 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	Check	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
29	Check	Liquid Injection 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
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
69	Check	Gas Analyzer Calibration Error
97	Check	Compressor Sensor Open Circuit
98	Check	Compressor Sensor Short Circuit
99	Check	USDA 1 Sensor Open Circuit
112	Check	Zero Current Too High
115	Check	Probe Error Return & Evaporator
116	Check	Probe Error Return & Supply
117	Check	Probe Error Supply RH and Supply LH

Commands Menu

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

- 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 (Full Pre-Trip) Test: Controller automatically completes a test of individual components, checks unit refrigeration capacity, heating capacity and temperature control.“CRR Full Pretrip (PTI Test Procedure)” on page 79.

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

- Power Management: Sets the power limit and power limit activation (“On”) time.
- 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.
- Brief PTI (Brief Pretrip Test): Controller automatically completes a test of individual components, checks unit refrigeration capacity, heating capacity and temperature control. See “CRR Brief PreTrip (PTI Test Procedure)” on page 75. Also refer to Full PTI Test above.

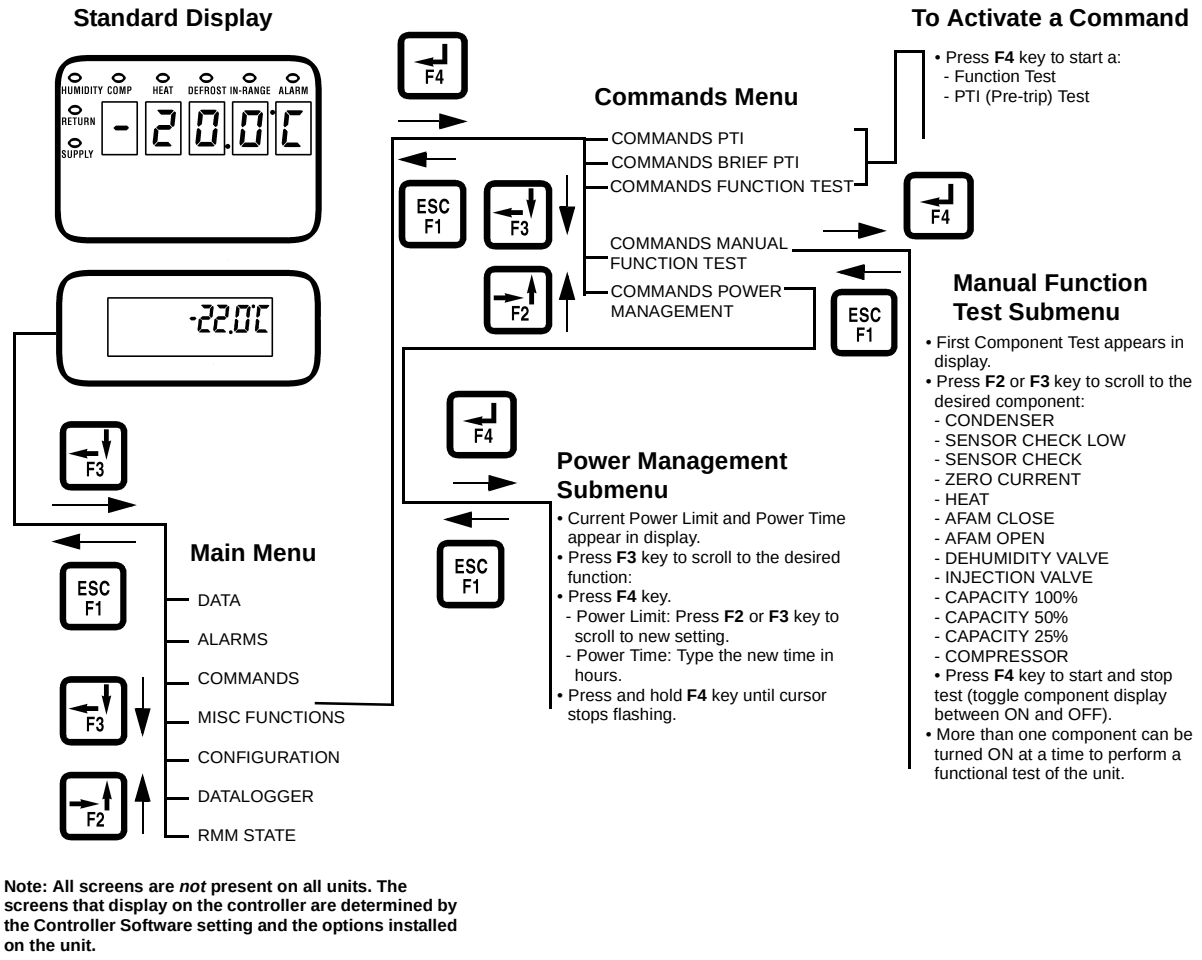


Figure 19: Commands Menu Screen Flow Diagram

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 (PTI Test) appears in the LCD display.
4. Press F2 or F3 key to scroll to the desired command:
   - PTI (Pretrip)
   - Power Management
   - Function Test
   - Manual Function Test
   - Brief PTI (Pre-Trip)
5. Press F4 key to activate the command selected.
   - 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.
   - 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.
   - Function Test: LCD display shows functional test currently being performed. Function test ends automatically. Unit automatically returns 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.Function Test: LCD display shows functional test currently being performed. Function test ends automatically. Unit automatically returns to normal operation.
   - Brief PTI (Pretrip): LCD display shows PTI Test currently being performed. Brief PTI test ends automatically. Press any key on the controller to return the unit to normal operation.

Brief Pretrip (PTI) Test

CAUTION: The Brief 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-3000a controller contains a special Brief 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 25 minutes to complete, depending on the container and ambient temperature.

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

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 appears in the LCD display.
3. Press F2 or F3 key to scroll to Brief PTI Test.
4. Press F4 key to start the Brief PTI Test. LCD display shows Brief PTI Test currently being performed. Brief PTI test ends automatically. Press any key on the controller to return the unit to normal operation.

See “CRR Brief Pretrip (PTI) Test Procedure” below for a detailed description of the Brief PTI Test. Detailed Brief PTI test results are stored in the MP-3000a 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.

CRR Brief PreTrip (PTI Test Procedure)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
Pb.00	Display Test Activated 0.1A 0.0A 0.1A	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
Pb.01	Sensor Test Activated 0.1A 0.0A 0.1A	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, 32, 33, 34, 35, 97, 98, 99, 109, 110, 112	10 Seconds
Pb.02	Heat Test Activated 5.2A 5.1A 5.2A	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
Pb.03	Defrost Activated 5.2A 5.1A 5.2A	If evaporator sensor is below +10 C (50 F), heat remains on until evaporator sensor reaches +18 C (65 F)	20	1 Hour Maximum
Pb.04	Evaporator Fan High Activated 2.4A 2.3A 2.4A	Condenser fan and compressor are turned Off. With evaporator fan on high speed, Amp draw is measured and compared to voltage and frequency: • CRR40 2.2 Amps approx. at 50 Hz, 2.6 Amps approx. at 60 Hz Evaporator fan high speed amperes are recorded in PTI log	12, 13	10 Seconds
Pb.05	Probe Test Activated	Evaporator fans operate on high speed for 3 minutes. Then probe test runs until temperature difference between sensor stops increasing. Maximum temperature difference allowed: • 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): 0.5C (0.9F)	52	3 Minutes Minimum to 13 Minutes Maximum
Pb.06	Condenser Fan Activated 0.8A 0.7A 0.8A	Condenser fan is turned ON. Amp draw is measured and compared to voltage and frequency: 0.8 Amps Maximum. Condenser fan amperes are recorded in PTI log.	16, 17	10 Seconds

CRR Brief PreTrip (PTI Test Procedure)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
Pb.07	Reverse Phase Activated	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
Pb.08	Compressor Activated 9.2A 9.1A 9.2A	With KVQ valve fully opened, condenser fan and compressor are turned ON. Amp draw is measured and compared to voltage. Evaporator temperature condenser coil temperature are measured and recorded in PTI log. If compressor has been OFF for last 18 hours (less than 30 seconds ON), a compressor sequence start occurs.	06, 07	14 Seconds
Pb.09	Compressor High Pressure Activated 15.2A 15.0A 15.2A	KVQ valve is fully opened. 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
Pb.09	Compressor High Pressure Activated 4.5A 4.4A 4.5A	With condenser fan off, compressor fan starts and operates. Compressor stops. Condenser fan operates 60 seconds more to lower condenser temperature.	54	60 Seconds plus 10 Seconds
Pb.10	Evaporator Fan Low Activated 1.1A 1.0A 1.1A	Condenser fan and compressor are turned OFF. With evaporator fan on low speed, Amp draw is measured and compared to voltage and frequency: • CRR40: 1.0 Amps approx. at 50 Hz., 1.0 Amps approx. at 60 Hz.	14, 15	10 Seconds
Pb.11	Capacity Test 1 Activated 13.1A 13.0A 13.1A	If return air sensor is above 20 C 968 F), unit precools return air temperature to 15 C (59 F). KVQ valve is fully open, condenser fan ON, compressor ON, and evaporator fans are on low speed. A difference of approx. 3.5 C (5.4 F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures.	22	3 Minutes (4 Minutes on CRR20) Precool if Required
Pb.12	Capacity Test 2 Activated 15.2A 15.0A 15.2A	With condenser fan ON, compressor ON and KVQ valve fully open, 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 P1.11	23	2 Minutes

CRR Brief PreTrip (PTI Test Procedure)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
Pb.13	Capacity Test 3 Activated 10.2A 10.1A 10.2A	KVQ valve is almost closed (set to -3 C). With condenser fan ON, compressor ON and evaporator fans on high speed; alarm is recorded if temperature difference exceeds: • CRR40: 1.5 C (2.7 F) • CRR20: 3.0 (5.4 F) • CRR40SL: 3.0 C (5.4 F)	24	4 Minutes (5 Minutes on CRR20)
Pb.14	Heat Test Activated 7.9A 7.9A 7.9A	With heaters ON and evaporator fans on high speed, alarm is recorded if supply temperature is not at least 0.4 C (0.7F) above the return air temperature.	27	4 Minutes
Pb.15	Evaporator Temperature Test Activated	KVQ valve is fully opened. With condenser fan ON and compressor ON, evaporator fans are turned OFF. The evaporator coil temperature must decrease to approx. -15 C 9+5 F), depending on the return air temperature.	25	5 minutes Maximum
Pb.15	Evaporator Temperature Test Activated 3.2A 3.1A 3.2A	“PT1 Part 1 End” is recorded in PTI log. Return/supply air temperature difference from tests P1.11, P1.12, P1.13 and P1.14 are recorded in PTI log. Condenser fan and compressor stop. Evaporator fans start and operate on high speed.	None	5 Minutes
Pb.15	Evaporator Temperature Test Activated 7.9A 7.9A 7.9A	If return air temperature is below 5C (41F), evaporator fans operate on high speed and heaters turn ON. Unit operates until return air temperature is above 5C (41F).	None	120 Minutes Maximum
Return Temp.	PTI PASS: Press (any) Key	If alarms (errors) occurred during PTI test, LCD display shows PTI FAIL. Press any key to clear display. Unit will remain OFF unit any key is pressed again.	None	-

Full Pretrip (PTI) Test

CAUTION: The Full 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-3000a controller contains a special Full 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 Full PTI test. The controller will automatically clear all existing alarms before beginning the Full PTI test.

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 appears in the LCD display.
3. Press F2 or F3 key to scroll to PTI Test.
4. Press F4 key to start the Full PTI 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.

See “CRR Full Pretrip (PTI) Test Procedure” below for a detailed description of the Full PTI Test. Detailed Full PTI test results are stored in the MP-3000a 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.

CRR Full 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 0.1A 0.0A 0.1A	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 0.1A 0.0A 0.1A	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, 32, 33, 34, 35, 97, 98, 99, 109, 110, 112	10 Seconds
P1.02	Heat Test Activated 5.2A 5.1A 5.2A	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 5.2A 5.1A 5.2A	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	Evaporator Fan High Activated 2.4A 2.3A 2.4A	Condenser fan and compressor are turned Off. With evaporator fan on high speed, Amp draw is measured and compared to voltage and frequency: • CRR40 2.2 Amps approx. at 50 Hz, 2.6 Amps approx. at 60 Hz Evaporator fan high speed amperes are recorded in PTI log	12, 13	10 Seconds
P1.05	Probe Test Activated	Evaporator fans operate on high speed for 3 minutes. Then probe test runs until temperature difference between sensor stops increasing. Maximum temperature difference allowed: • 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): 0.5C (0.9F)	52	3 Minutes Minimum to 13 Minutes Maximum
P1.06	Condenser Fan Activated 0.8A 0.7A 0.8A	Condenser fan is turned ON. Amp draw is measured and compared to voltage and frequency: 0.8 Amps Maximum. Condenser fan amperes are recorded in PTI log.	16, 17	10 Seconds

CRR Full Pretrip (PTI Test Procedure)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.07	Reverse Phase Activated	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
P1.08	Compressor Test Activated 9.2A 9.1A 9.2A	With KVQ valve fully opened, condenser fan and compressor are turned ON. Amp draw is measured and compared to voltage. Evaporator temperature condenser coil temperature are measured and recorded in PTI log. If compressor has been OFF for last 18 hours (less than 30 seconds ON), a compressor sequence start occurs.	06, 07	14 Seconds
P1.09	Compressor High Pressure Activated 15.2A 15.0A 15.2A	KVQ valve is fully opened. 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
P1.09	Compressor High Pressure Activated 4.5A 4.4A 4.5A	With condenser fan off, compressor starts and operates. Compressor stops. Condenser fan operates 60 seconds more to lower condenser temperature.	54	60 Seconds plus 10 Seconds
P1.10	Evaporator Fan Low Activated 1.1A 1.0A 1.1A	Condenser fan and compressor are turned OFF. With evaporator fan on low speed, Amp draw is measured and compared to voltage and frequency: • CRR40: 1.0 Amps approx. at 50 Hz., 1.0 Amps approx. at 60 Hz.	14, 15	10 Seconds
P1.11	Capacity Test 1 Activated 13.1A 13.0A 13.1A	If return air sensor is above 20 C 968 F), unit precools return air temperature to 15 C (59 F). KVQ valve is fully open, condenser fan ON, compressor ON, and evaporator fans are on low speed. A difference of approx. 3.6 C (5.4 F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures.	22	3 Minutes (4 Minutes on CRR20) Precool if Required
P1.12	Capacity Test 2 Activated 15.2A 15.0A 15.2A	With condenser fan ON, compressor ON and KVQ valve fully open, 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 P1.11	23	2 Minutes

CRR Full Pretrip (PTI Test Procedure)

P1.13	Capacity Test 3 Activated 10.2A 10.1A 10.2A	KVQ valve is almost closed (set to -3 C). With condenser fan ON, compressor ON and evaporator fans on high speed; alarm is recorded if temperature difference exceeds: • CRR40: 1.5 C (2.7 F) • CRR20: 3.0 (5.4 F) • CRR40SL: 3.0 C (5.4 F)	24	4 Minutes (5 Minutes on CRR20)
P1.14	Heat Test Activated 7.9A 7.9A 7.9A	With heaters ON and evaporator fans on high speed, alarm is recorded if supply temperature is not at least 0.4 C (0.7F) above the return air temperature.	27	4 Minutes
P1.15	Evaporator Temperature Test Activated	KVQ valve is fully opened. With condenser fan ON and compressor ON, evaporator fans are turned OFF. The evaporator coil temperature must decrease to approx. -15 C 9+5 F), depending on the return air temperature.	25	5 minutes Maximum
P1.15	Evaporator Temperature Test Activated 3.2A 3.1A 3.2A	“PT1 Part 1 End” is recorded in PTI log. Return/supply air temperature difference from tests P1.11, P1.12, P1.13 and P1.14 are recorded in PTI log. Condenser fan and compressor stop. Evaporator fans start and operate on high speed.	None	5 Minutes
P1.15	Evaporator Temperature Test Activated 7.9A 7.9A 7.9A	If return air temperature is below 5C (41F), evaporator fans operate on high speed and heaters turn ON. Unit operates until return air temperature is above 5C (41F).	None	120 Minutes Maximum
Supply Temp.	Running PTI Setpoint: 0C (32F)	Unit operates in normal cool mode with 0C (32F) setpoint. When supply air temperature decreases to setpoint, “Chill Arrival” temperatures are recorded in PTI log.	23	120 Minutes Maximum
Supply Temp.	Running PTI Setpoint: 0C (32F)	Unit operates in normal mode with 0C (32F) 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 4.5A 4.4A 4.5A	Defrost is initiated. Defrost terminates when evaporator temperature increases to 18C (65F).	20	90 Minutes Maximum
Return Temp.	PTI Running Setpoint: -18C (0F)	Unit operates in normal mode with -18C (0F) setpoint. When return air temperature decreases to setpoint, “Frozen Arrival” temperatures are recorded in PTI log. 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. “PTI End” is recorded in the PTI log. A Trip Start is automatically activated. Current load port, discharge port, comment and USDA entries are cleared from controller memory. Alarms (if any) are cleared from data logger. However, alarms (if any) remain in alarm list as not active until acknowledged.	22, 60	180 Minutes Maximum
Return Temp.	PTI PASS: Press (any) Key	If alarms (errors) occurred during PTI test, LCD display shows PTI FAIL. Press any key to clear display. Unit will remain OFF unit any key is pressed again.	None	-

Function Test

The MP-3000a 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.

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.

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 appears in the LCD display.
3. Press F2 or F3 key to scroll to Function Test.
4. Press F4 key to start the Function Test. LCD display shows functional test currently being performed. Function test ends automatically. Unit automatically returns to normal operation. See “CRR Function Test” on page 82.

CRR Function Test

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 0.1A 0.0A0.1A	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 0.1A 0.0A 0.1A	All Sensors must have values within their measuring range.	00 01, 02, 03, 04, 05, 32, 33, 34, 35, 97, 98, 109, 110, 112	2 Seconds
F1.02	Evaporator Fan Low Activated 1.1A 1.0A 1.1A	Amp draw is measured and compared to voltage and frequency. CRR40 1.0 Amps approx. at 50 Hz 1.0 Amps approx. at 60 Hz	14, 15	10 Seconds
F1.03	Evaporator Fan High Activated 2.4A 2.3A 2.4A	Amp draw is measured and compared to voltage and frequency CRR40 2.1 Amps approx. at 50 Hz 2.5 Amps approx. at 60 Hz	12, 13	10 Seconds
F1.04	Condenser Fan Activated 0.8A 0.7A 0.8A	Amp draw is measured and compared to voltage and frequency: 0.8 Amps.	16, 17	10 Seconds
F1.05	Reverse Phase Activated 08.A 0.7A 0.8A	Condenser fans 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

CRR Function Test

F1.06	Compressor Test Activated 9.2A 9.1A 9.2A	With condenser fan ON and compressor ON, Amp draw is measured and compared to voltage. Evaporator temperature and condenser coil temperature are measured and stored. If compressor has been OFF for last 18 hours (less than 30 seconds ON), a compressor sequence start occurs.	06, 07	14 Seconds
F1.07	Heat Test Activated 5.2A 5.1A 5.2A	Amp draw is measured and compared to voltage: 4.4 Amps approx. at 400V 5.1 Amps approx. at 460V	10, 11	10 Seconds
F1.08	Injection Valve Test Activated 0.1A 0.0A 0.1A	Liquid Injection valve is turned ON for 2 seconds, OFF for 2 seconds and ON for 2 seconds to verify valve operation	None	6 Seconds
F1.09	Humidify Valve Test Activated 0.1A 0.0A 0.1A	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

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
      - Sensor Check Low
      - Sensor Check
      - Zero Current
      - Heat
      - AFAM Close
      - AFAM Open
      - Dehumidity Valve (pre 2002)
      - Injection Valve
      - Capacity 100%
      - Capacity 50%
      - Capacity 25%
      - Compressor

- 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.

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. 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. 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.

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

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.

Cargo Data: Sets important trip information about the container and the load in the controller.

C/F Mode: Sets the temperature value (Celsius or Fahrenheit) the controller uses to record and display temperature (including historical data).

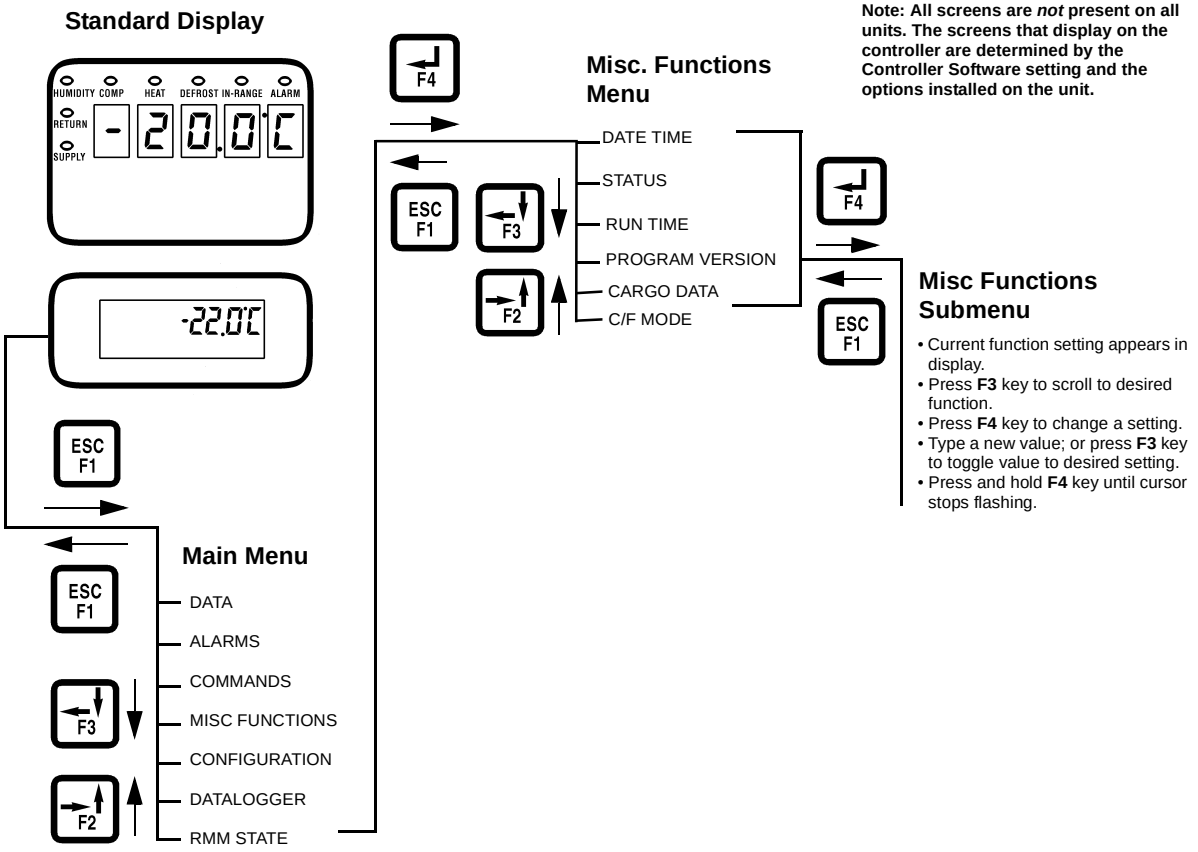


Figure 20: Misc. Functions Menu Screen Flow Diagram

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
   - Run Time
   - Program Version
   - Cargo Data
   - C/F Mode
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.
5. 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.
6. 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.
7. 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.
8. Press F4 key with cursor in Date menu line. An Enter Arrow appears in the menu line and the previous date disappears.
9. 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.
10. 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.
11. Press ESC key to exit the Date Time 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.

Setting Cargo Data

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 “CARGO DATA”.
3. Press F4 key to access the Cargo Data screen. Cargo Data screen appears with cursor in LOC. BRT menu line.
4. 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.

Changing the Temperature Display Value (C/F)

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 “C/F MODE”.
3. 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.
4. To change the temperature value, press F4 key. Cursor moves to end of menu line and flashes.

5. Press F2 key to toggle temperature value in the menu line between C and F.
6. 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.
7. Press ESC key to exit the C/F Mode 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 power up, the controller turns the Auto Configuration feature Off. See "Automatic Configuration of Spare Parts 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 Container ID menu line.
4. Press F3 key to scroll cursor to view or reset the desired function:
   - Container ID: Sets the container identification number. Enter up to 11 characters (numbers or letters).
   - 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).
   - 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.

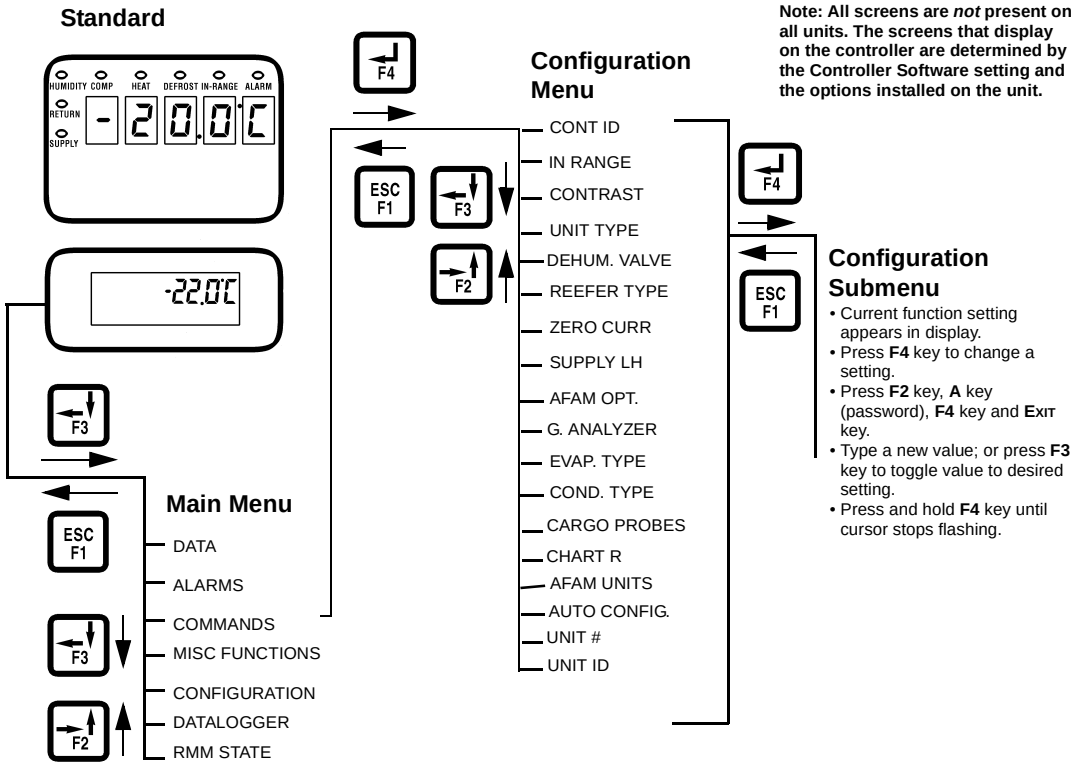


Figure 21: Configuration Menu Screen Flow Diagram

- 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).
- Unit Type: 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 CSR20SL 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.
- Evaporator Type: Sets the evaporator fan value to 2 fan or 3 fan. Must be manually set.
- Condenser Type: Sets the condenser fan value to 1/2 HP, 2 HP or 3/4 HP. Must be manually set.
- USDA Type: Sets the controller for 3THERM, PT100 or 4THERM type USDA sensors. Must be manually set to activate USDA data logging with NTC (3THERM or 4THERM) type sensors.
- Chart R: Shows: Not Present, -20 F & 80 F 31 day, -30 C to +25 C 31 day, -25 C to 25 C 31 day.
- Auto Configuration; View display on or off value 9factory 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.
- Unit #: Sets the unit serial number. Enter up to 11 characters (number or letters). Serial number must be manually set. Serial number is required to enable automatic detection of PT100 type USDA sensors on units with serial numbers beginning with MAE, MSF, or MWC prefix.
- Unit ID: An 11 digit alpha-numeric container number.

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 the F4 key and release. Press the exit key. 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 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 Trip start: 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

   - PTI State

   - 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 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. “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.

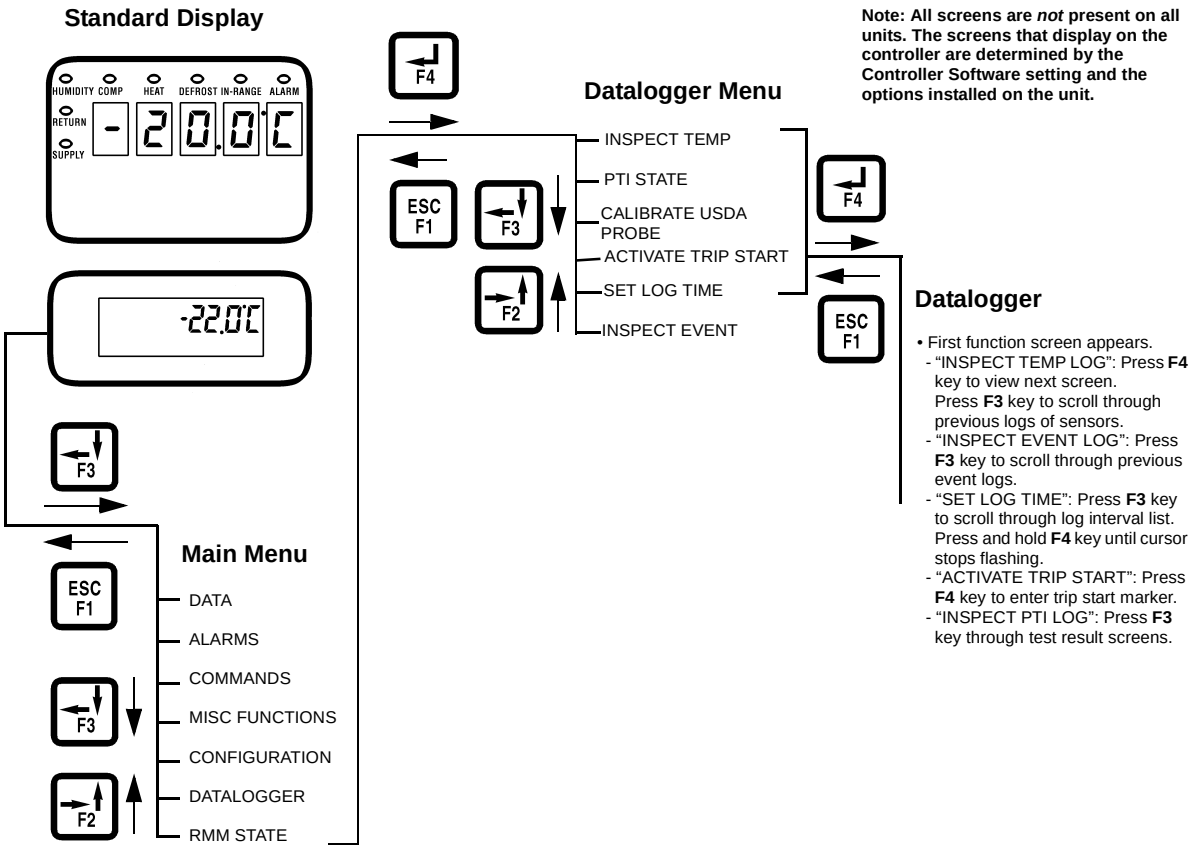


Figure 22: Datalogger Menu Screen Flow Diagram

- 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 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. “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.
6. Press ESC key to exit the Event Log.

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)

Set Log Time

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. “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 data-logger 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 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. “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 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. “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.

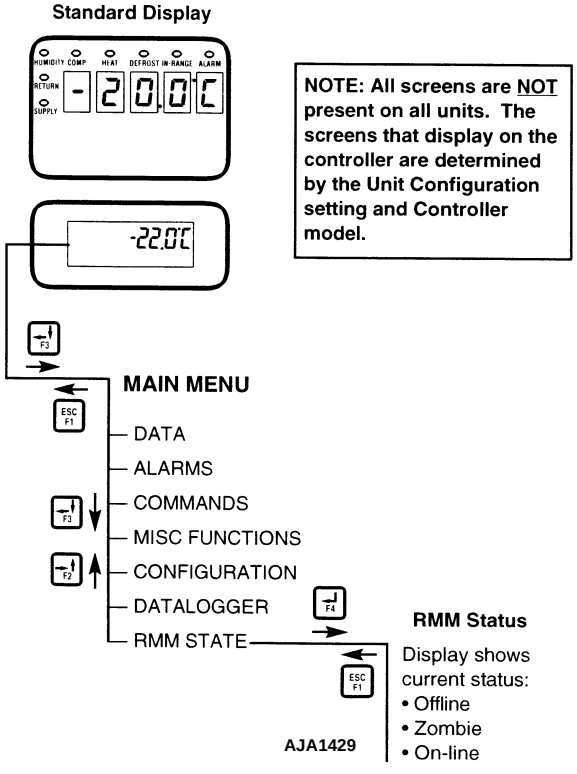


Figure 23: RMM State Menu Screen Flow Diagram

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.

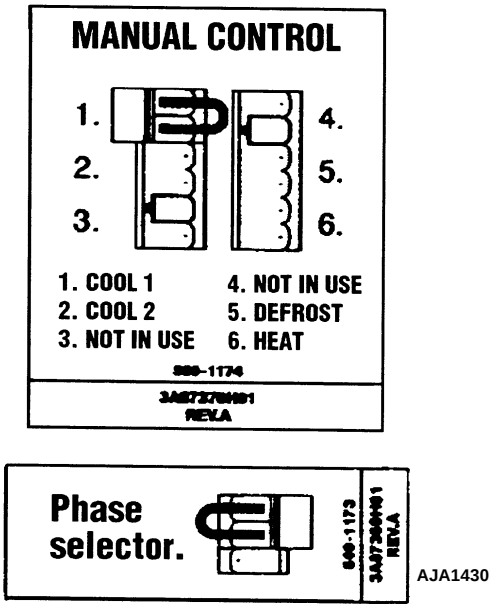


Figure 24: Manual Emergency Control Connections

- 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 the 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 back-wards, 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.
   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 carefully 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 lap-top 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 power up, 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.

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.

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.
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 setpoint setting, or erase data log currently stored in the controller.

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 Temperature
- Ambient Air

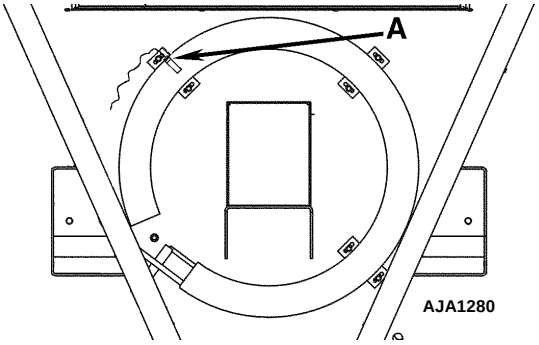
CAUTION: Sensors are permanently calibrated and can be checked using an ohmmeter. Ohm readings should agree with data shown in Sensor Resistance Tables.

- 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 installs in the sensor tube next to the control box.
- Return air sensor installs in a grommet between the evaporator fans.

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

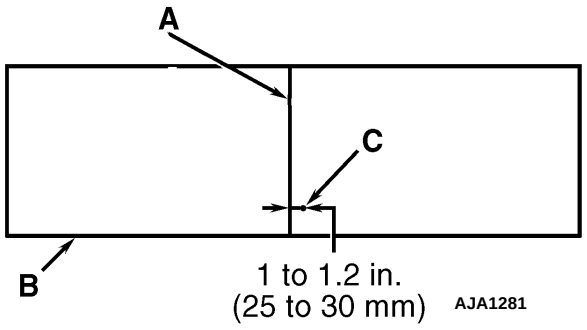
Resistance Values for Compressor Discharge Line Sensor					
Temp. °F	Temp. °C	OHMS	Temp. °F	Temp. °C	OHMS
32	0	351017	158	70	15502
35.6	2	315288	161.6	72	14410
39.2	4	283558	165.2	74	13405
42.8	6	255337	168.8	76	12479
46.4	8	230210	172.4	78	11625
50	10	207807	176	80	10837
53.6	12	187803	179.6	82	10110
57.2	14	169924	183.2	84	9438
60.8	16	153923	186.8	86	8817
64.4	18	139588	190.4	88	8242
68	20	126729	194	90	7710
71.6	22	115179	197.6	92	7216
75.2	24	104796	201.2	94	6759
78.8	26	95449	204.8	96	6335
82.4	28	87023	208.4	98	5941
86	30	79428	212	100	5574
89.6	32	72567	215.6	102	5234
93.2	34	66365	219.2	104	4917
96.8	36	60752	222.8	106	4623
100.4	38	55668	226.4	108	4348
104	40	51058	230	110	4092
107.6	42	46873	233.6	112	3854
111.2	44	43071	237.2	114	3631
114.8	46	39613	240.8	116	3423
118.4	48	36465	244.4	118	3229
122	50	33598	248	120	3047
125.6	52	30983	251.6	122	2877
129.2	54	28595	255.5	124	2718
132.8	56	26413	258.8	126	2569
136.4	58	24419	262.4	128	2430
140	60	22593	266	130	2299
143.6	62	20921	269.6	132	2176
147.2	64	19388	273.2	134	2118
150.8	66	17961	276.8	136	1953
154.4	68	16689	280.4	138	1852



A.	Insert Sensor into condenser coil between tube rows 1 and 2

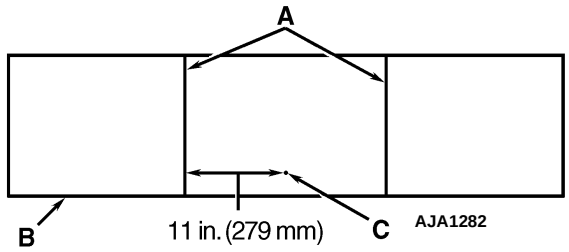
Figure 25: Condenser Coil Sensor Location

- 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.



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

Figure 26: 2-Fan Evaporator: Evaporator (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

Figure 27: Evaporator (Defrost) Sensor Location

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. Pressure 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.

Status Messages and Controller Actions

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

Status Messages and Controller Actions

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

Message No.	Status Message	Controller Action
1	**Power Error, Check 20A Fuses** Indicates: • One or more phases are missing • Compressor is able to draw amps on all phases while heater lacks amps on one or more phases.	• Controller activates Alarm 18 • Controller will try to restart unit after 60 minutes.
2	**High Pressure Cutout, Check Water Cooling** Indicates: • Unit stops due to high pressure cutout and condenser fan switch is in WATER position	• 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: • Incorrect temperature difference between Supply-LH, Supply-RH, or Return air sensor for 10 minutes with evaporator fan amps ok.	• 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: • Controller disables sensor due to open or short circuit or sensor failed a Probe Test.	• 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: • Controller disables sensor due to open or short circuit or sensor failed a Probe Test.	• 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.
6	**KVQ Valve Found, Please Change Type** Indicates • 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. One Moduload units, KVQ sensor input must be left open.

Code	Description	Corrective Action
7	**High Pressure Cutout, Check Condenser Probe** Indicates: • 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.	• 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: • Temperature difference between the left hand and right hand Supply sensor 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.	• Controller clears message during defrost and when Unit On/Off switch is turned OFF.
9	**High Pressure Cutout, Check Condenser Fan** Indicates: • Unit stops due to high pressure cutout, condenser fan switch is in FAN AIR position and condenser temperature is high	• 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).

21	**Total Current Too High (Alarm)**
	• Unit or component current draw is 25% above expected amps for 4 minutes.
	• Indicates:
	  • KVQ 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.
		• 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.

Code	Description	Corrective Action

22	**Total Current Too Low (Alarm)**
	• Compressor Start-up: unit or component current draw is 50% below expected amps for 4 minutes.
	• Indicates:
	  • 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 locations
		• 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.

23	**Supply Air Temperature Too High (Check Alarm)**
	• During Chill or Frozen Mode: Supply air temperature is too high compared to return air temperature under operating conditions.
	• Indicates:
	  • 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
		• Check discharge an suction pressure gauge readings and refrigerant charge.
		• 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

24	**Evaporator Coil Temperature Too High (Check Alarm)**
	• During Chill or Frozen Mode: Evaporator coil temperature is too high compared to return air temperature under operating conditions.
	• Indicates:
	  • Low refrigerant charge.
	  • Defective evaporator coil or return air sensor
	  • incorrect connection or location of evaporator coil or return air sensor
		• Check for sensor alarm codes.
		• Check discharge and suction pressure gauge readings and check refrigerant charge.
		• Check evaporator coil and return air sensor connections and locations.

25	**Return Air Temperature Too High (Check Alarm)** • During Defrost: Return air temperature increases above 40 C (104 F). • Indicates: -Defective return or evaporator coil sensor -Return and evaporator coil sensor connections are reversed	• Check for sensor alarm codes. • Check supply and return sensor connections and locations.

26	**Evaporator Coil Temperature Too Low (Check Alarm)**
	• During Chill or Frozen Mode: Evaporator coil temperature is tool low compared to return air temperature under actual operating conditions.
	• Controller initiates defrost if not recent defrost.
	• Indicates:
	  • Air flow 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
		• 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 flow and cargo load. Remove any debris or cargo from blocking return air grille.
		• At setpoints below 5 C (41 F0, maximum air vent setting is not allowed.
		• Check evaporator coil and return air sensor connections and locations.

Alarm Codes, Descriptions and Corrective Actions

NOTE: Sensors used with the 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)**
	• Sensor circuit resistance higher than 100,000 ohms.
	• Temperature below -70C (-94F)
	• Indicates:
	  • 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
		• 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 25C (77F).
		• Check cable No.1 and cable No.3 between the controller and relay board.
		• Check evaporator air flow.

01	**Supply Air Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance lower than 200 ohms.
	• Temperature below 80C (176 F).
	• Indicates:
	  • 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
		• 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 25C (77F).
		• Check cable No.1 and cable No.3 between the controller and relay board.

02	**Return Air Sensor Open Circuit (Check Alarm)**
	• Sensor circuit resistance higher than 100,000 ohms.
	• Temperature below -70C (-94F).
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No.1
	  • Defective controller
		• Check sensor resistance between pins 3 and 4 on plug j15. Resistance must be 2,000 ohms at 25C (77F)
		• Check cable No.1 between controller and relay board.

Code	Description	Corrective Action

03	**Return Air Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance lower than 200 ohms.
	• Temperature above 80C (176F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No.1
	  • Defective controller
		• Check sensor resistance between pins 3and 4 on plug J15. Resistance must be 2,000 ohms at 25C (77F).
		• Check cable No.1 between controller and relay board.

04	**Evaporator Coil Sensor Open Circuit (Check Alarm)**
	• Sensor circuit resistance higher than 100,000 ohms.
	• Temperature below -70C (-94F).
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No.1
	  • Defective controller
	  • Low evaporator coil temperature
		• Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25C (77F).
		• Check cable No.1 between controller and relay board.
		• Check evaporator air flow.

05	**Evaporator Coil Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance lower than 200 ohms.
	• Temperature above 80C (176F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25C (77F).
		• Check cable No.1 between controller and relay board.

Code	Description	Corrective Action

06*	**Compressor Current Too High (Check Alarm**
	• 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:
	  • Defective KVQ 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
		• Check evaporator, condenser and ambient sensor temperatures for correct value (+/-C [+/-9F] 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*	**Compressor Current Too Low (Check Alarm)**
	• Occurs during Pretrip (PTI) or Function test only.
	• Compressor power consumption is 25% below expected current draw (below approximately 9 amps).
	• Indicates:
	  • 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
		• 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 discharge and suction pressure gauge readings. Evaluate readings based on current cargo and ambient temperatures.
		• Check volt and ampere meter.
		• Check power supply volts.

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.		

10*	**Heater Current Too High (Check Alarm)**
	• Occurs during Pretrip (PTI) or Function Test.
	• Heater power consumption is 25% above expected current draw (above approximately 4.4 amps and 5.1 amps, depending on voltage).
	• Indicates:
	  • Incorrect heaters or heater connections
	  • Defective volt or amp meter on relay board
	  • Defective heater element
		• 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.

Code	Description	Corrective Action

11*	**Heater Current Too Low (Check Alarm)**
	• 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:
	  • Defective high evaporator temperature switch
	  • Defective heater element or heat relay
	  • Defective wire connection
	  • Incorrect heaters or heater connections
		• 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 54c (130F); 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)**
	• Occurs during Pretrip (PTI) or Function test only.
	• Evaporator fan power consumption is 25% above expected current draw (above 2.0 to 3.0 amps, depending on voltage)
	• Indicates:
	  • Defective or stuck evaporator fan motor
	  • Incorrect motor or motor connections
	  • Defective volt or amp meter on relay board
		• 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 measurement. 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***		

13**	**Evaporator Fan high Speed Current Too Low (Check Alarm)**
	• Occurs during Pretrip (PTI), Function test or Probe test.
	• Evaporator fan power consumption is 25% below expected current draw (below 1.5 to 2.3 amps, depending on voltage).
	• Indicates:
	  • 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
		• 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.

Code	Description	Corrective Action

14**	**Evaporator Fan Low Speed Current Too High (Check Alarm)**
	• 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:
	  • 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
		• 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)**
	• 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:
	  • 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
		• 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.		

16*	**Condenser Fan Current Too High (Check Alarm)**
	• 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:
	  • Defective or stuck condenser fan motor
	  • Defective volt or amp meter on relay board
	  • Incorrect motor or motor connections
		• 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 volts and ampere meter.

Code	Description	Corrective Action

17*	**Condenser Fan Current Too Low (Check Alarm)**
	• 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:
	  • Defective condenser fan motor relay
	  • Defective or open fan motor internal over temperature protection switch
	  • Defective volt or amp meter on relay board.
		• 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 (Alarm)**
	• One or more frequency inputs are missing for more than 20 seconds.
	• Indicates:
	  • One phase on power line is missing
	  • Defective fuse on relay board
	  • Defective digital inputs on relay board
	  • Defective controller
		• 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 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).		

19	**Temperature Too Far from Setpoint (Check Alarm)**
	• After 75 minutes of operation, supply or return air temperature is not in-range and does not approach setpoint within preset pulldown rate.
	• Indicates:
	  • Ice or frost on evaporator coil
	  • Low refrigerant charge
	  • Air exchange vent open too much
	  • Container air leakage (doors open)
		• 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 rice or frost and initiate manual defrost if necessary.
		• Check refrigerant charge
		NOTE: This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.

Code	Description	Corrective Action

20	**Defrost Time Too Long (Check Alarm)**
	• Heat signal has been ON for more than 90 minutes on 60 Hz power during Defrost (120 minutes on 50 Hz power).
	• Indicates:
	  • 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
		• 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.
		NOTE: This alarm can be activated at low voltage and very low box temperature conditions, even under normal operating conditions.

22	**Capacity Test 1 Error (Check Alarm)**
	• Occurs during Pretrip (PTI) test only.
	• Difference between supply and return air temperature is too small with low speed evaporator fans (less than approximately 4.5C [8 F])
	• Return air temperature does not reach -18C (0 F) within preset time.
	• Indicates:
	  • 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
		• 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 discharge and suction pressure readings. Also check the refrigerant charge.
		NOTE: This alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.

Code	Description	Corrective Action

23	**Capacity Test 2 Error (Check Alarm)**
	• 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:
	  • 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
		• 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).
		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.
		• 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 discharge and suction pressure readings. Also check the refrigerant charge.
		NOTE: Alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.

24	**Capacity Test 3 Error (Check Alarm)**
	• Occurs during Pretrip (PTI) test only.
	• Difference between supply and return air temperature is too high with KVQ valve almost closed and high speed evaporator fans (more than 1.5 C [2.7 F]).
	• Indicates:
	  • Defective KVQ valve
	  • Two gaskets (or thick gasket) in KVQ valve actuator
	  • 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.
		• Enter Manual Function Test and start the following components: Condenser fan, evaporator fan (high), compressor and compressor 25%. Check to be sure the KVQ valve closes (suction pressure below 0 kPa, 0 bar, 0 psig).
		• Check the supply and return air sensor connections.
		• Check the supply and return air sensor calibration.
		• Check expansion valve superheat setting.

Code	Description	Corrective Action

25	**Evaporator Temperature Test Error (Check Alarm)**
	• Occurs during Pretrip (PTI) test only.
	• Evaporator coil temperature too high with no evaporator fans running (above about -15 C [+5 F]).
	• Indicates
	  • 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.
		• Check evaporator coil sensor location.
		• Check evaporator coil sensor and return air sensor connections.
		• Check expansion valve superheat setting.

27	**Heat Capacity Test Error (Check Alarm)**
	• 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 [0.7F]}.
	• Indicates:
	  • 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
		• Enter Manual Function Test and start evaporator fans on HIGH speed. Then select Sensor Checks test and operates 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 high speed.
		• Check the sensor connections.

32	**Condenser Temperature Sensor Open Circuit (Check Alarm)**
	• Sensor circuit resistance higher than 100,000 ohms.
	• Temperature below -70 C (-94 F).
	• Indicates
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable no.1
	  • Defective controller
		• 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	**Ambient Air Sensor Open Circuit (Check Alarm)**
	• Sensor circuit resistance higher than 100,000 ohms.
	• Temperatures below -70 C(-94 F).
	• Indicates:
	  • Sensor circuit resistance lower than 200 ohms.
	  • Temperature above 80 C (176 F).
	  • Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• 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.

34	**Ambient Air Sensor Open Circuit (Check Alarm)** • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -70 C (-94 F). • Indicates: -Open circuit to sensor -Defective or wrong sensor -Defective relay board -Defective cable No.1 -Defective controller	• 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)** • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C(176 F). • Indicates: -Short circuit to sensor -Defective or wrong sensor -Defective relay board -Defective cable No.1 -Defective controller	• Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).

Code	Description	Corrective Action

52	**Probe Error (Check Alarm)**
	• 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 RD supply sensors is too high (0.5 C [1.0 F] difference maximum)
	• Indicates:
	  • Incorrect temperature reading on one sensor
	  • Supply air sensor not placed in air flow stream
		• 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.

NOTE: Code 52 has been replaced by codes 115, 116, 117 in the current revision of the controller software. If code 52 appears on the controller screen, the controller software is not current and needs to be updated.		

53	**High Pressure Cutout Switch Off Error (Check Alarm)**
	• Occurs during Pretrip (PTI) test only.
	• Compressor does not stop during high pressure cutout switch test.
	• Indicates:
	  • 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
		• Check discharge and suction pressure gauge readings and check refrigerant charge.
		• 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 at 2250 kPa, 22.5 bar, 326 psig (high pressure cutout switch opens).

54	**High Pressure Cutout Switch On Error (Check Alarm)** • Occurs during Pretrip (PTI) test only. • Compressor does not start within normal time during high pressure cutout switch test. • Indicates: -High pressure cutout switch did not respond to pressure change within 5 seconds -Air in refrigeration system -Defective high pressure cutout switch	• Check discharge and suction pressure gauge readings. • 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 at 2250 kPa, 22.5 bar, 326 psig (high pressure cutout switch opens). Then start condenser fan. Discharge pressure must drop quickly (10 to 20 seconds) to 1550 kPa, 15.5 bar, 225 psig and compressor should start (switch closes).

Code	Description	Corrective Action

56	**Compressor Temperature Too High (Shutdown Alarm)**
	• Compressor dischage line temperature is above 130 C (266 F). COmpressor stopped until discharge line temperature decreases to 90 C (194 F);
	• Indicates:
	  • Air in refrigeration system
	  • Low refrigerant charge
	  • Defective compressor or valve plate
	  • Defective liquid injection system
	  • Wrong or defective sensor
		• Operate unit on Cool and check discharge and suction pressure gauge readings.
		• 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.
		NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.

58	**Phase Sensor Error (Check Alarm)**
	• Occurs during Pretrip (PRI) or Function test only.
	• During Phase Sensor Test, amperage difference between correct and wrong condenser fan rotation is more than 0.2 amps.
	• Indicates:
	  • Defective phase relay
	  • Defective relay board
	  • Defective relay board cable No. 2
		• 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	**Delta Current Error (Alarm)** • 100% ampere difference between current phases. • Indicates: • Open connection on one phase of power supply to a motor or heater element	• Enter Manual Function Test menu and test (operate) each 3-phase component to locate defective connection.

60	**Humidity Sensor Error (Check Alarm)**
	• Occurs during Pretrip (PTI) test only.
	• Relative humidity reading not between 20% and 95%.
	• Indicates:
	  • Sensor disconnected
	  • Wrong controller software configuration
	  • Defective sensor
		• Check sensor connections.
		• Check controller configuration for correct humidity setting.
		• Replace sensor.

Code	Description	Corrective Action

98	**KVQ Sensor Open Circuit (Alarm)**
	• Sensor circuit resistance higher than 10,000,000 ohms.
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No.1
	  • Defective controller
		• 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.

99	**USDA 1 Sensor Open Circuit (Check Alarm)**
	• Occurs during Pretrip (PTI) test only.
	• Container ID starts with MAE, MSF or MWC.
	• Temperature below -50 C (-58 F).
	• Indicates:
	  • All 3 USDA sensors are missing
	  • Defective cable No. 3
		• Check USDA sensors and sensor connections.
		• Check cable No. 3 between controller and relay board.

109	**KVQ Sensor Open Circuit (Check Alarm)**
	• Sensor circuit resistance higher than 10,000,000 ohms.
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 11 and 12 on plug J15. Resistance must be 20,000 ohms at 25 C (77 F).
		• Check cable No.1 between controller and relay board.

110	**KVQ Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance lower than 200 ohms.
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• 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

111	**KVQ Heat Error (Check Alarm)**
	• KVQ valve actuation temperature is not in range within preset time.
	• Indicates:
	  • Disconnected CB7A
	  • Defective heat element in valve actuator
	  • Inaccurate actuator temperature measurement
	  • Defective relay board
	  • Defective circuit between pin 4 and 6 on plug J11 (KVQ actuator requires power from both relays 2 and 3)
	  • Defective cable No. 2
	  • Defective controller
		• Carefully inspect actuator:
		If actuator is hot, check that the actuator sensor has been mounted correctly in p ins 11 and 12 on plug J15.
		If actuator is not hot, check resistance between pins 5 and 6 on plug J11. Resistance must be about 17 Ohms. Check voltage from pins 5 and 6 (relays 2 and 3).
		• Check cable No. 2 between controller and relay board.

112	**Zero Current Too High (Check Alarm)** • Ground (zero current) circuit 30 milliamps. • Indicates: • Defective motor or heater insulation to ground	• Enter Manual Function Test manual and test (operate) each motor and heater separately. not when alarm occurs.
115	**Probe Error (Check Alarm)** • 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)	• 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.
116	**Probe Error (Check Alarm)** • Occurs during Pretrip (PTI) test or Probe Test failed in CHilled mode • Temperature difference between return air and supply air sensors is too high (0.8 C[1.5 F]	• 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.

117	**Probe Error (Check Alarm)**
	• Occurs during Pretrip (PTI) test or Probe Test failed in CHilled mode
	• Temperature difference between LH supply and RD supply sensors is too high (0.5 C [1.0 F] difference maximum)
	• Indicates:
	  • Incorrect temperature reading on one sensor
	  • Supply air sensor not placed in air flow stream
		• 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.

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 con-denser 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, the controller LCD display shows a High Pressure Cutout message after 1 minute:

  - High Pressure Cutout Check Condenser Probe: Condenser Fan On/Off switch is ON and the condenser temperature is low.

  - High Pressure Cutout Check Condenser Fan: Condenser Fan On/Off switch is ON and the condenser temperature is high.

  - High Pressure Cutout Check Water Cooling: Condenser Fan On/Off switch is OFF.

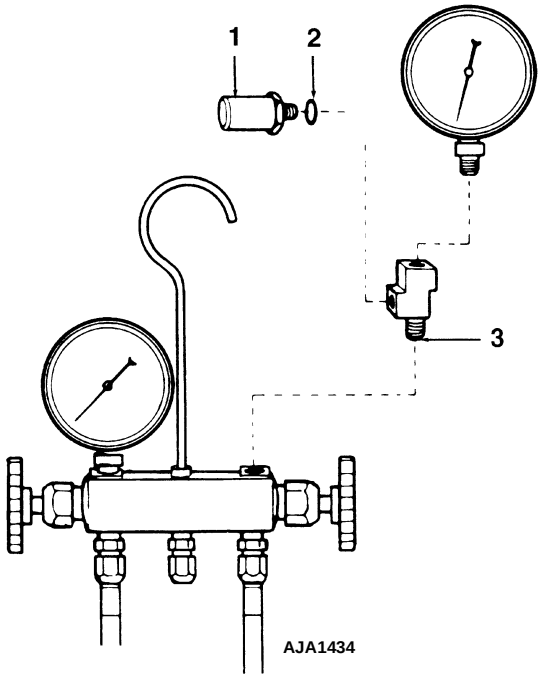
- After 1 minute, the controller also energizes the compressor contactor so the compressor will restart when the over-load condition is corrected (switch resets) if power is available.
- If the switch remains open for 5 minutes, the controller also turns ON the Alarm LED and records Alarm 37, Total Power Consumption Too Low.

High Pressure Cutout Switch:

Opens: 2240 +/- 70 kPa, 22.4 +/- 0.7 bar, 325 +/- 10 Psig

Closes: 1590 +/- 70 kPa, 15.9 +/- 0.7 bar, 230 +/- 10 Psig

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



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

Figure 28: High Pressure Cutout Manifold

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.
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.

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.

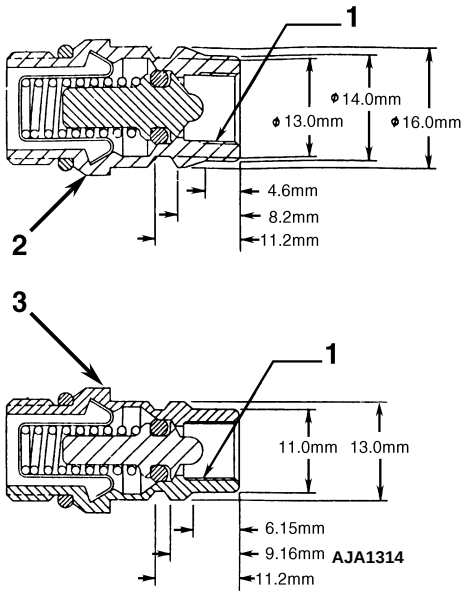
  NOTE: When repairing heater connections, protect the new connections from the ingress of moisture with heat shrink tubing. All heaters should be secured to prevent contact with sharp metal edges.

Refrigeration Maintenance and Service Operations

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: It is generally good practice to replace the filter drier whenever the high side is opened or when the low side is opened for an extended period of time.



1.	Internal Threads for Cap
2.	High Pressure Fitting
3.	Low Pressure Fitting

Figure 29: Service Fittings Specifications

Service Tools

CAUTION: When servicing Thermo King R-134a 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-134a refrigerant and Polyol ester based compressor oils. Residual non-HFC refrigerant or non-Ester based oils will contaminate HFC systems.

Unit Service Fittings

Special fittings are used on R-134a systems to prevent mixing of non-HFC refrigerants in R-134a units. These fittings are located in three places on CRR refrigeration systems:

- Low side near the compressor suction service valve (or suction adapter),
- High side near the compressor discharge service valve (or discharge manifold),
- High side on the receiver tank.

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

A new gauge manifold set (P/N 204-758) should be dedicated for use with R-134a only. Gauge hoses should also be dedicated to R-134a.

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-134a 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-134a systems.

Refrigerant Recovery

Use only refrigerant recovery equipment approved for and dedicated to R-134a recovery.

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.

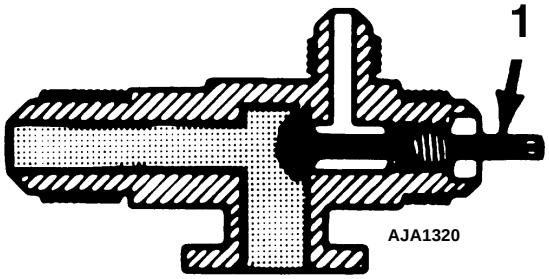
Compressor Discharge and Suction Service Valves

The discharge and suction valves isolate the compressor from the high and low sides of the refrigeration system for system diagnosis, service and repair.

NOTE: The only maintenance possible on the discharge or suction service valve is to periodically tighten the packing nut or to replace the packing. The valves are a permanently assembled unit and must be replaced in total if defective.

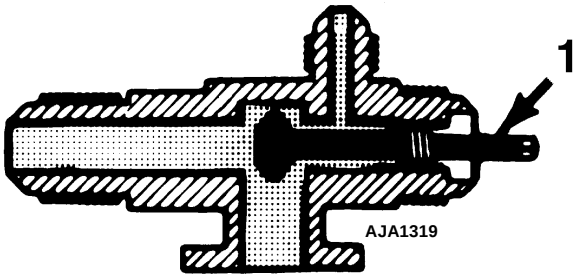
- Back Seated: Normal operation position.
- Open to Service Port: Position for servicing.
- Front Seated: To check or remove compressor.

WARNING: Do not start unit with discharge valve in FRONT SEATED position.



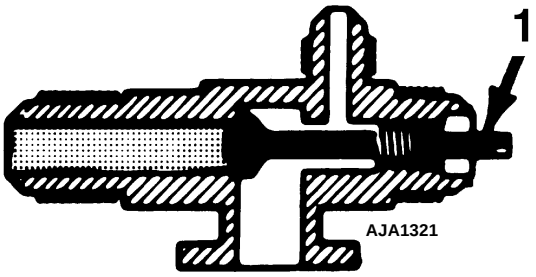
1.	Full Counterclockwise

Figure 30: Service Valve Back Seated



1.	1/2 Turn In

Figure 31: Service Valve Open to Port

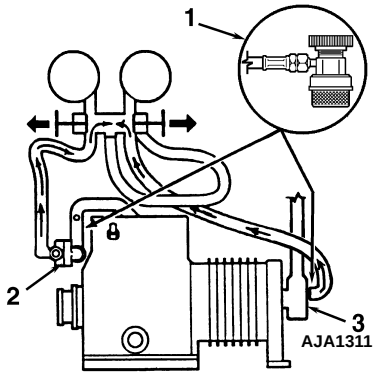


1.	Full Clockwise

Figure 32: Service Valve Front Seated

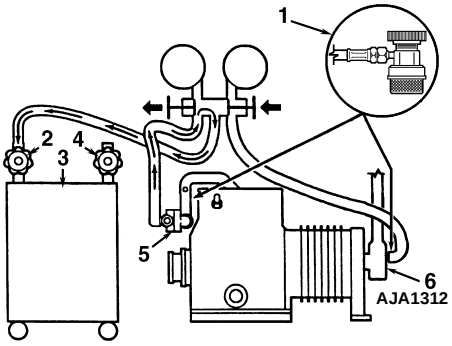
Gauge Manifold Valve Positions

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



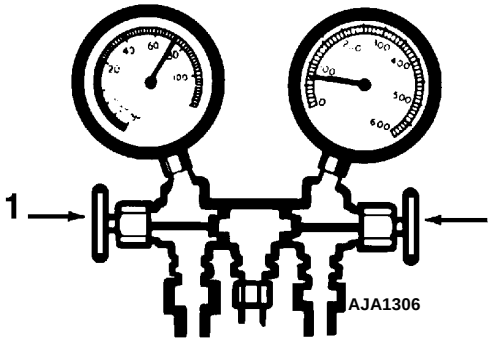
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

Figure 33: Balancing the Pressure



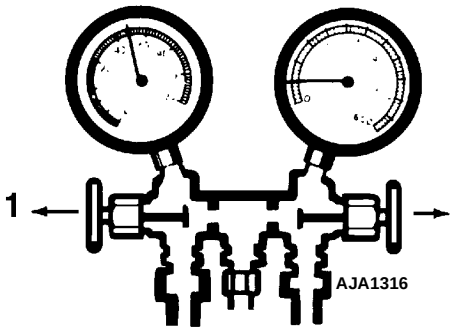
1.	Quick Disconnect Access Valve
2.	In
3.	Recliner
4.	Out
5.	Discharge Service Valve (DSV)
6.	Suction Service Valve (SSV)

Figure 34: Removing Refrigerant



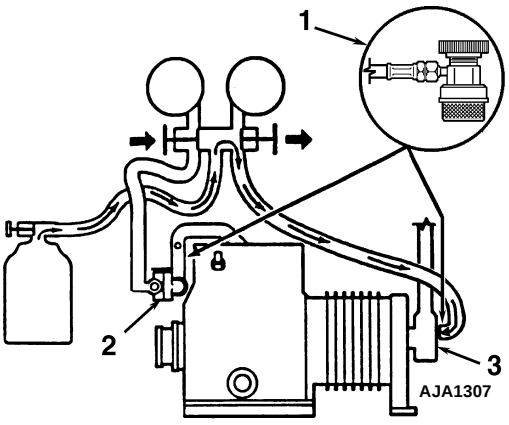
1.	Close Hand Valves

Figure 35: Gauge manifold Closed to Center Port



1.	Open Hand Valves

Figure 36: Gauge Manifold Open to Center Port



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

Figure 37: Charging the System

Gauge Manifold Set (With Low Loss Fittings) Attachment And Purging

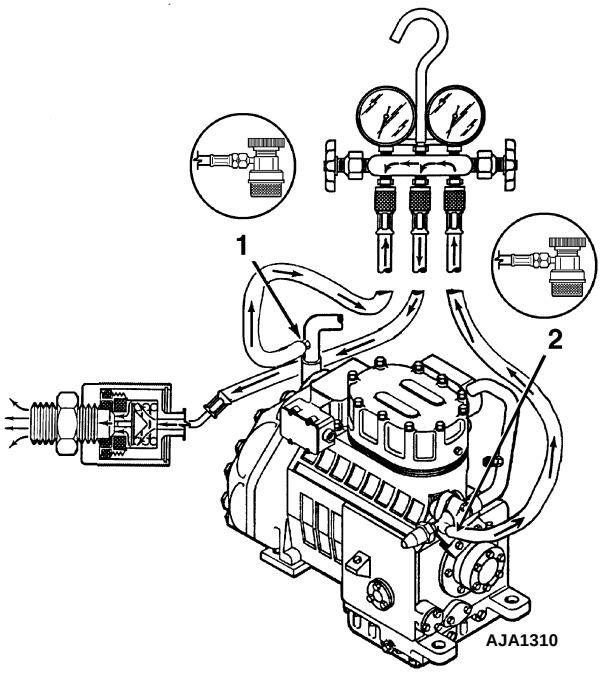
Thermo King recommends the use of access valves or self-sealing, quick disconnect fittings whenever possible to limit the loss of refrigerant into the atmosphere. A separate gauge manifold set with low loss fittings (P/N 204-758) should be dedicated for use with R-134a only. Gauge hoses should also be dedicated to R-134a.

NOTE: When any of these devices are used, carefully check to ensure that access connections are functioning properly.

Gauge Manifold Set Installation

NOTE: The following procedure purges the gauge hoses and must be followed when using new gauges or hoses for the first time. The system should be operating on Cool (10 psig [69 kPa] or greater suction pressure) when using this procedure to purge the low side hose. Gauge hoses may be removed and re-installed without additional purging so long as a slight positive pressure remains in the manifold and lines when removed from the unit.

1. Inspect gauge manifold for proper hose and fitting connections.
2. Clean dirt and moisture from around service ports.
3. Remove small service port caps from suction and discharge service fittings. Save and re-use the caps and sealing washers or gaskets.
4. Rotate both hose coupler hand wheels counterclockwise to back the stem out of the high and low hose fittings. Then attach low hose (compound gauge) to the suction line valve port.
5. With 69 kPa, 0.69 bar, 10 psig or greater pressure in the low side (unit operating on Cool), open the suction service manifold hand valve fully. Then rotate the suction hose fitting hand wheel clockwise to open (depress) the suction line port valve to the low hose.
6. 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. Remove ACME fitting after purging.



1.	Suction Connection
2.	Discharge Connection

Figure 38: Purging Gauge Manifold

7. Close the suction service manifold hand valve fully to center port.
8. Attach high side hose (pressure gauge) to the discharge service line port.
9. Open discharge service manifold hand valve fully. Then rotate discharge fitting hand wheel clockwise to open (depress) discharge line port valve to the high hose.
10. Slowly screw a 1/2 inch ACME fitting into the manifold's service (center) line to purge the high and service hoses. Remove ACME fitting after purging.
11. Close discharge service manifold hand valve fully to center port. You are now ready to use the gauge manifold to check system pressures or perform MOST service procedures.

    NOTE: These gauges may be removed and reinstalled without additional purging so long as a slight positive pressure remains in the manifold and hoses when removed from the unit.

Gauge Manifold Set Removal

NOTE: To ensure minimum refrigerant release to the atmosphere, THE SYSTEM SHOULD BE RUNNING. However, this is not possible in all cases, but the same procedure should be followed.

1. Rotate discharge hose fitting hand wheel counterclockwise to withdraw the fitting stem from the discharge line port valve. Then open both service manifold valves to center port.
2. Close the liquid line service valve and pump down the low side. Then turn the unit OFF.
3. Rotate the discharge fitting hand wheel counterclockwise to depress the port valve stem to equalize pressure at 21 kPa, 0.21 bar, 3 psig.
4. Rotate both coupler hand wheels counterclockwise to close (seal) the valve port stems to the high and low hoses.
5. Remove the gauge lines from the suction and discharge service fittings and cap the service ports.
6. Open liquid line service valve and cap valve stem.
7. Secure all manifold lines to manifold hose anchors when the manifold is not in use.

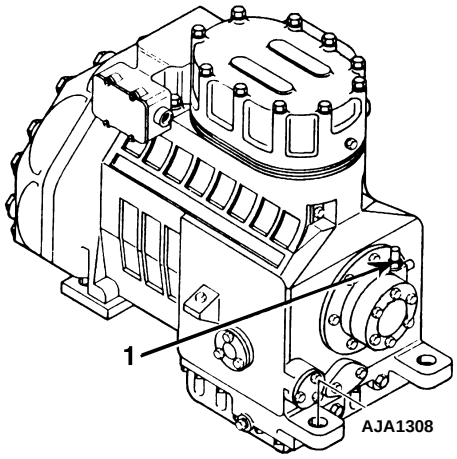
Checking Compressor Oil

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil, P/N 203-433. DO NOT mix Polyol Ester based and standard synthetic compressor oils.
CAUTION: Rubber gloves are recommended when handling Ester based compressor oil.
CAUTION: 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!

The compressor oil should be checked during pretrip inspections and when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

To check compressor oil level with an ambient air temperature above 10 C (50 F)

Install gauge manifold on the compressor. Operate the unit on COOL with a 138 kPa, 1.38 bar, 20 psig minimum suction pressure and a 689 kPa, 6.89 bar, 100 psig discharge pressure for 15 minutes or more. After the unit has maintained the above conditions for 15 minutes, observe the compressor oil level. The oil should be 1/2 to 3/4 up in the sight glass.



1.	Add and remove compressor oil at the compressor oil fitting

Figure 39: Adjusting Compressor Oil Level

To check compressor oil level with an ambient air temperature below 10 C (50 F)

With the evaporator temperature below 10 C (50 F), initiate a Manual Defrost to operate the unit through a complete DEFROST CYCLE. After completing the defrost cycle, operate the unit on COOL for a few minutes. After 2 to 3 minutes, observe the oil level. The oil should be 1/2 to 3/4 up in the sight glass.

If the container is empty, you can operate the unit on the heat cycle instead of the defrost cycle.

Adding Compressor Oil

1. Install gauge manifold set (refer to “Gauge Manifold Set Attachment and Purging”). Pump the compressor down (refer to “Low Side Pump Down”).

2. After stopping the compressor, adjust the low side pressure to 21 kPa, 0.21 bar, 3 psig using the service gauge set. (Pressure measured at the suction line service port.)
3. Remove the cap from oil pressure fitting on oil pump.
4. Using a commercial hand pump, force oil in through the oil pressure fitting. Slowly add oil and allow 5 to 10 minutes for the oil to flow down through the compressor into the sump. Add Polyol Ester oil, P/N 203-433 ONLY!
5. When the compressor oil sight glass is 1/2 to 3/4 full, remove hand pump and replace the cap on the oil pressure fitting.
6. Open the compressor suction service valve (or liquid line service valve) and operate the unit. Recheck the refrigerant charge level and the oil level before returning the unit to service.

Removing Excess Compressor Oil

1. Install an access valve actuator on the oil pressure fitting.
2. Operate the unit and remove oil while watching the level in the compressor sight glass.

   NOTE: Heavy foaming of the oil as it leaves the compressor may indicate an excess of refrigerant in the oil. Remove the access valve actuator and operate the system for 15 minutes to ensure warm sump. Then recheck the oil level.
3. When the compressor oil sight glass is 1/2 to 3/4 full, remove access valve and replace the cap on the oil pressure fitting.
4. Operate the unit and recheck the refrigerant charge level and the oil level before returning the unit to service.

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.

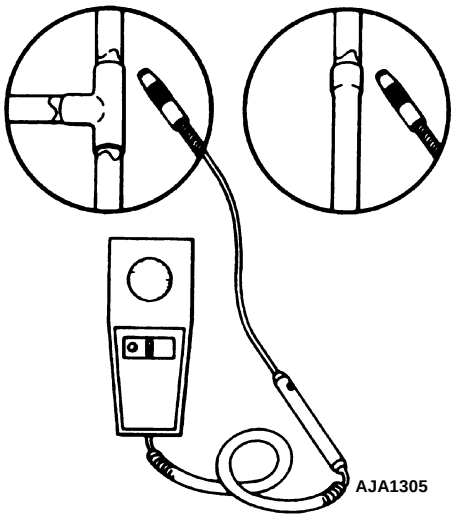


Figure 40: Testing for Refrigerant Leaks

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 manual chapter.

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

Low Side Pump Down

1. Install the gauge manifold on the compressor.
2. Set the controller setpoint temperature well below the return air temperature and operate the unit in the Cool mode until the temperature stabilizes (at least 5 minutes).
3. Close the liquid line service valve. Allow the unit to operate until it reaches -15 to -40 kPa, -0.15 to -0.40 bar, 5 to 11 in. vacuum on the suction pressure gauge (3-5 minutes). Then shut the unit down manually with the On/Off switch.

CAUTION: Never open the low side to the atmosphere while it is in a vacuum. Air and moisture will be drawn in and contaminate the refrigerant system.

4. To place the unit back in service, open the liquid line service valve and turn the On/Off switch ON.

Refrigerant Charge

The refrigerant charge should be checked 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. The refrigerant charge can be checked by inspecting the receiver tank sight glasses.

NOTE: See "Receiver Tank Sight Glass" under Unit Instruments in the Operating Instructions chapter for information about checking the moisture indicator in the sight glass.

Unit Refrigerant Charge:

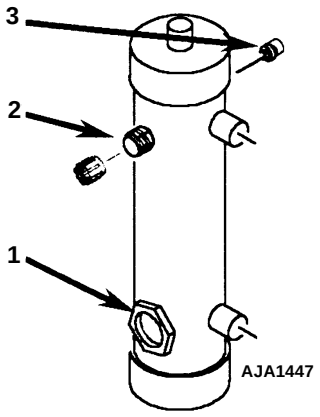
- Standard receiver: 4.9 kg (10.8 lb) of R-134a.
- Water-cooled condenser-receiver: 5.2 kg (11.5 lb) of R-134a.

Checking the Refrigerant Charge

1. Inspect the receiver tank sight glasses with the unit operating in COOL.
2. a. Standard Receiver Tank:
   - If the balls FLOAT in the sight glass at any time, R-134a charge is OK.
   - If the balls DO NOT FLOAT, R-134a charge is low.

   b. Water-cooled Condenser-receiver Tank with two sight glass:
   - If the BOTTOM sight glass balls FLOAT, the R-134a charge level is ok.
   - If the BOTTOM sight glass balls DO NOT FLOAT, R-134a charge level may be low. Go to step 3.

   c. Water-cooled Condenser-receiver Tank with one sight glass:
   - If the balls FLOAT in the sight glass at any time, R-134a charge is ok.
   - If the balls DO NOT FLOAT, R-134a charge may be low



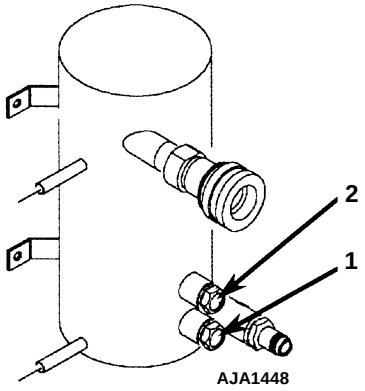
1.	Sight Glass: Refrigerant charge is OK if ball FLOATS at any time
2.	Service Fitting
3.	Fusible Plug

Figure 41: Standard Receiver Tank

3. Operate the unit on MAXIMUM COOL for 5 minutes. If necessary, place the unit in COOL using the Manual Function Test menu (start compressor, condenser fan, evaporator fans (high or low) and compressor 100%).
   a. Standard Receiver Tank:
      - If the balls FLOAT in the sight glass at any time, the R-134a charge is OK.
   b. Water-cooled Condenser-receiver Tank with two sight glass:
      - If the BOTTOM sight glass balls FLOAT, the R-134a charge level is OK.
      - If the BOTTOM sight glass balls DO NOT FLOAT, the R-134a charge is low.
      - If the TOP sigh glass ball FLOATS ALL THE WAY TO TOP of sight glass, the unit is overcharged

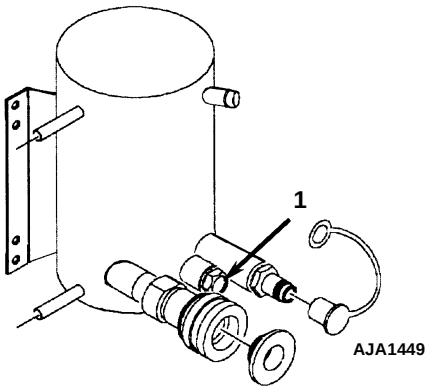
   NOTE: Inspect the unit for refrigerant leaks with a reliable leak detector if the unit is low on R-134a charge.

CAUTION: When adding R-134a to the unit, be careful not to OVERCHARGE the unit: Standard Receiver Tank: When the balls float in the middle of the sight glass, stop adding refrigerant. Water-cooled Condenser-receiver Tank: When the balls in the sight glass float, stop adding refrigerant.



1.	Refrigerant Level for Air-cooled Condenser Operation: The refrigerant charge is OK if balls FLOAT at any time.
2.	Refrigerant Level for Water-cooled Condenser Operation: The refrigerant charge is OK if balls FLOAT at any time.

Figure 42: Water-Cooled Condenser-Receiver Tank with Two Sight Glasses



1.	Refrigerant Level: • Air-cooled Condenser Operation: The refrigerant charge is OK if balls FLOAT at any time. • Water-cooled Condenser Operation: It is normal for the balls to float at the top of the sight glass. To check the refrigerant charge, operate unit on air-cooled condenser.

Figure 43: Water-Cooled Condenser-Receiver Tank with One Sight Glass

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.

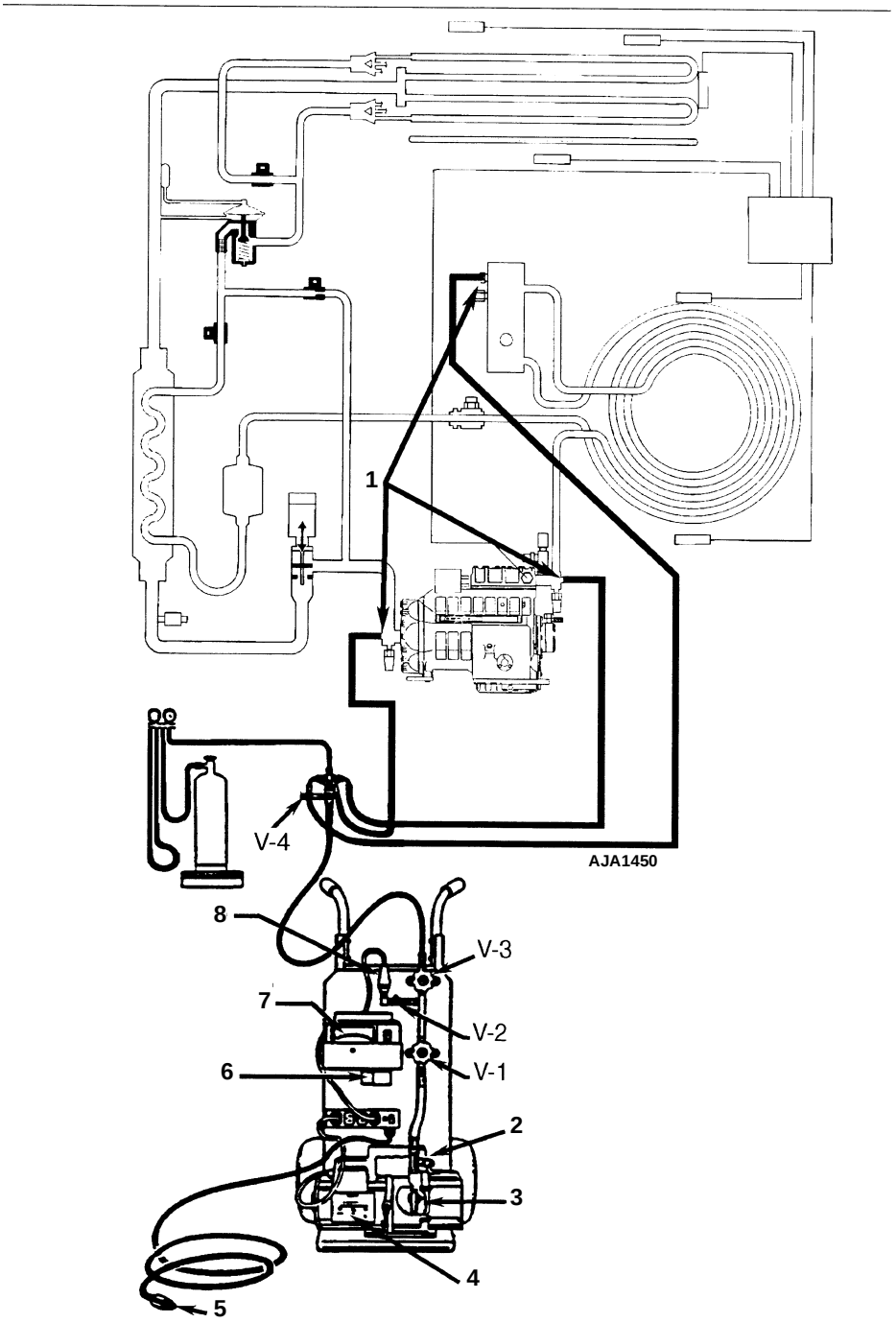
Compressor Oil Color Code

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 and the filter drier. Then perform a refrigeration system cleanup.



1.	Special, self-sealing quick disconnect couplers are required for R-134a units.	5.	To 220/190 VAC Power
2.	Gas Ballast Valve	6.	Calibration Standard
3.	Iso Valve	7.	Micron Meter
4.	Two-stage Vacuum Pump	8.	Sensor

Figure 44: Evacuation Station and unit Hook-up

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.
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. It is recommended that the pump oil be changed first to see if the rate of reaching a deep vacuum is improved.
4. Connect the Evacuation Station and refrigerant tank with gauge manifold (optional) to the unit.See “Evacuation Station and unit Hook-up” on page 132. Connect evacuation hoses to the compressor suction and discharge service fittings and the receiver tank service fitting.
5. Open Evacuation Station valves (V1, V3, and V4). It is only necessary to open valve V2 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. It is recommended that 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.

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.

   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 out gas for long periods of time.
2. If the vacuum level appears to stall above 500 microns, back seat the discharge service 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.

Pressure Rise Test

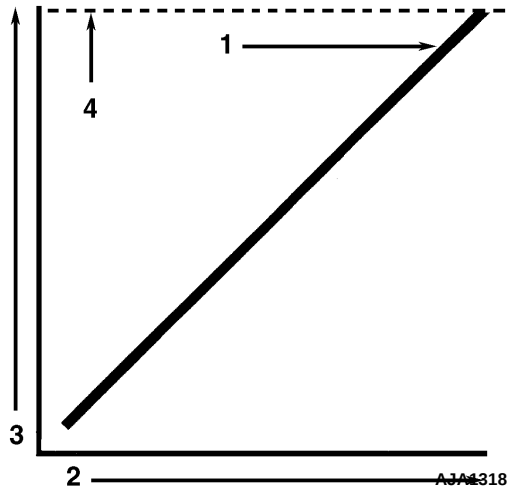
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the Micron Meter rises, one of the following conditions exist.

- **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”, below).
- **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”, below).

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



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

Figure 45: Constant Pressure Rise after Evacuation Indicates System Leak

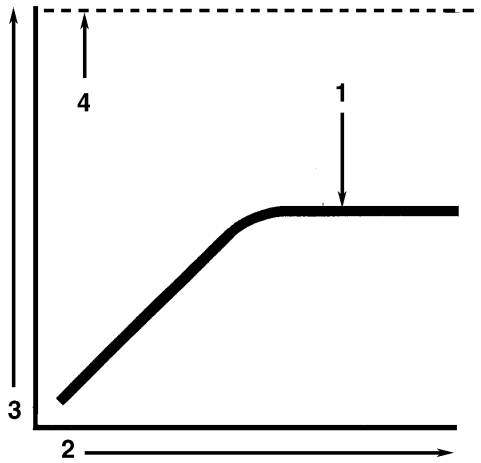
Hose size, both diameter and length, affect evacuation times. Laboratory tests show that the evacuation time can be significantly reduced by larger diameter hoses and shorter hoses. To obtain optimum pumping speed, keep hoses as short as

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 (1/4 inch) diameter hose as it does through a 12 mm (1/2 inch) diameter hose. It takes twice as long to pull a vacuum through a 2 meter (6 foot) long hose as it does through a 1 meter (3 foot) 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.



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 to much moisture. Dehydration and additional evacuation time are required.
2.	Time
3.	Pressure (Vacuum)
4.	Atmospheric Pressure

Figure 46: Pressure Rise Levels Off after Evacuation Indicates Moisture in System

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.

Unit Charging (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 remains mid-seated.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (see “Evacuation Station and Unit Hookup” in this chapter).
6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge then subtract the amount of the charge to be input to your unit from the total weight of the tank of refrigerant. This provides final tank weight after the unit receives a full system 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 (described in the following steps, “Evacuation Station Removal”). See following, “Final Charging Procedure for Partially Charged Units” to complete charging procedure.

Evacuation Station Removal

1. Back seat the discharge service valve.
2. Remove the service hose from the refrigerant tank service fitting. Cap the receiver tank service port.
3. Operate the unit in cool mode.
4. Open the hand valve at the gauge manifold and read suction pressure.

5. Front seat the suction service valve and pump down the system to 21 to 35 kPa, 0.21 to 0.35 bar, 3 to 5 psig.
6. Back seat the suction service valve.
7. Remove the hoses from the discharge service valve.
8. Install a gauge manifold set.
    - If the unit is fully charged, perform a functional check out.
    - If the unit has a partial charge, complete the charging process as described below.

Final Charging Procedure for Partially Charged Units

1. Connect the gauge manifold to the suction line and discharge line service ports. Be sure to purge the air from the lines (see “Gauge Manifold Set Attachment and Purging” in the Refrigeration Maintenance chapter of this manual).
2. Back seat and crack the discharge service valve.
3. Connect a refrigerant tank to the gauge manifold service line.
4. Set the refrigerant tank for liquid charging. Open the refrigerant tank hand valve.
5. Start and operate the unit in the COOL mode.
6. Read the suction pressure and slowly open the gauge manifold low pressure hand valve to permit suction pressure to increase approximately 170 kPa, 1.7 bar, 25 psig. This will meter liquid refrigerant slowly into the low side.
7. Add refrigerant until the receiver tank balls float in the top sight glass.
8. Close the hand valve on the refrigerant tank.
9. Operate the unit on COOL for 10 minutes and recheck refrigerant charge.
10. Remove the gauge manifold set.
11. Cap all service ports and valve stems.

CAUTION: If the controller temperature setpoint was lowered to force COOL operation, be sure to return the controller to the setpoint indicated on the shipping manifest.

Evaporator Pressure Regulator (KVQ) Valve

The evaporator pressure regulator valve is used to control the flow of refrigerant to the compressor when the unit is operating in the Power Limit and Modulation Cool modes. As the supply air temperature approaches setpoint, the controller sends a voltage pulse to a heater in the valve. The heater warms a pressure reservoir in the valve actuator. As the pressure in the fluid reservoir increases, a pressure pin overcomes the spring tension in the bellows, closing the valve plate a precise amount. This throttles the suction gas returning to the compressor and reduces cooling capacity. As the frequency of the voltage pulse is increased, the pressure pin closes the valve plate an additional amount. Due to valve design, the flow of refrigerant gas exerts no opening or closing forces on the valve plate, allowing very precise operation.

NOTE: If electrical circuit to heating element fails, the valve moves to the full open position.

Service of the evaporator pressure regulator valve includes replacement of the actuator assembly or replacement of the valve body.

Tools Required:

- Digital Multimeter (P/N 204-615)
- Actuator Assembly
- Adjustable Wrench
- Torque Wrench

Heater Circuit Checkout Procedure

1. Unplug the evaporator pressure regulator valve lead wire harness.
2. Using a FLUKE multimeter, test each lead (4) resistance to ground. Low resistance indicates a short is present. Repair or replace any damaged or exposed wires.

3. Check the heater circuit and thermistor circuit resistance.

- A good heater circuit has a resistance of 20 ohms at 25 C (78 F).
- A good thermistor circuit has a resistance of 20,000 ohms at 25 C (78 F).

NOTE: The ohmmeter will display a slightly higher heater resistance if the valve was energized just prior to testing the circuit resistance.

4. To return the unit to service, plug the evaporator pressure regulator valve lead connector into the unit wire harness.

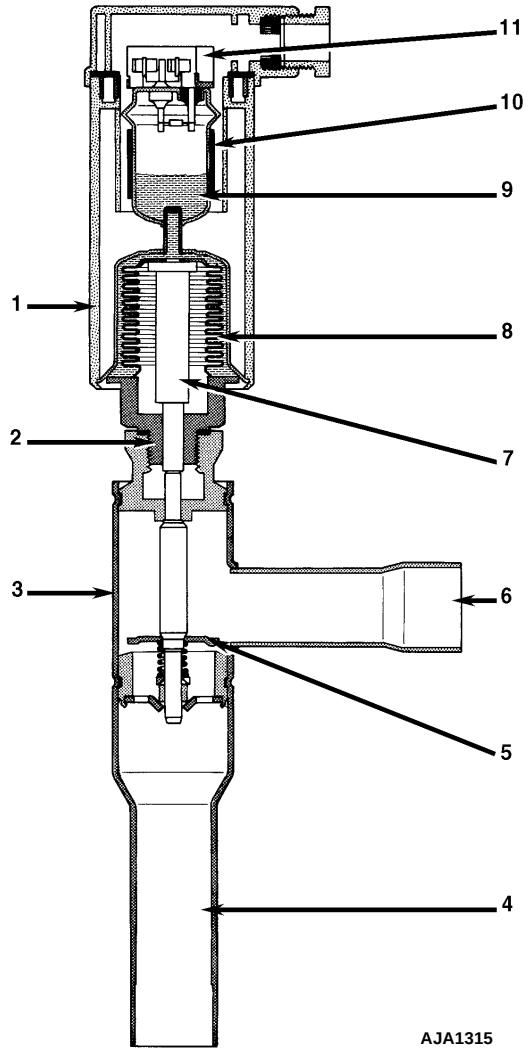
Valve Actuator Replacement

If the evaporator pressure regulator valve fails to operate properly, remove the actuator cover and inspect the assembly for rust or corrosion. Rust or corrosion can damage the actuator or heater circuit, preventing the valve from operating properly.

1. To replace actuator assembly, unplug the heater and thermistor lead wire harnesses.
2. Connect the unit's main power cable to the main power source and switch the refrigeration unit's On/Off switch to ON. Close the liquid line service valve and pump down the low side. Equalize suction pressure to 21 kPa, 0.21 bar, 3 psig.
3. Turn the unit On/Off switch to OFF. Then disconnect the main power cable from the main power source again. Close (front seat) the discharge service valve.

CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up

4. Inspect the actuator terminals and note the wire connection sequence. Then disconnect wire leads.
5. Unscrew the actuator assembly from the valve body.
6. Immediately insert new actuator assembly in valve body.
7. Thread new actuator into valve body until it is hand tight. Then tighten to 45 N.m (33 ft-lb).
8. Connect wire leads to actuator terminals in proper sequence.
9. Replace cover on actuator assembly.
10. Connect the heater and thermistor lead wire harnesses.
11. Evacuate the low side.
12. Open the discharge valve. Then open the liquid line service valve.
13. Verify that all personnel are clear and connect main power plug to power supply. Place the unit back in service.



1.	Actuator Assembly
2.	Threaded Connection
3.	Valve Body
4.	Inlet Tube
5.	Valve Plate
6.	Outlet Tube
7.	Pressure Pin
8.	Bellows Assembly
9.	Pressure Reservoir
10.	Heating Element
11.	Terminal Connections

Figure 47: KVQ Valve

KVQ Valve Replacement

If the valve body is damaged, replace the entire valve.

1. Connect the unit's main power cable to the main power source. Switch the refrigeration unit's On/Off switch to ON.
2. Close the liquid line service valve and pump down the low side to 21 kPa, 0.21 bar, 3 psig.
3. Turn the unit On/Off switch to OFF. Then disconnect the main power cable from the main power source. Close (front seat) the discharge service valve.

CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

4. Unplug the heater and thermistor lead wire harnesses.
5. Unsolder the valve outlet (compressor side) joint from the suction line. Unsolder the inlet joint and remove valve.
6. Clean the tubes for soldering. Position the new valve in position in the suction line.
7. Solder both KVQ valve connections.

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

8. Pressurize the low side and test for refrigerant leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).

   NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

9. If no leaks are found, evacuate the low side and recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
10. Plug the heater and thermistor wire harnesses into the unit wire harness.
11. Open the discharge valve. Then open the liquid line service valve.

12. Verify that all personnel are clear and connect main power plug to power supply. Start the unit and check the refrigerant charge. Add refrigerant as required.

Refrigerant Recovery

CAUTION: Use only refrigerant recovery equipment approved for and dedicated to R-134a 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 reduce the refrigerant pressure to a safe working level when maintenance must be performed on high-pressure side components.
- To empty the unit of refrigerant when an unknown amount of charge is in the system and a proper charge is required.
- To empty the unit of contaminated refrigerant when the system has become contaminated.

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

Vapor Recovery

1. Install a gauge manifold set on the unit. Attach the service line to the recovery machine and properly purge the lines. Set the recovery machine for vapor recovery.
2. Keep unit OFF and mid-seat the discharge service valve.
3. Turn ON the recovery machine and open (back seat) both gauge manifold and hand valves.
4. Continue to operate the recovery machine until unit pressures drop to 0 kPa, 0 bar, 0 psig pressure.

Liquid Recovery

1. Install a gauge manifold's low-pressure line to the service fitting on the suction service valve. Attach the manifold's high-pressure line to receiver tank service port. Attach the service line to the recovery machine and purge the lines.
2. Operate the unit and build discharge pressures to approximately 1380 kPa, 13.80 bar, 200 psig.
3. Close the liquid line service valve and pump down the low-pressure side of the system.
4. Stop the unit.
5. Set recovery machine for liquid recovery and turn it ON.
6. Open (back seat) high-pressure valve on gauge manifold.
7. Operate the recovery machine until the unit system pressures reach approximately 0 kPa, 0 bar, 0 psig.

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

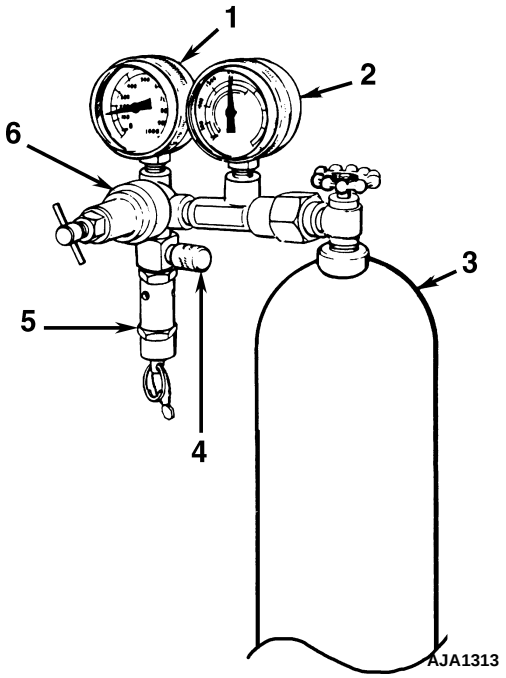
Observe the proper handling of cylinders:

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.



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

Figure 48: Typical Pressurized Gas Bottle with Pressure Regulator and Gauges

Procedure

1. Attach gauge manifold set (refer to “Gauge Manifold Set Attachment and Purging” for proper procedure for connecting to compressor).
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.

The following procedures should utilize the following MAXIMUM gas pressure:

- Leak Testing: 1030 to 1200 kPa, 10.3 to 12.0 bar, 150-175 psig,
- Purging/Dehydration: 70 to 140 kPa, 0.7 to 1.4 bar, 10-20 psig,
- During Soldering: 35 kPa, 0.35 bar, 5 psig.

Compressor Replacement

Removal

1. Remove the compressor compartment bracket. Close the liquid line service valve and pump down the low side to - 35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.

   NOTE: If the compressor does not operate, or the compressor is unable to pump the low side down, the refrigerant charge must be reclaimed before service can be performed on the refrigeration system.

2. Front seat the discharge valve.

CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

3. Remove discharge service valve, suction service valve, and liquid injection line from the compressor.
4. Disconnect the wire connector for the high pressure cutout switch.

5. Remove the three-phase electric power connection.
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.

   NOTE: 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 added before placing the new compressor or repaired compressor in the unit.

Installation

1. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.
2. Bolt the discharge valve to the compressor with a new gasket lightly coated with compressor oil. Bolt the suction service valve to the compressor using a new O-ring coated with compressor oil.
3. Apply refrigerant locktite to the threads of the switches. Install the switches. Connect the wire connectors for the high pressure cutout switch.
4. Connect liquid injection line to compressor body.
5. Connect three-phase electric power to the compressor.
6. Pressurize the compressor with refrigerant gas (same gas as that used in the system). Check for refrigerant leaks around the compressor assembly and gasket connections.
7. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter). Because this refrigerant gas will contain some air, place it in a contaminated refrigerant bottle to be reclaimed later.
8. After all pressure is removed from the low side and compressor, hook up your evacuation equipment.
9. Evacuate the low side and compressor (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
10. Back seat the discharge service valve and open the liquid line service valve fully.
11. Operate the unit at least thirty minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.
12. Check the refrigerant charge and add refrigerant if needed.

Condenser Coil Replacement

Removal

1. Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).
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 coil inlet and liquid line connections.
5. Support the coil and unbolt the condenser coil mounting brackets. Slide the coil from the unit.

Installation

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

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

4. Pressurize the system and test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
5. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).

6. Then evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
7. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
8. Recharge the unit with R-134a refrigerant and check the compressor oil level. Add oil if necessary.

Dehydrator (Filter Drier) Replacement

Removal

1. Close the liquid line service valve and pump down the low side. Open the outlet valve slightly to equalize the pressure between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Place the new filter drier near the unit for immediate installation.
3. Using two wrenches, “crack” both filter drier line mountings. Use two wrenches on flare fittings to prevent line damage.
4. Separate the filter drier line mountings.
5. Remove the filter bracket clamping nuts and bolts.

   NOTE: Perform the following four procedures as quickly as possible to prevent contamination.

6. Remove the old dehydrator from the line.

Installation

1. Remove the sealing caps from the new dehydrator.
2. Apply clean compressor oil to dehydrator threads.
3. Assemble new dehydrator to lines. Finger tighten mounting nuts.

   NOTE: To prevent incorrect installation of the dehydrator, the inlet and outlet fittings are different sizes.

4. Reinstall filter drier clamping brackets, nut and bolts. Tighten the bolts.
5. Tighten the filter drier inlet line mounting nut.
6. Open the liquid line service valve on the inlet side of the filter drier slowly to release a small amount of refrigerant from the receiver tank to purge the air through the filter. Then tighten the outlet nut.

   NOTE: When removing or replacing the o-ring nuts on the dehydrator, always hold the body of the filter drier near the flange fittings to prevent twisting the tubing when the nuts are being loosened or tightened.

7. Back seat (open) the liquid line service valve on the inlet side of the filter drier.
8. Test the filter drier for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
9. If no leaks are found, place the unit in operation.

Expansion Valve Replacement

Removal

1. Close the liquid line service valve and pump down the low side to -35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Remove insulating tape and unclamp feeler bulb from the suction line in the evaporator. 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.
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.

4. Solder equalizer line to expansion valve.
5. 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.
6. Pressurize the low side and test for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
7. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in this chapter).
8. Evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
9. Cover expansion valve outlet line with insulating tape.
10. Open the liquid line service valve and place the unit in operation.
11. Operate the unit and note the suction pressure and container temperature to see that the expansion valve is properly installed and that the feeler bulb is properly located.

Heat Exchanger Replacement

Removal

1. Close the liquid line service valve and pump down the low side to -35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Remove the "U" mounting clamps that hold the heat exchanger assembly to the wall of the condenser section.
3. Heat and unsolder 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. Heat and unsolder the suction 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 line connections.

   NOTE: It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (see "Using Pressurized Nitrogen" in this chapter).

   NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source the prevent accidental compressor start-up.

4. Solder the liquid line connections.
5. Pressurize the low side and check for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
6. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in this chapter).
7. Evacuate the low side (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. Open the liquid line service valve and place unit in operation. Operate unit and note suction pressure and container temperature to see that feeler bulb is properly installed.

Receiver Tank Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Unsolder the outlet valve on the liquid outlet line.
3. Unsolder the liquid line inlet connection.
4. Loosen the mounting nuts and remove the tank.
5. Remove the adapter with fusible plug, service fitting and water fittings (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 and outlet valve line with high temperature silver solder (30% silver).

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

   NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

3. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
4. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
5. Recharge the unit (see “Refrigerant Charge” in this chapter).

High Pressure Cutout Switch Replacement

Removal

1. Close the liquid line service valve and pump down the low side. Open the outlet valve slightly to equalize the pressure between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Front seat the discharge service valve.

   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

3. Purge the high pressure from the compressor head through the service port on the discharge line.
4. Disconnect the leads from the wire harness and remove the switch from the compressor discharge manifold (or remove the sensor from the compressor head).

Installation

1. Apply a refrigeration locktite (sealant) to the threads of the switch (or sensor).
2. Install and tighten the switch (or sensor). Connect the leads to the wire harness.
3. Open discharge service valve slightly to pressurize the compressor head and tube assembly. Check for leaks (see “Refrigerant Leak Test Procedure” in this chapter). Front seat the discharge service valve.
4. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
5. Open the liquid line service valve and compressor discharge service valve and place the unit in operation.

Liquid Line Solenoid Valve Replacement

Removal

1. Close the liquid line service valve and pump down the low side to -35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Turn the unit On-Off switch OFF. Disconnect electrical connections to liquid line solenoid.

   NOTE: In most cases, only the coil requires replacement. No other repair is possible on the liquid line solenoid.
3. Unsolder the liquid line connections from the valve.
4. Remove the valve from the unit.

Installation

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

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

3. Release a small amount of refrigerant from the receiver tank to pressurize the liquid line. Check for leaks (see “Refrigerant Leak Test Procedure” in the Refrigeration Maintenance chapter of this manual).
4. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in the Refrigeration Maintenance chapter of this manual).
5. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in the Refrigeration Maintenance chapter of this manual).
6. Reconnect the electrical wires to the valve.
7. Open the liquid line service valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

Liquid Injection Valve Replacement

Removal

1. Close the liquid line service valve and pump down the low side to -35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Disconnect the unit power source from the unit. Disconnect the electrical connections to the liquid injection valve.

   NOTE: In most cases, only the coil requires replacement. No other repair is possible on the liquid injection valve.
3. Unsolder the liquid line connections.
4. Unbolt and remove the valve from the unit.

Installation

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

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

4. Pressurize the low side with refrigerant and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
5. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
6. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
7. Reconnect the electrical wires to the valve.
8. Open the liquid line service valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

Dehumidify Valve Replacement

Removal

1. Close the liquid line service valve and pump down the low side to -35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Remove insulating tape from liquid line.
3. Disconnect the electrical connections to the dehumidify valve.

   NOTE: In most cases, only the coil requires replacement. No other repair is possible on the liquid injection valve.
4. Unsolder the liquid line connections.
5. Unbolt and remove the valve from the unit.

Installation

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

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

4. Pressurize the low side with refrigerant and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
5. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
6. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
7. Cover liquid lines with insulating tape.
8. Reconnect the electrical wires to the valve.
9. Open the liquid line service valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

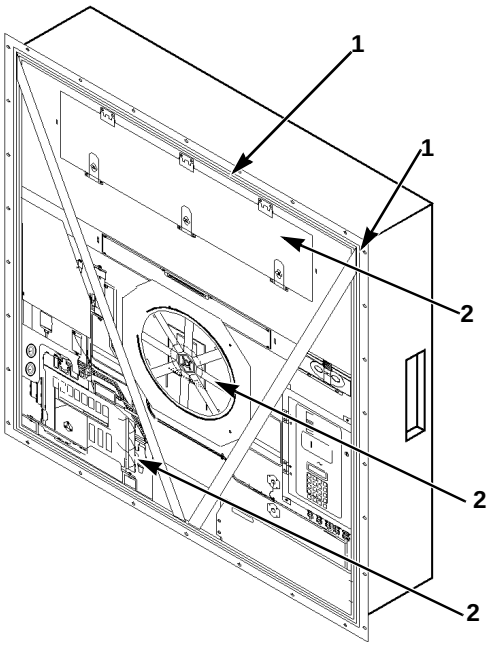
Structural/Accessory Maintenance

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.



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

Figure 49: 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.

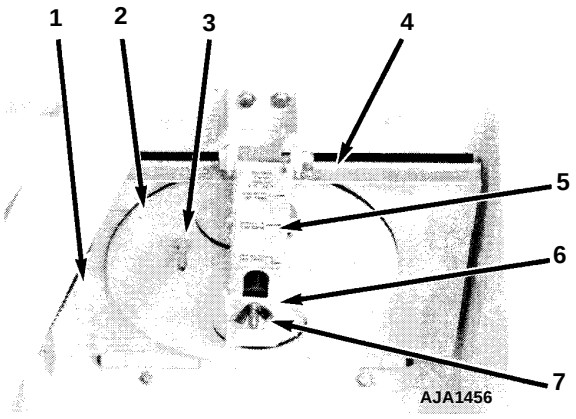
Fresh Air Exchange System

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:
   - CRR40 and CRR40SL Models: 0 to 125 m 3 /hr (0 and 75 ft 3 /min.)
3. Tighten the wing nut.



1.	Disk Scale: Low Ventilation Rates
2.	Disk Assembly with Rate Indicator
3.	CO_2 Port
4.	Ventilation Door
5.	Handle Assembly with Scale: high Ventilation rates
6.	Handle Bracket
7.	Wing Nut

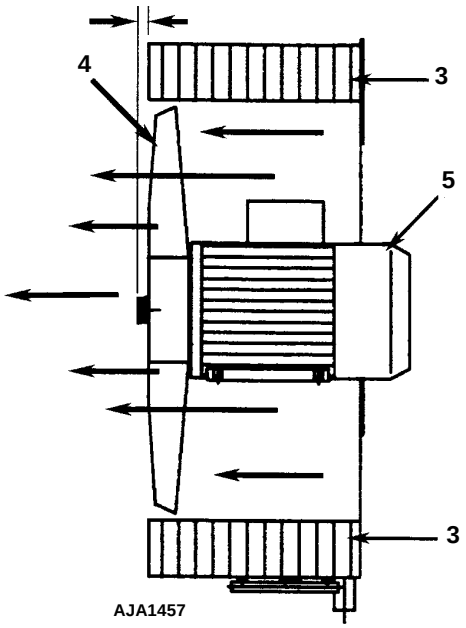
Figure 50: Air Exchange System

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:- CRR40and CRR40SL Models: 150 to 280 m 3 /hr (90 to 165 ft 3 /min.)

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.



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

Figure 51: Condenser Fan Blade Placement

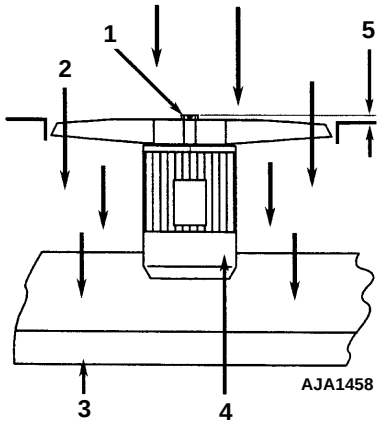
Condenser Fan Location

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.

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.

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.

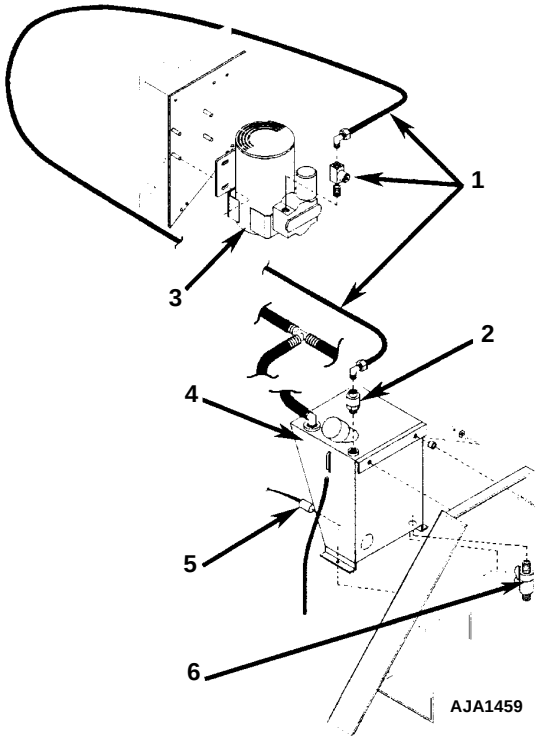


1.	Evaporator Fan Blade
2.	Airflow Direction
3.	Evaporator Coil
4.	Evaporator Motor
5.	13 mm (0.5 in.)

Figure 52: Evaporator Fan Blade Placement

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.



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

Figure 53: Humidify System (Option)

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.

Diagnosis

Mechanical Diagnosis

Condition	Possible Cause	Remedy
Compressor does not operate- no amperage draw	Controller ON; unit start sequence still timing	Wait up to 3 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 pressure cutout switch	Replace high pressure cutout 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
Compressor does not operate; excessive amperage draw or intermittent cycling on overload ***NOTE: Controller sequence starts the compressor when the unit has been off for more than 18 hours.***	Piston stuck	Remove compressor head. Look for broken valve and jammed parts
	Seized or frozen compressor bearings	Replace compressor
	Improperly wired	Check/correct wiring against wiring diagram
	Low line voltage	Check line voltage-determine location of voltage drop
	High head pressure	Eliminate cause of high head pressure
	Contacts in compressor contactor not closing completely	Check by operating manually. Repair or replace
	Open circuit in compressor motor winding	Check motor stator connections. Check stator winding for continuity. If open, replace compressor
	Defective compressor motor internal thermal overload protector	Replace thermal overload protector or compressor

Condition	Possible Cause	Remedy
Compressor contactor burned out	Low line voltage	Increase line voltage to at least 90% of compressor motor rating
	Excessive line voltage	Reduce line voltage to at least 110% of compressor motor rating
	Short cycling	Eliminate cause of short cycling
Unit short cycles	Refrigerant overcharge causing cycling on high pressure cutout	Purge system
	Inefficient condenser operation causing cycling on high pressure cutout	Check condenser airflow, condenser fan motor, condenser fan grille, water pressure switch (option), water flow rate (option) and \water-cooled condenser-receiver tank (optional)
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Loose mounting bolts	Tighten mounting bolts
	Oil slugging or refrigerant flooding back	Add oil or refrigerant charge. Check expansion valve adjustment
	Worn fan motor bearings	Replace bearings or motor
	Faulty compressor	Repair or replace compressor
Condenser fan motor does not operate	Unit in Heat or Defrost	Check indicator lights. If unit is in Heat or Defrost, unit operation is normal (no remedy required)
	Unit in Cool with Low condenser temperature	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)
	Condenser Fan switch OFF (Water-cooled position) (Option)	If unit is on water cooled condenser operation, unit operation is normal. Otherwise Condenser Fan On/Off switch position must be ON for air-cooled condenser operation.
	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 condenser fan contactor	Replace defective contactor
	No condenser fan output signal from controller	Diagnose and replace condenser fan relay, main relay board, or controller

Condition	Possible Cause	Remedy
Evaporator fan motor(s) does not operate	Unit on defrost	Check operating mode indicator LED's
	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
Unit operating in a vacuum (unit not cooling) ***NOTE: When unit is in Cool with Modulation or the return air temperature is below -18 C (0 F), the suction pressure will be less than 0 kPa, 0 bar, 0 psig during normal operation***	Shortage of refrigerant	Repair leak and recharge
	Compressor motor contacts frozen	Clean points or replace contactor
	Compressor inefficient	Check valves and pistons
	Defective liquid line solenoid valve	Repair or replace liquid line solenoid valve
	Partial obstruction in low side or filter drier	Locate obstruction and repair
	Iced or plugged evaporator coil	Defrost or clean evaporator coil
	Expansion valve partially closed by ice, dirt or wax	Clean or replace expansion valve
	Expansion valve power element lost its charge	Replace expansion valve
	Defective container insulation	Correct or replace container insulation
	Poor fitting container doors	Repair or replace doors
	Partial obstruction in high side	Locate obstruction and repair
	Suction pressure gauge out of calibration	Replace service gauge
	Evaporator pressure regulator (KVQ) valve stuck closed or defective	Repair or replace valve
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact	Correct feeler bulb installation

Condition	Possible Cause	Remedy
Load temperature too high (unit not cooling)	Compressor does not operate	See “Mechanical Diagnosis”
	Shortage of refrigerant	Repair leak and recharge
	Overcharge of refrigerant	Purge system
	Air in refrigeration system	Evacuate and recharge
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Controller setpoint too high	Adjust controller setpoint
	Too much compressor oil in system	Remove compressor oil from compressor
	Iced or dirty evaporator coil	Defrost or clean evaporator coil
	Restricted lines on high side	Clear restriction
	Plugged dehydrator	Change dehydrator
	Compressor inefficient	Perform compressor efficiency test. Check valves and pistons
	Evaporator pressure regulator (KVQ) valve stuck closed or defective	Repair or replace valve
	Condenser coil dirty or airflow restricted	Clean condenser coil, clear restriction, or repair or replace fan motor or condenser fan blade
	Water-cooled Condenser: COndenser Fan switch OFF and no water flow to water-cooled condenser	Restore water flow to water-cooled condenser-receiver tank or turn Condenser fan blade
	Expansion valve open too much	Adjust or replace valve
	Expansion valve power element lost its charge	Replace power element
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact	Correct feeler bulb installation
Condition	**Possible Cause**	**Remedy**

Head pressure too low ***NOTE: This unit has a suction modulation capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is in Modulation Cool (control temperature within 10 C [18 F] of setpoint or in Power Limit mode).***	Shortage of refrigerant Low ambient air temperature Service gauge out of calibration Compressor suction or discharge valve inefficient	Repair leak and recharge No remedy Replace gauge Clean or replace leaking valve plates
Head pressure too high	Refrigerant overcharge Air in refrigeration system Dirty or restricted condenser coil Condenser fan not operating Condenser fan grille damaged or missing Condenser fan blade damaged High ambient air temperature Restricted filter drier or high side Defective high pressure gauge	Purge system Evacuate and recharge Clean condenser coil See “Condenser fan motor does not operate” under Mechanical Diagnosis Repair or replace grille Replace fan blade No remedy Replace filter drier or clear restriction Replace service gauge
Compressor loses oil	Refrigerant leak	Repair leak and recharge
Compressor oil migrates to system	Short cycling	See “Unit short cycles” under Mechanical Diagnosis”
Rapid cycling between Cool and Heat modes	Air short cycling through evaporator Defective controller or main relay board Short Cycling Evaporator pressure regulator (KVQ) valve stuck closed or defective	Check and correct cargo load Diagnose main relay board and controller. Replace defective component See “Unit short cycles” under Mechanical Diagnosis Repair or replace valve
Hot liquid line	Shortage of refrigerant Expansion valve open too wide	Repair or recharge Adjust or replace expansion valve
Frosted liquid line	Liquid line service valve partially closed or restricted Restricted filter drier	Open valve or remove restriction Replace filter drier
Condition	**Possible Cause**	**Remedy**

Frosted or sweating suction line	Expansion valve admitting excess refrigerant	Check feeler bulb and adjust expansion valve
	Evaporator coil needs defrosting	Check defrost circuit including controller and evaporator coil sensor
	Evaporator fan does not operate	See “Evaporator fan motor does not operate” under Mechanical Diagnosis
Unit in vacuum. Frost on expansion valve only	Ice plugging expansion valve screen or orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace filter drier
High suction pressure	Overcharge of refrigerant	Purge system
	Expansion valve open too much	Adjust or replace valve
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Suction pressure gauge out of calibration	Adjust or replace service gauge
Low suction pressure ***NOTE: This unit has a suction modulation capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is on Modulation Cool (control temperature within 10 C [18 F] of setpoint or in Power Limit mode).***	Shortage of refrigerant	Repair leak and recharge
	Low ambient air temperature	No remedy
	Iced or dirty evaporator coil	Defrost or clean evaporator coil
	Restricted lines	Locate and clear restriction
	Plugged filter drier	Replace filter drier
	Expansion valve closed too much	Adjust or replace valve
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact	Correct feeler bulb installation
	Evaporator fans off	Check evaporator fan motors and control circuit and correct fault
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Suction pressure gauge out of calibration	Adjust or replace gauge

Index

Wiring and Schematic Diagrams Index

REVISIONS						
CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
74687	A	RELEASED	29-Jan-99	OT	OT	OT
75363	B	REMOVED SUBCOOLING AND SIGHTGLASS	2-JUN-99	OT	OT	OT

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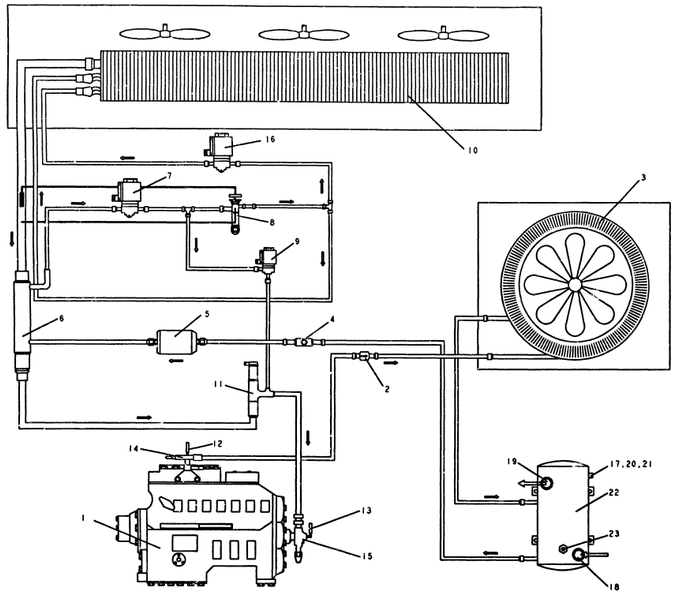

1. Compressor
2. Non return valve
3. Condenser coil
4. Ball valve
5. Drier refrigerant
6. Heat exchanger
7. Liquid solenoid valve
8. TX expansion valve
9. Liquid injection solenoid valve
10. Evaporator coil
11. Evaporator pressure regulator
12. Discharge service
13. Suction service
14. Discharge service valve
15. Suction service valve
16. Dehumidity valve (option)
17. Adapter w.c.c.
18. Coupling, male (water in)
19. Coupling, female (water out)
20. Discharge service valve
21. Fusible plug
22. Condenser, water cooled
23. Sight glass with moisture indicator

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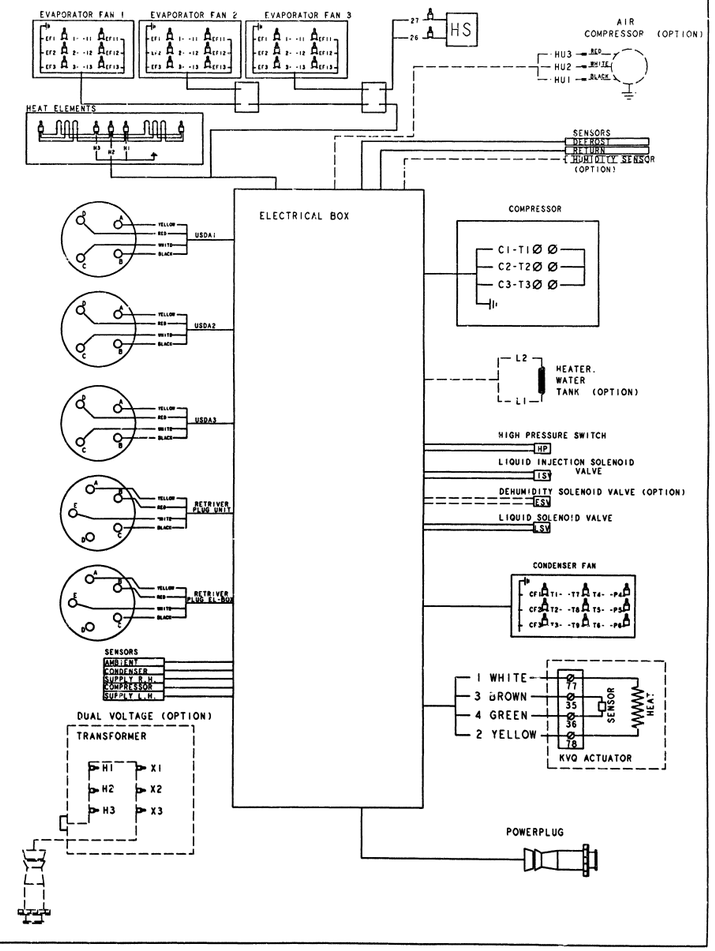

ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
	REV		LIST OF MATERIAL		

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS11-131

THIRD ANGLE PROJECTION

LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS

DRAWING CONFORMS TO ANSI Y14.5M-1982

DESIGN DIMENSIONS ARE IN INCHES. DIMENSIONS IN [] ARE MILLIMETRE EQUIVALENT

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DIAGRAM SCHEMATIC MPC 2000

THERMO KING CORPORATION MINNEAPOLIS, MINNESOTA USA

DRAWING NUMBER	REV
5D51092	B

SCALE NONE | SHEET 1 OF 1

PROE D

MPC2000 High Voltage Wiring Diagram

REVISIONS					
CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
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76515	B	PIN 1 ADDED, POS 3B10291 AND 6A10145 CHANGED	05-Jan-00	LH	OT	OT

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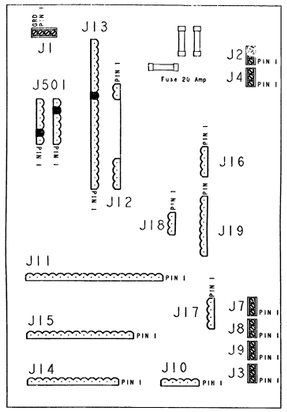

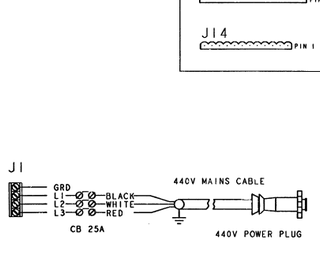

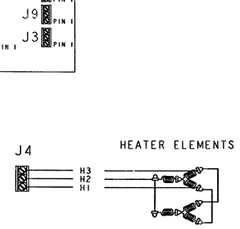

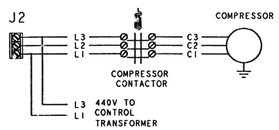

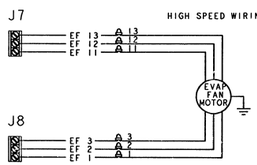

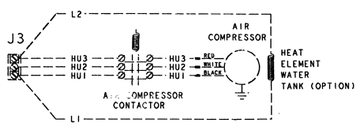

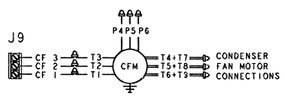

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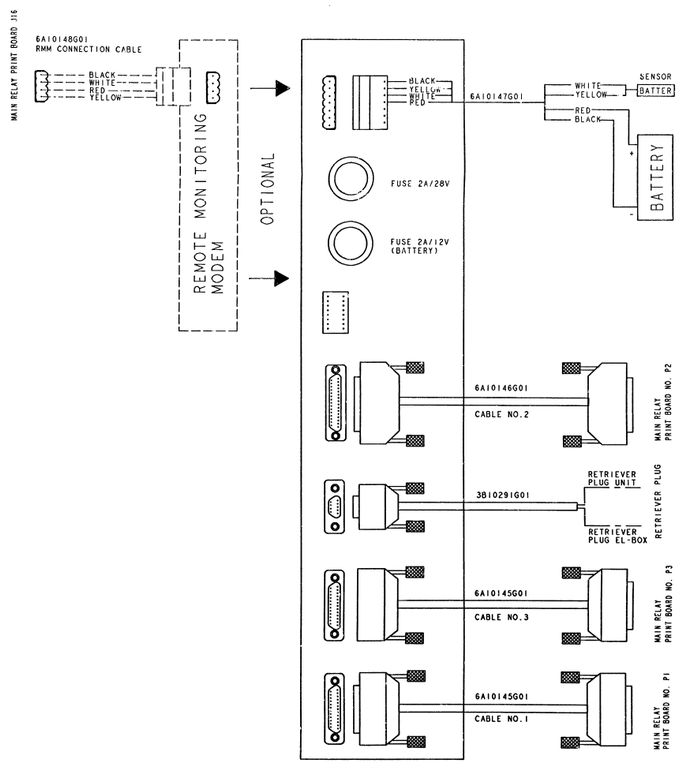

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					REV	LIST OF MATERIAL				

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS11-131

THIRD ANGLE PROJECTION

LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS

DRAWING CONFORMS TO ANSI Y14.5M-1982

DESIGN DIMENSIONS ARE IN INCHES DIMENSIONS IN () ARE MILLIMETRE EQUIVALENT

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DIAGRAM WIRING HIGH VOLTAGE MPC 2000

SCALE NONE SHEET 1 OF 1

THERMO KING CORPORATION MINNEAPOLIS, MINNESOTA USA

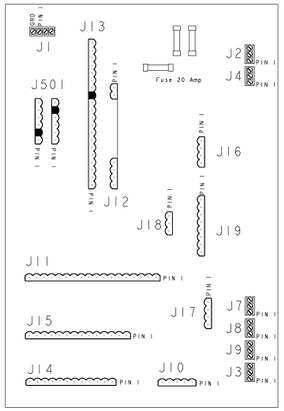
DRAWING NUMBER 5D51093 REV B

PROF D

MPC2000 Low Voltage Wiring Diagram

REVISIONS						
CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
74687	A	RELEASED	29-Jan-99	OT	OT	OT
76515	B	PIN 1 ADDED IN DIAGRAM	05-Jan-00	LH	OT	OT
500555	C	CB 7A CHANGED TO FUSE 7.5 A	16-Oct-01	LG	OT	OT

DIAGRAM CHART NO.: 5D51094



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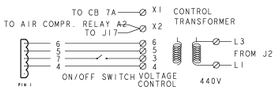

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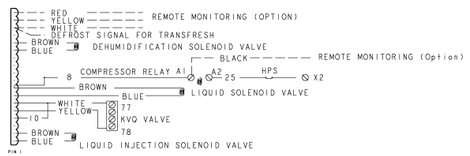

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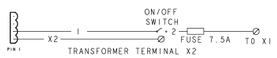

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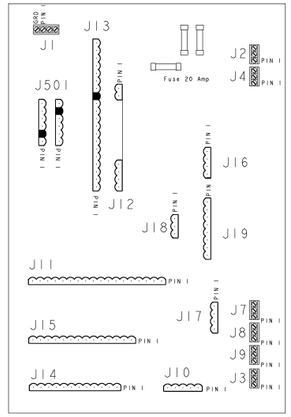
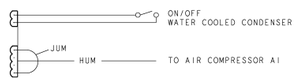
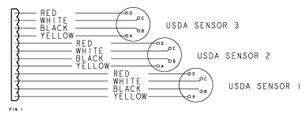


J12 OPTION: WATER COOLED CONDENSER



J13 OPTION: USDA SENSOR



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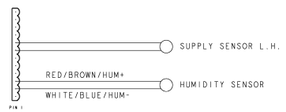

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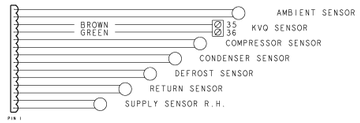

J18 MANUAL CONTROL

J501 MANUAL CONTROL

G05	G04	G03	G02	G01	ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
					REV			LIST OF MATERIAL		

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THIRD ANGLE PROJECTION

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DIAGRAM WIRING LOW VOLTAGE MPC 2000

SCALE NONE SHEET 1 OF 1

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

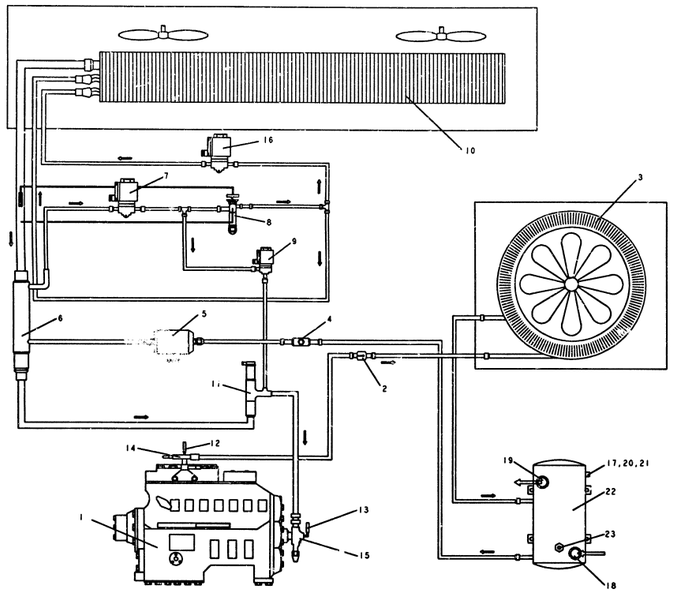
DRAWING NUMBER	REV
5D51094	C

PROE_D

MPC2000 WCC Wiring Schematic

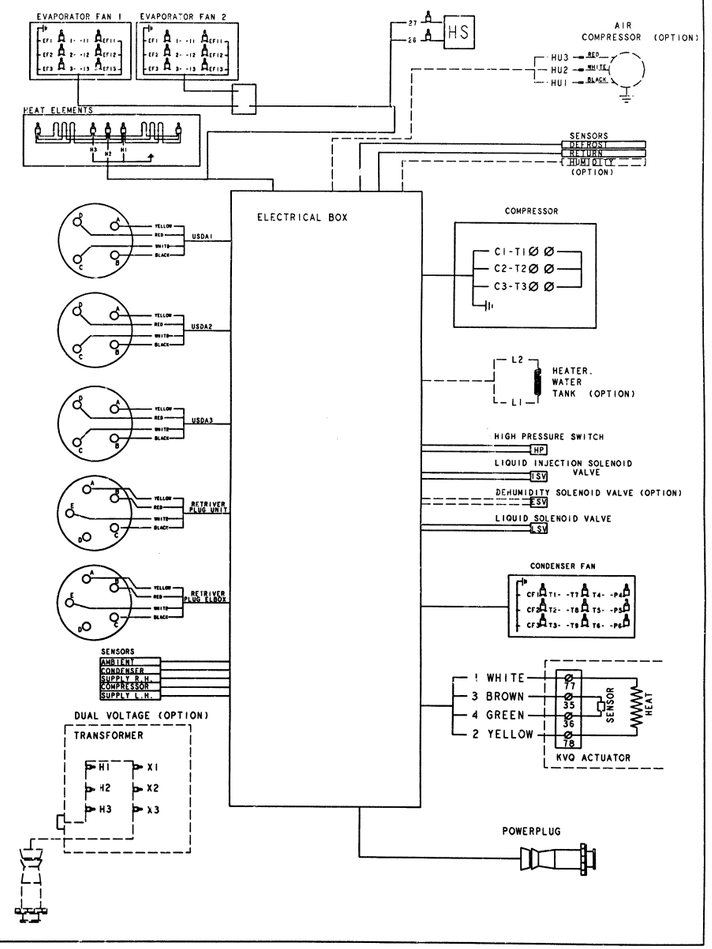
REVISIONS						
CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
74968	A	RELEASED	23-MAR-99	OT	OT	OT
75363	B	REMOVED SUBCOOLING AND SIGTHGLASS	2-JUNI-99	OT	OT	OT

DIAGRAM CHART NO.: 5D51661



1. Compressor
2. Non return valve
3. Condenser coil
4. Ball valve
5. Drier refrigerant
6. Heat exchanger
7. Liquid solenoid valve
8. TX expansion valve
9. Liquid injection solenoid valve
10. Evaporator coil
11. Evaporator pressure regulator
12. Discharge service
13. Suction service
14. Discharge service valve
15. Suction service valve
16. Dehumidity valve (option)
17. Adapter w.c.c.
18. Coupling, male (water in)
19. Coupling, female (water out)
20. Discharge service valve
21. Fusible plug
22. Condenser, water cooled
23. Sight glass with moisture indicator

DIAGRAM CHART NO.: 5D51661



ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
		REV	LIST OF MATERIAL		

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS11-131
THIRD ANGLE PROJECTION
LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS
DRAWING CONFORMS TO ANSI Y14.5M-1982
DESIGN DIMENSIONS ARE IN INCHES DIMENSIONS IN [] ARE MILLIMETRE EQUIVALENT
FINISH NONE

DRAWN	OT	23-MAR-99
CHECKED	OT	23-MAR-99
APPROVED	OT	23-MAR-99
APPROVED	-	-

THIS PRINT SUPERSEDES ANY OF EARLIER DATE DESTROY SAME

DIAGRAM SCHEMATIC
MPC 2000
WCC

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

DRAWING NUMBER 5D51661 | REV B

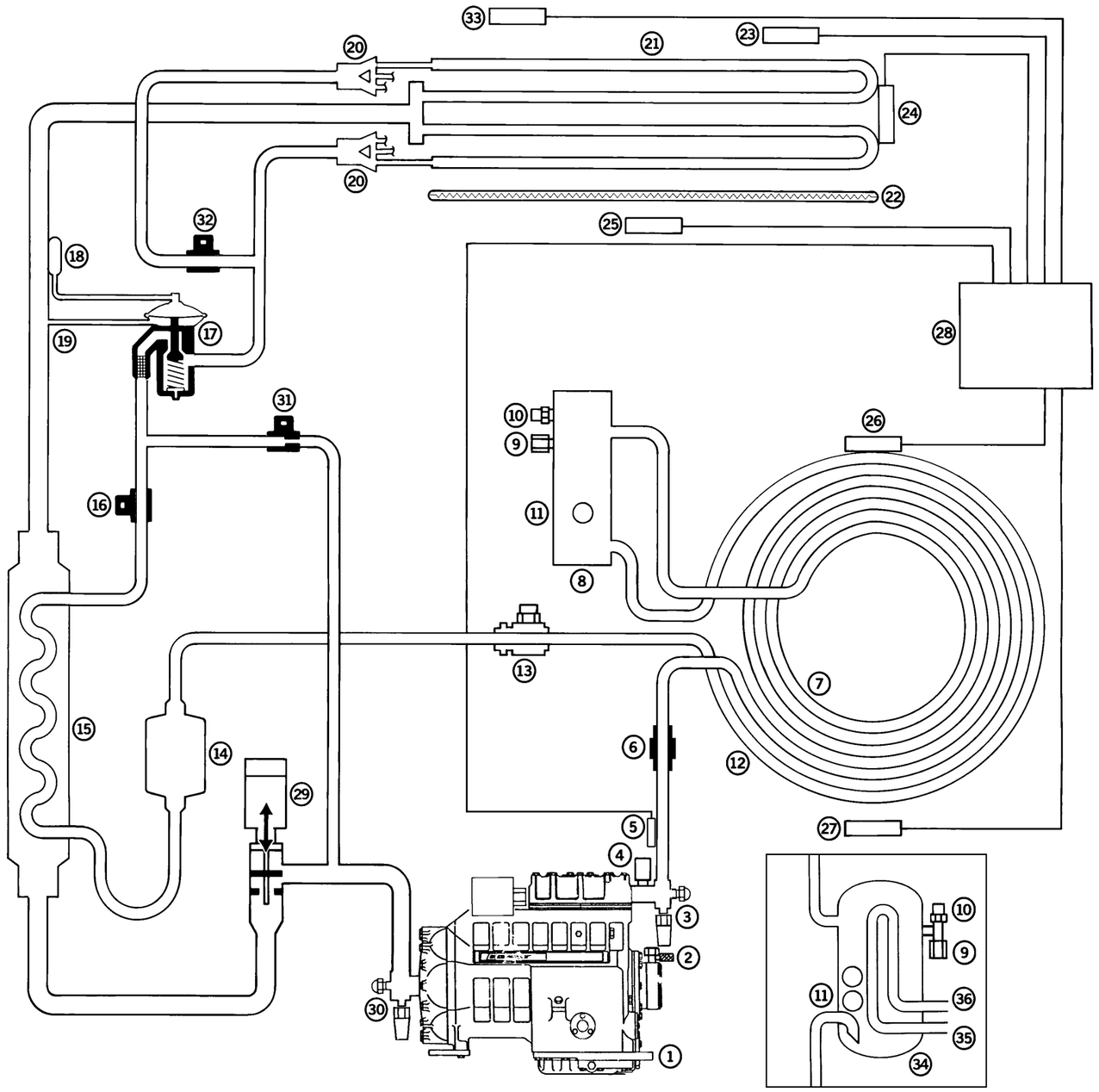
SCALE NONE | SHEET 1 OF 1

PROE D

CRR-40

Refrigeration System Components

1. 3DS Compressor
2. Oil Fill / Drain Fitting
3. Discharge Service Valve
4. High Pressure Cutout Switch
5. Compressor Discharge Line Temperature Sensor
6. Condenser Check Valve
7. Condenser Coil (Circular)
8. Receiver Tank
9. High Pressure Relief (Fusible Plug)
10. Receiver Tank Service Fitting
11. Sight Glass(es)
12. Condenser Coil Subcooler Circuit
13. Liquid Line Service Valve
14. Dehydrator (Filter Drier)
15. Heat Exchanger
16. Liquid Line Solenoid (LLS)
17. Expansion Valve (TXV)
18. Expansion Valve Feeler Bulb
19. Equalizer Line
20. Distributor
21. Evaporator Coil
22. Electric Heaters
23. Return Air Sensor
24. Defrost (Evaporator Coil) Sensor
25. Supply Air Sensor
26. Condenser Coil Sensor
27. Ambient Sensor
28. Controller (MPC2000ID or MP-3000)
29. KVQ Valve (Evaporator Pressure Regulator)
30. Suction Service Valve
31. Liquid Injection Valve
32. Dehumidify Solenoid Valve
33. Humidity Sensor
34. Water-Cooled Condenser-Receiver Tank
35. Water Inlet Coupling
36. Water Outlet Coupling



Flow and Pressure Diagram

CRR-40

Full Cool

1. **D3DS Compressor**
   Compressor operation has a variable delay on initial start-up. A sequence start of the compressor occurs when the compressor has been OFF for more than 18 hours.

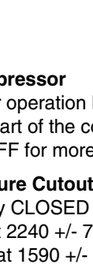
4. **High Pressure Cutout Switch (HPCO)**
   Is a normally CLOSED switch.
   It OPENS at 2240 +/- 70 kPa, 22.4 +/- 0.7 bar, 325 +/- 10 psig.
   It CLOSES at 1590 +/- 70 kPa, 15.9 +/- 0.7 bar, 230 +/- 10 psig.

9. **High Pressure Relief (Fusible Plug)**
   BLOWS at 100 C (212 F).

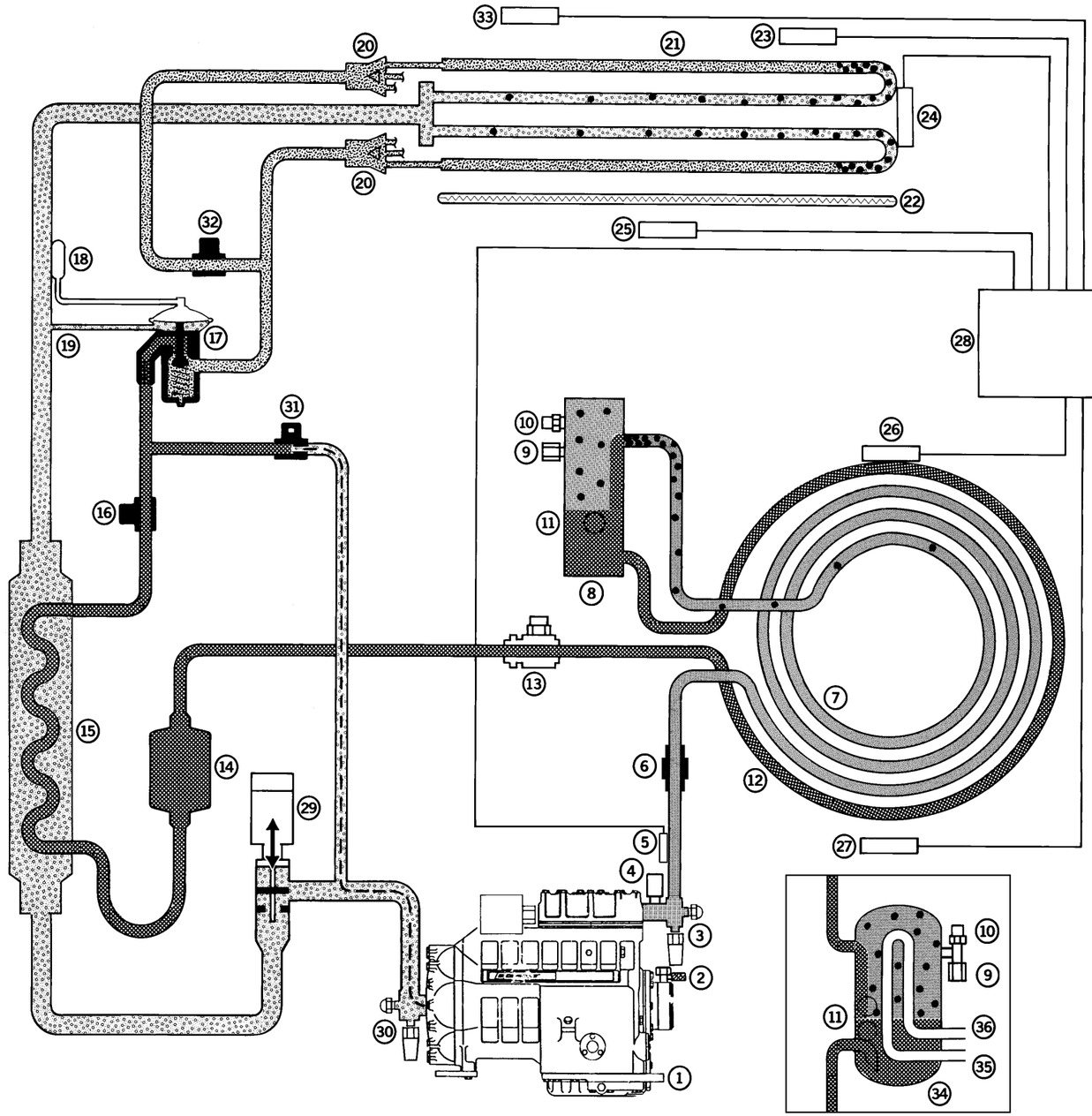
16. **Liquid Line Solenoid (LLS)**
    Is a normally CLOSED solenoid.
    It OPENS when energized, when the compressor operates.

22. **Electric Heaters**
    During the DEFROST mode, the electric heaters are pulsed ON and OFF. The compressor, condenser fan and evaporator fans are OFF.
    During the HEAT mode, the electric heaters are pulsed ON and OFF. The compressor and condenser fan are OFF. The evaporator fans continue to operate (evaporator fan speed is determined by the setpoint and economy mode setting).

28. **Controller**
    Microprocessor with digital thermostat, thermometer and fault indicator monitor.



High pressure gas
High pressure liquid
Low pressure gas
Low pressure liquid
Condensing high pressure gas
Low pressure vaporizing liquid
Liquid refrigerant injection



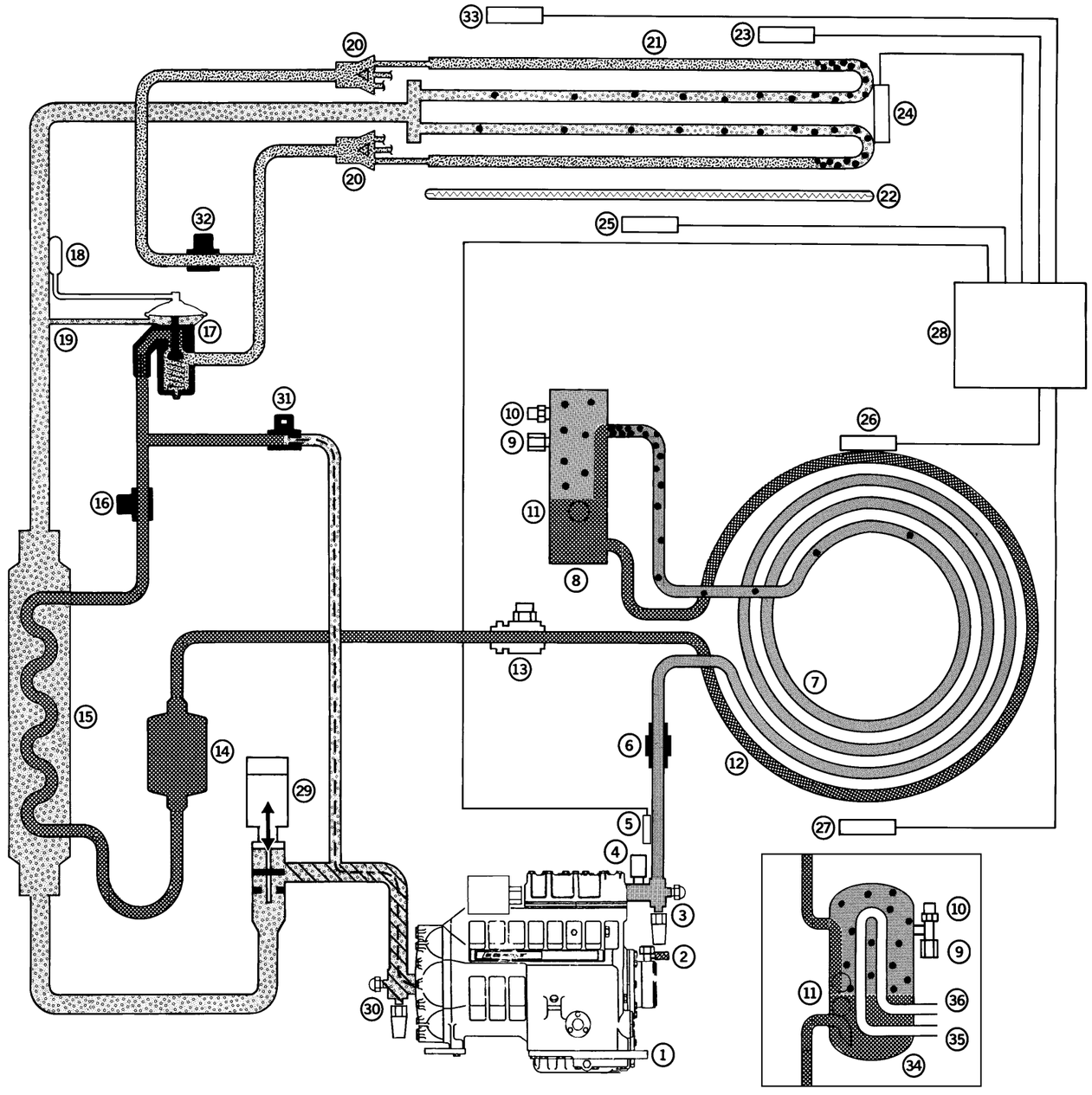
Flow and Pressure Diagram

CRR-40

Cool with Modulation (or Power Limit)

29. Evaporator Pressure Regulator (KVQ Valve)
Is a normally OPEN actuator valve. It CLOSES (or OPENS) according to the strength and frequency of a pulsing voltage signal from the controller. The voltage signal energizes a heating element in the actuator power element. Increasing the temperature of the heating element increases the pressure on the main valve actuator, forcing the valve towards the closed position. Decreasing the temperature of the heating element decreases the pressure on the main valve actuator, drawing the valve towards the open position.

31. Liquid Injection Valve (LIV)
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 duty cycle.
Liquid injection is controlled by the compressor discharge temperature and the temperature control algorithm.



High pressure gas
High pressure liquid
Low pressure gas
Low pressure liquid
Condensing high pressure gas
Low pressure vaporizing liquid
Liquid refrigerant injection
Modulated pressure

Flow and Pressure Diagram

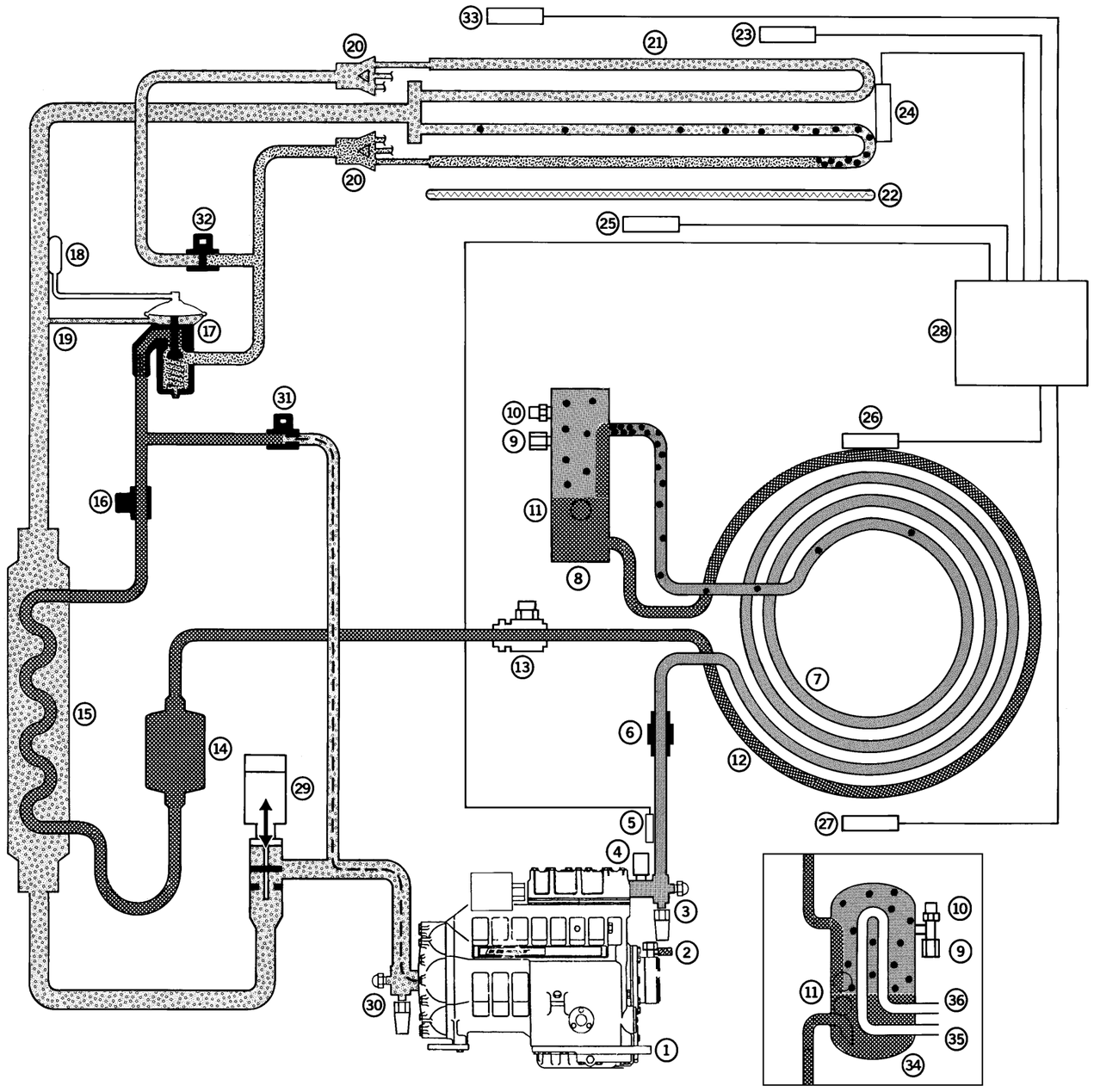
CRR-40

Dehumidification

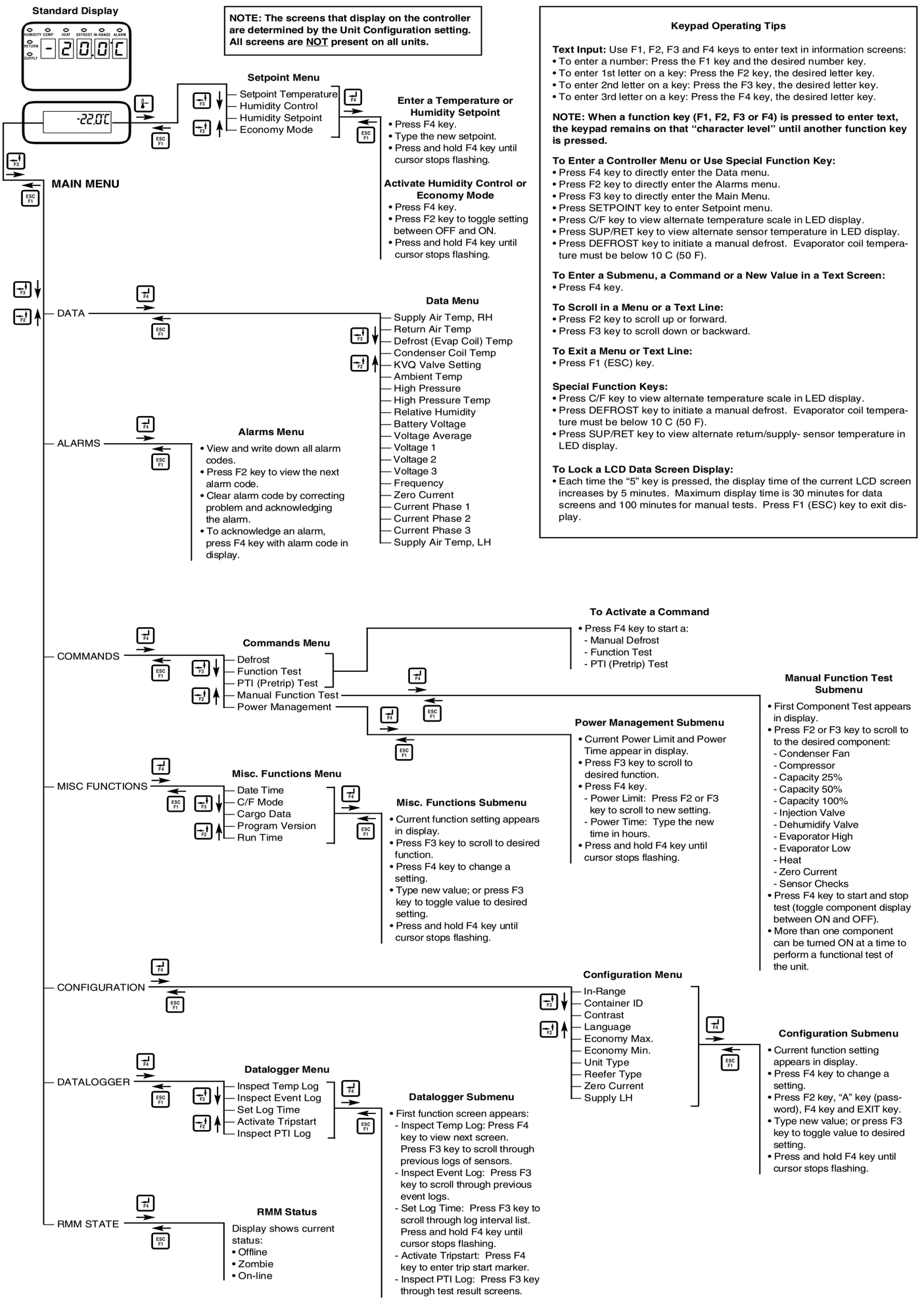
32. Dehumidify Solenoid Valve (DSV)
Is a normally OPEN valve.
If the container humidity is 2% or more above the humidity setpoint and the KVQ valve has reduced cooling capacity by about 25%, the controller will energize (CLOSE) the normally open solenoid. This closes refrigerant distribution to 50% of the evaporator coil, thereby lowering the temperature of the active part of the coil and condensing more moisture from the container air.

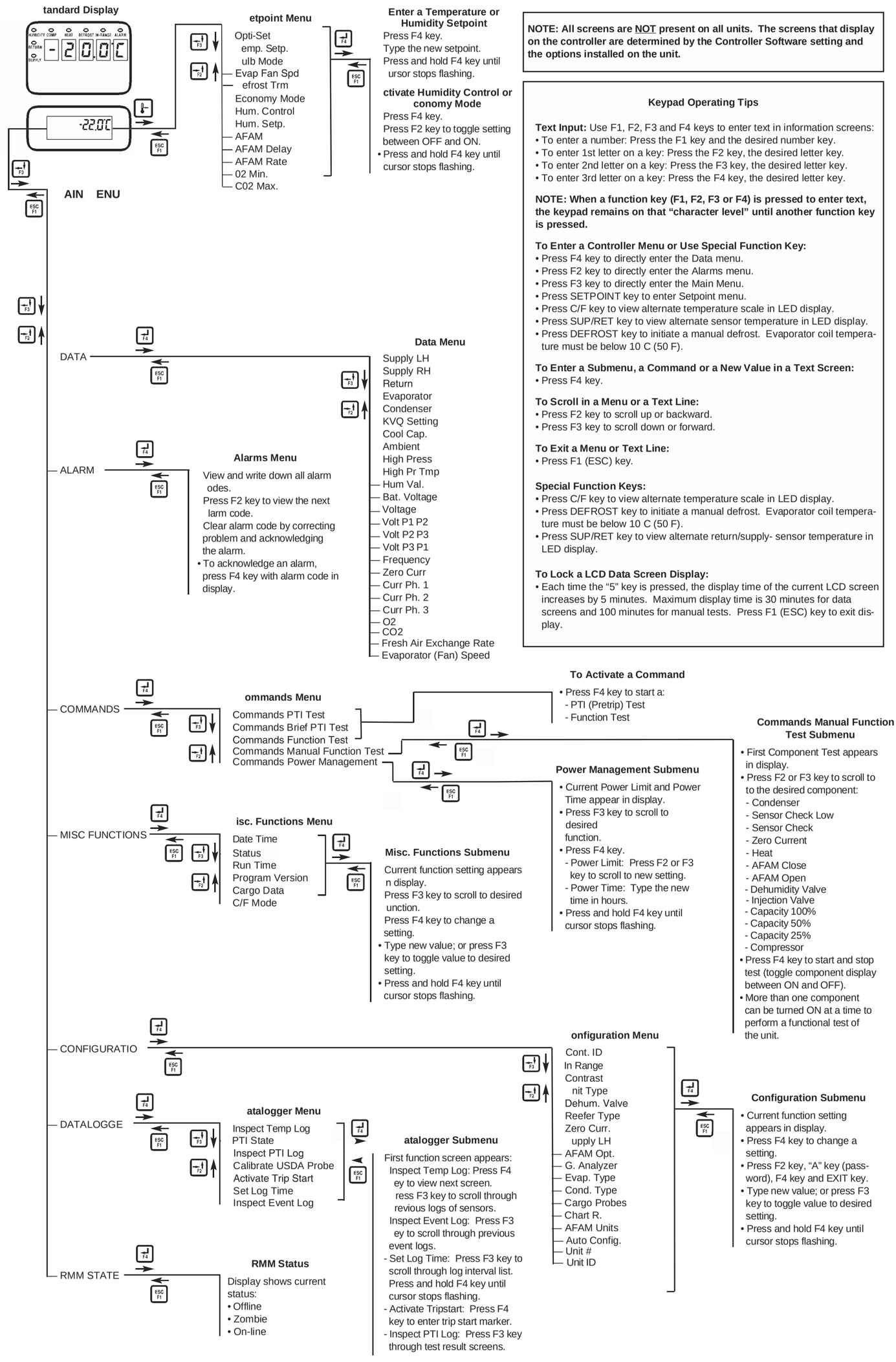
22. Electric Heaters
If the container humidity is 5% or more above the humidity setpoint, and the KVQ valve has closed to reduce cooling capacity by about 50%, the controller will pulse the electric heaters ON and OFF. This increases the cooling load on the evaporator coil, thereby lowering the temperature of the entire coil and condensing more moisture from the container air.

33. Humidity Sensor (rH)
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.



- High pressure gas
- High pressure liquid
- Low pressure gas
- Low pressure liquid
- Condensing high pressure gas
- Low pressure vaporizing liquid
- Liquid refrigerant injection


Standard Display
HUMIDITY COMP
HEAT
DEFROST
IN-RANGE
ALARM
RETURN
SUPPLY
-20.0C
-22.0C
NOTE: The screens that display on the controller are determined by the Unit Configuration setting. All screens are NOT present on all units.
Setpoint Menu
Setpoint Temperature
Humidity Control
Humidity Setpoint
Economy Mode
Enter a Temperature or Humidity Setpoint
• Press F4 key.
• Type the new setpoint.
• Press and hold F4 key until cursor stops flashing.
Activate Humidity Control or Economy Mode
• Press F4 key.
• Press F2 key to toggle setting between OFF and ON.
• Press and hold F4 key until cursor stops flashing.
MAIN MENU
DATA
Data Menu
Supply Air Temp, RH
Return Air Temp
Defrost (Evap Coil) Temp
Condenser Coil Temp
KVQ Valve Setting
Ambient Temp
High Pressure
High Pressure Temp
Relative Humidity
Battery Voltage
Voltage Average
Voltage 1
Voltage 2
Voltage 3
Frequency
Zero Current
Current Phase 1
Current Phase 2
Current Phase 3
Supply Air Temp, LH
ALARMS
Alarms Menu
• View and write down all alarm codes.
• Press F2 key to view the next alarm code.
• Clear alarm code by correcting problem and acknowledging the alarm.
• To acknowledge an alarm, press F4 key with alarm code in display.
COMMANDS
Commands Menu
Defrost
Function Test
PTI (Pretrip) Test
Manual Function Test
Power Management
To Activate a Command
• Press F4 key to start a:
- Manual Defrost
- Function Test
- PTI (Pretrip) Test
Manual Function Test Submenu
• First Component Test appears in display.
• Press F2 or F3 key to scroll to to the desired component:
- Condenser Fan
- Compressor
- Capacity 25%
- Capacity 50%
- Capacity 100%
- Injection Valve
- Dehumidify Valve
- Evaporator High
- Evaporator Low
- Heat
- Zero Current
- Sensor Checks
• Press F4 key to start and stop test (toggle component display between ON and OFF).
• More than one component can be turned ON at a time to perform a functional test of the unit.
Power Management Submenu
• Current Power Limit and Power Time appear in display.
• Press F3 key to scroll to desired function.
• Press F4 key.
- Power Limit: Press F2 or F3 key to scroll to new setting.
- Power Time: Type the new time in hours.
• Press and hold F4 key until cursor stops flashing.
MISC FUNCTIONS
Misc. Functions Menu
Date Time
C/F Mode
Cargo Data
Program Version
Run Time
Misc. Functions Submenu
• Current function setting appears in display.
• Press F3 key to scroll to desired function.
• Press F4 key to change a setting.
• Type new value; or press F3 key to toggle value to desired setting.
• Press and hold F4 key until cursor stops flashing.
CONFIGURATION
Configuration Menu
In-Range
Container ID
Contrast
Language
Economy Max.
Economy Min.
Unit Type
Reefer Type
Zero Current
Supply LH
Configuration Submenu
• Current function setting appears in display.
• Press F4 key to change a setting.
• Press F2 key, “A” key (password), F4 key and EXIT key.
• Type new value; or press F3 key to toggle value to desired setting.
• Press and hold F4 key until cursor stops flashing.
DATALOGGER
Datalogger Menu
Inspect Temp Log
Inspect Event Log
Set Log Time
Activate Tripstart
Inspect PTI Log
Datalogger Submenu
• First function screen appears:
- Inspect Temp Log: Press F4 key to view next screen. Press F3 key to scroll through previous logs of sensors.
- Inspect Event Log: Press F3 key to scroll through previous event logs.
- Set Log Time: Press F3 key to scroll through log interval list. Press and hold F4 key until cursor stops flashing.
- Activate Tripstart: Press F4 key to enter trip start marker.
- Inspect PTI Log: Press F3 key through test result screens.
RMM STATE
RMM Status
Display shows current status:
• Offline
• Zombie
• On-line
Keypad Operating Tips
Text Input: Use F1, F2, F3 and F4 keys to enter text in information screens:
• To enter a number: Press the F1 key and the desired number key.
• To enter 1st letter on a key: Press the F2 key, the desired letter key.
• To enter 2nd letter on a key: Press the F3 key, the desired letter key.
• To enter 3rd letter on a key: Press the F4 key, the desired letter key.
NOTE: When a function key (F1, F2, F3 or F4) is pressed to enter text, the keypad remains on that “character level” until another function key is pressed.
To Enter a Controller Menu or Use Special Function Key:
• Press F4 key to directly enter the Data menu.
• Press F2 key to directly enter the Alarms menu.
• Press F3 key to directly enter the Main Menu.
• Press SETPOINT key to enter Setpoint menu.
• Press C/F key to view alternate temperature scale in LED display.
• Press SUP/RET key to view alternate sensor temperature in LED display.
• Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10 C (50 F).
To Enter a Submenu, a Command or a New Value in a Text Screen:
• Press F4 key.
To Scroll in a Menu or a Text Line:
• Press F2 key to scroll up or forward.
• Press F3 key to scroll down or backward.
To Exit a Menu or Text Line:
• Press F1 (ESC) key.
Special Function Keys:
• Press C/F key to view alternate temperature scale in LED display.
• Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10 C (50 F).
• Press SUP/RET key to view alternate return/supply- sensor temperature in LED display.
To Lock a LCD Data Screen Display:
• Each time the “5” key is pressed, the display time of the current LCD screen increases by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests. Press F1 (ESC) key to exit display.



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Keypad Operating Tips

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