THERMO KING

Maintenance Manual

Superfreezer CRR DF MP3000

Revision B

June 2022

TK 50134-4-MM-EN

TRANE TECHNOLOGIES

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Introduction

This manual is published for informational purposes only. Thermo King® makes no representations warranties express or implied, with respect to the information recommendations and descriptions contained herein. Information provided should not be regarded as all-inclusive or covering all contingencies. If further information is required, Thermo King Service Department should be consulted.

Thermo King's warranty shall not apply to any equipment which has been "so installed, maintained, repaired or altered as, in the manufacturer's judgment, to affect its integrity."

Manufacturer shall have no liability to any person or entity for any personal injury, property damage or any other direct, indirect, special, or consequential damages whatsoever, arising out of the use of this manual or any information, recommendations or descriptions contained herein. The procedures described herein should only be undertaken by suitably qualified personnel. Failure to implement these procedures correctly may cause damage to the Thermo King unit or other property or personal injury.

General Information

The maintenance information in this manual covers unit models:

Superfreezer CRR-40 DF with MP3000

For further information, refer to:

Superfreezer CRR DF Parts Manual	TK 50262
Diagnosing Thermo King Container Refrigeration Systems	TK 41166
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.

Revision History

Revision A	(Oct 2021) New manual format, general updates throughout manual.
Revision B	(Jun 2022) Update drawing 5D52338

Recover Refrigerant

Note: *In the USA, EPA Section 608 Certification is required to work on refrigeration systems. In the EU, local F-gas Regulations must be observed when working on refrigeration systems.*

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.

When working on transport temperature control systems, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law. In addition, service personnel must be aware of the applicable European Union, National, Federal, State, and/or Local regulations governing the use of refrigerants and certification of technicians. For additional information on regulations and technician programs, contact your local THERMO KING dealer.

Service Tools - Use the proper service tools. Gauge manifold sets should include appropriate shutoff valves or disconnects near the end of each service line.

Recovery Equipment - Recovery equipment must be used. Proper recovering, storing and recycling of refrigerants is an important part of all service work.

Service Procedures - Recommended procedures must be used to minimize refrigerant loss.

Components may be isolated by closing service valves and performing system pump-downs.

Components unable to be isolated for service must be repaired only after refrigerant is properly recovered.

R-134a/R-23

NOTICE

Equipment Damage!

Use only Polyolester-based refrigeration compressor oil in R-134a/R-23 systems. See Thermo King Parts Manual for part number.

NOTICE

System Contamination!

Do not mix Polyolester and standard synthetic compressor oils. Keep Polyolester compressor oil in tightly sealed containers. If Polyolester oil becomes contaminated with moisture or standard oils, dispose of properly–DO NOT USE.

NOTICE

System Contamination!

When servicing Thermo King R-134a/R-23 unit, use only those service tools certified for and dedicated to R-134a/R-23 refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-23 systems. Please check serial# plate for type and volume of Refrigerant charged. Please do not blend with other refrigerants than the original charged refrigerant

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Table of Contents

Safety Precautions

Danger, Warning, Caution, and Notice

Thermo King® recommends that all service be performed by a Thermo King dealer and to be aware of several general safety practices.

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this unit depend upon the strict observance of these precautions. The four types of advisories are defined as follows:

⚠ DANGER

Hazard!

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Hazard!

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Hazard!

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury and unsafe practices.

NOTICE

Hazard!

Indicates a situation that could result in equipment or property-damage only accidents.

General Practices

⚠ DANGER

Hazard of Explosion!

Never apply heat to a sealed refrigeration system or container. Heat increases internal pressure, which might cause an explosion resulting in death or serious injury.

⚠ DANGER

Hazardous Gases - Personal Protective Equipment (PPE) Required!

Refrigerant in the presence of an open flame, spark, or electrical short produces toxic gases that are severe respiratory irritants which can cause serious injury or possible death. When working with or around hazardous chemicals, ALWAYS refer to the applicable Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ DANGER

Risk of Injury!

Keep your hands, clothing, and tools clear of fans and/or belts when working on a unit that is running or when opening or closing compressor service valves. Loose clothing might entangle moving pulleys or belts, causing serious injury or possible death.

⚠ DANGER

Refrigerant Vapor Hazard!

Do not inhale refrigerant. Use caution when working with refrigerant or a refrigeration system in any confined area with a limited air supply. Refrigerant displaces air and can cause oxygen depletion, resulting in suffocation and possible death. When working with or around hazardous chemicals, ALWAYS refer to the applicable Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ WARNING

Hazard of Explosion!

Never close the compressor discharge service valve when the unit is operating. Never operate the unit with the discharge valve closed (front seated). This condition increases internal pressure, which can cause an explosion.

⚠ WARNING

Proper Equipment Condition!

Gauge manifold hoses must be in good condition before using them. Never let them come in contact with moving belts, fans, pulleys or hot surfaces. Defective gauge equipment can damage components or cause serious injury.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Always wear goggles or safety glasses and proper PPE when working on a unit. Refrigerant liquid, oil, and battery acid can permanently damage your eyes. When working with or around hazardous chemicals, ALWAYS refer to the applicable Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ WARNING

Equipment Damage and Risk of Injury!

Never drill holes into the unit unless instructed by Thermo King. Holes drilled into high voltage cables could cause an electrical fire, severe personal injury, or even death.

⚠ WARNING

Risk of Injury!

When using ladders to install or service refrigeration systems, always observe the ladder manufacturer's safety labels and warnings. A work platform or scaffolding is the recommended method for installations and servicing.

⚠ CAUTION

Sharp Edges!

Exposed coil fins can cause lacerations. Service work on the evaporator or condenser coils should only be accomplished by a certified Thermo King technician.

NOTICE

Equipment Damage!

All unit mounting bolts must be installed, be the correct length for their application, and torqued to specifications. Missing bolts, incorrect bolt lengths and improper torque specifications can damage equipment and void the warranty.

Refrigerant Hazards

⚠ DANGER

Hazardous Pressures!

Always store refrigerant in proper containers, out of direct sunlight and away from intense heat. Heat increases pressure inside storage containers, which can cause them to burst and could result in severe personal injury.

⚠ DANGER

Combustible Hazard!

Do not use oxygen (O_2) or compressed air for leak testing. Oxygen mixed with refrigerant is combustible.

⚠ WARNING

Hazardous Gases!

Do not use a Halide torch. When a flame comes in contact with refrigerant, toxic gases are produced. These gases can cause suffocation, even death.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Refrigerant in a liquid state evaporates rapidly when exposed to the atmosphere, freezing anything it contacts. Wear butyl lined gloves and other clothing and eye wear when handling refrigerant to help prevent frostbite. When working with or around hazardous chemicals, ALWAYS refer to the applicable Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

NOTICE

Equipment Damage!

When being transferred, refrigerant must be in liquid state to avoid possible equipment damage.

Electrical Hazards

Electrical Precautions

- The possibility of serious or fatal injury from electrical shock exists when servicing a refrigeration unit. Extreme care must be used when working with a refrigeration unit that is connected to its power source.
- Extreme care must be used 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.
- In general, disconnect the units power cord before repairing or changing any electrical components.
- Even though the controller is turned off, one of the phases is still live and represents a potential danger of electrocution.

High Voltage

⚠ DANGER

Hazardous Voltage!

Lethal amounts of voltage are present in some electrical circuits. Use extreme care when working on an operating refrigeration unit. If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.

⚠ WARNING

Hazardous Voltage!

Treat all wires and connections as if they were high voltage until a meter and wiring diagram indicate otherwise. Only use tools with insulated handles. Never hold uninsulated metal tools near exposed, energized conductors. If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.

⚠ WARNING

Hazardous Voltage!

Never work alone on high voltage circuits in the refrigeration unit. Another person should be nearby to shut off the unit and provide aid in the event of an accident. If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

In the event of an electrical accident, all required PPE should be near the work area in accordance with OSHA, NFPE 70E, or other local, state, or country-specific requirements for a Category 2 risk.

⚠ WARNING

Hazardous Voltage!

The unit On/Off switch must be turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.

⚠ WARNING

Risk of Injury!

The unit power plug must be clean and dry before connecting it to a power source.

⚠ WARNING

Risk of Injury!

Do not make rapid moves when working on high voltage circuits in refrigeration units. Do not grab for falling tools because you might accidentally touch a high voltage source.

Low Voltage

⚠ WARNING

Live Electrical Components!

Control circuits are low voltage (24 Vac and 12 Vdc). This voltage potential is not considered dangerous. 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 shortcut electrical circuits and cause severe burns to the wearer.

Electrostatic Discharge Precautions

Precautions must be taken to prevent electrostatic discharge while servicing the microprocessor controller and related components. The risk of significant damage to the electronic components of the unit is possible if these precautionary measures are not followed. 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.

Electrostatic Discharge and the Controller

You must avoid electrostatic discharges when servicing the controller. Solid-state integrated circuit components can be severely damaged or destroyed with less than a small spark from a finger to metal object. You must rigidly adhere to the following statements when servicing these units. This will avoid controller damage or destruction.

- Disconnect all power to the unit.
- Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
- Do wear a static discharge wrist strap (refer to Tool Catalog) with the lead end connected to the controller's ground terminal. These straps are available at most electronic equipment distributors. *Do not* wear these straps with power applied to the unit.
- Avoid contacting the electronic components on the circuit boards of the unit being serviced.
- Leave the circuit boards in their static proof packing materials until ready for installation.
- Return a defective controller for repair in the same static protective packing materials from which the replacement component was removed.
- Check the wiring after servicing the unit for possible errors. Complete this task before restoring power.

Welding on Refrigeration Units or Containers

Electric welding can cause serious damage to electronic circuits when performed on any portion of the refrigeration unit, genset, container, or container chassis with the refrigeration unit attached. It is necessary to verify that welding currents are not allowed to flow through the electronic circuits of the unit. The procedures below MUST be strictly followed when servicing units to avoid damage or destruction of the microprocessor.

1. Disconnect the battery connections (if equipped) and lock out - tag out the unit according to local regulations.
2. Disconnect all power to or from the refrigeration unit or genset.
3. Disconnect all quick-disconnect wire harnesses from the back of the controller.
4. Switch all of the electrical circuit breakers in the control box to the Off position.
5. When steps 1 through 5 are complete, weld the unit and/or container using 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 welding is complete, restore the unit power cables, wiring, and circuit breakers to their normal condition.

First Aid

REFRIGERANT

- **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 warm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection. Get prompt medical attention. Wash contaminated clothing before reuse.
- **Inhalation:** Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.
- **Frost Bite:** In the event of frost bite , the objectives of First Aid are to protect the frozen area from further injury, warm the affected area rapidly, and to maintain respiration.

REFRIGERANT OIL

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. 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 use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.
- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

ENGINE COOLANT

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

BATTERY ACID

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention. Wash skin with soap and water.
- **Skin:** Immediately remove contaminated clothing. Wash skin with large volumes of water, for at least 15 minutes. Wash skin with soap and water. Do not apply fatty compounds. Seek immediate medical assistance.
- **Inhalation:** Provide fresh air. Rinse mouth and nose with water. Seek immediate medical assistance.
- **Ingestion:** If the injured person is fully conscious: make the person drink extensive amounts of milk. Do not induce vomiting. Take the injured person immediately to a hospital.

ELECTRICAL SHOCK

Take IMMEDIATE action after a person has received an electrical shock. Get quick medical assistance, if possible.

The source of the shock must be quickly stopped, by either shutting off the power or removing the victim. If the power cannot be shut off, the wire should be cut with an non-conductive tool, such as a wood-handle axe or thickly insulated cable cutters. Rescuers should wear insulated gloves and safety glasses, and avoid looking at wires being cut. The ensuing flash can cause burns and blindness.

If the victim must be removed from a live circuit, pull the victim away with a non-conductive material. Use wood, rope, a belt or coat to pull or push the victim away from the current. DO NOT TOUCH the victim. You will receive a shock from current flowing through the victim's body. After separating the victim from power source, immediately check for signs of a pulse and respiration. If no pulse is present, start Cardio Pulmonary Resuscitation (CPR). If a pulse is present, respiration might be restored by using mouth-to-mouth resuscitation. Call for emergency medical assistance.

ASPHYXIATION

Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.

Identifying Unit Safety and Warning Decals

Serial Number Location

Serial numbers can be found on the component's nameplate.

- Electric Motor: Attached to the motor housing.
- Compressor: On front of the compressor.
- Unit: On unit frame in power cord storage compartment.
- Controller: On top of controller.

Service Guide

A closely followed maintenance program will help to keep your Thermo King unit in top operating condition. The following table should be used as a guide when inspecting or servicing components on this unit.

Pretrip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Electrical:
•			Perform a controller pretrip inspection (PTI) check.
•	•	•	Visually check condenser fan and evaporator fan.
•	•	•	Visually inspect electrical contacts for damage or loose connections.
•	•	•	Visually inspect wire harnesses for damage or loose connections.
	•	•	Download the data logger and check data for correct logging.
		•	Check operation of protection shutdown circuits.
			Refrigeration:
•	•	•	Check refrigerant charge.
	•	•	Check for proper discharge and suction pressures.
		•	Check filter drier/in-line filter for a restriction pressures.
			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.
Note: *If a unit has been carrying cargo which contains a high level of sulphor or phosphorous (e.g., garlic, salted fish etc.), it is recommended to clean the evaporator coil after each trip.*			

Specifications

Full Cool Operation Net Cooling Capacity

Table 1. CRR DF Model - Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consumption	Net Cooling Capacity			Power Consumption
	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	kW @460V	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	kW @380V
-30C (-22F)	8,250	7,094	28,175	16.3	7,112	6,115	24,289	13.6
**-70 C (-94 F)	3,744	3,219	12,786	9.6	3,228	2,775	11,023	7.7

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

**Lowest possible set-point - provided Box Size is set to 10´ or 20´. -65C would be lowest possible set-point for Box Size 40´"

System Net Defrost Heating Capacity

Table 2. CRR DF Model - System Net Defrost Heating Capacity

Heater Type	460V, 3 Phase, 60 Hz Power			380V, 3 Phase, 50 Hz Power		
	Heating Capacity			Heating Capacity		
	Watts	Kcal/hr	BTU/hr	Watts	Kcal/hr	BTU/hr
Electric resistance rods	8,160	7,018	27,850	6,000	5,160	20,475

Evaporator Airflow

Table 3. CRR DF Model - Evaporator Airflow*

External Static Pressure (water column)	460V, 3 Phase, 60 Hz Power		380V, 3 Phase, 50 Hz Power	
	Low Speed		Low Speed	
	m3/hr	ft3/min	m3/hr	ft3/min
0 mm (0 in.)	3,700	1,835	2,900	1,708
10 mm (0.4 in.)	3,300	1,943	2,350	1,384
20 mm (0.8 in.)	2,800	1,649	1,750	1,031
30 mm (1.2 in.)	2,300	1,355	1,000	589

*22° pitch fan blades.

R-134a Refrigeration System

Table 4. CRR DF Model - R-134a Refrigeration System

Compressor Model No.	D3DST-075E-TFD, Semi-hermetic Reciprocating with Copeland Discus® Valve Design
Refrigerant Charge	3.5 Kg (7.7 lb) R-134a
Compressor Oil Capacity	4.6 liter (4.86 qt)*

Table 4. CRR DF Model - R-134a Refrigeration System (continued)

Compressor Oil Type	Polyol Ester Based Type (required), TK Part No. 203-433**
Typical System Pressures at 37.8 C (100 F) Ambient	
Standby (Unit Off, Empty Box): High Side	—
Low Side	—
-30 C (-22 F) Box, Unit Cooling: High Side	1500 to 1800 kPa, 15.0 to 18.0 bar, 218 to 261 psig
Low Side	60 to 90 kPa, 0.60 to 0.90 bar, 9 to 13 psig
-60 C (-76 F) Box, Unit Cooling: High Side	1380 to 1500 kPa, 13.8 to 15.0 bar, 200 to 218 psig
Low Side	20 to 50 kPa, 0.20 to 0.50 bar, 3 to 7 psig
High Pressure Cutout Switch	
Cutout	2410 ± 68kPa, 24.10 ± 0.68 bar, 350 ± 10 psig
Cutin	1640 ± 68kPa, 16.4 ± 0.68 bar, 238 ± 10 psig
Fusible Plug (High Pressure Relief) Relief Temp.	100 C (212 F)

R-23 Refrigeration System

Table 5. CRR DF Model - R-23 Refrigeration System

Compressor Model No.	ZM18K4E-TFD-N275, Hermetic Scroll
Refrigerant Charge Evacuated System **Add Partial Charge by Pressure**	3.2 Kg (7.05 lb) R-23 Charge to 1700 kPa, 17.00 bar, 247 psig
Compressor Oil Capacity	1.77 liter (60 oz.)*
Compressor Oil Type	Polyol Ester Based Type (required), TK Part No. 203-433**
Typical System Pressures at 37.8 C (100 F) Ambient Standby (Unit Off, Empty Box): High and Low Side	
0 C / 32 F 20 C / 68 F 38 C / 100 F	1600 kPa, 16.0 bar, 232 psig 1700 kPa, 17.0 bar, 2247 psig 1800 kPa, 18.0 bar, 261 psig
-30 C (-22 F) Box, Unit Cooling: High Side Low Side	2100 to 2300 kPa, 21.0 to 23.0 bar, 305 to 334 psig 250 to 280 kPa, 2.5 to 2.8 bar, 36 to 41 psig
-60 C (-76 F) Box, Unit Cooling: High Side Low Side	1400 to 1600 kPa, 14.0 to 16.0 bar, 203 to 232 psig 900 to 1100 kPa, 0.9 to 1.1 bar, 131 to 160 psig
High Pressure Cutout Switch	
Cutout Cutin	3250 ± 50 kPa, 32.5 ± 0.50 bar, 470 ± 7 psig 2590 ± 250 kPa, 25.90 ± 2.5 bar, 375 ± 38 psig
High Pressure Relief Valve	
Relief Pressure Reset	3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig 2758 kPa, 27.58 bar, 400 psig

*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!*

Electrical System

Table 6. CRR DF Model - Electrical System

R-134a Circuit Compressor Motor:		
Type	Semi-hermetic Reciprocating	
Voltage	460/380V, 60/50 Hz, 3 Phase	
Kilowatts (60 Hz)	5.60 kW	
Horsepower (60 Hz)	7.5 hp	
RPM (60 Hz)	1750 rpm	
Full Load Amps	15.5 amps — 460V; 15.5 amps — 380V	
Locked Rotor Amps (60 Hz)	83 amps — 460V; 82 to 91 amps — 380V	
R-23 Circuit Compressor Motor:		
Type	Hermetic Scroll	
Voltage	460/380V, 60/50 Hz, 3 Phase	
Kilowatts (60 Hz)	4.48 kW	
Horsepower (60 Hz)	6.0 hp	
RPM (60 Hz)	3550 rpm	
Full Load Amps (60 Hz)	11 amps — 460V	
Locked Rotor Amps (60 Hz)	70 amps — 460V	
Condenser Fan Motor:		
Type	460/380V, 60/50 Hz, 3 Phase	460/380V, 60/50 Hz
Kilowatts (60 Hz)	1.5 kW	749 Watts
Horsepower (60 Hz)	2.0 hp	0.75 hp
RPM (60 Hz)	1725 rpm	1725 rpm
Full Load Amps (60 Hz)	3.1 amps — 460V	1.25 amps
Locked Rotor Amps (60 Hz)	25 amps — 460V	35.7 amps
Evaporator Fan Motors*:		
Type	460/380V, 60/50 Hz, 3 Phase	
Number	3	
Kilowatts (60 Hz) (Each)	0.75 kW	
Horsepower (60 Hz) (Each)	1.0 hp	
RPM (60 Hz) (Each)	3450 rpm, High Speed1725 rpm, Low Speed*	
Full Load Amps (60 Hz) (Each)	1.4 amps — 460V, High Speed0.5 amps — 460V, Low Speed	
Locked Rotor Amps (60 Hz)	10.3 amps — 460V, High Speed*2.9 amps — 460V, Low Speed*	
Electric Resistance Heater Rods:		
Type	460/380V, 60/50 Hz, 3 Phase	
Number	12	
Watts (60 Hz) (Each)	680 Watts	
Current Draw (Amps)	10 amps nominal (total) across each phase at the heater contactor	

Table 6. CRR DF Model - Electrical System (continued)

Control Circuit Voltage:	29 Vac @ 60 Hz; 24 Vac @ 50 Hz
Evaporator Overheat Switch:	
Opens	54 ±3 C (130 ±5 F)
Closes	38 ±4C (100 ±8 F)

*CRR DF applications operates the two-speed evaporator fan motors continuously on low speed. Evaporator fans stop during defrost.

Microprocessor Controller

Table 7. CRR DF Model - Microprocessor Controller

Temperature Controller:	
CRR-40 DF MP3000	MP3000 microprocessor
Description	MP3000 microprocessors include thermostat, digital thermometer, programming keypad, mode indicators, LED display and LCD display for displaying unit operating and cargo information. Data logger is furnished separately on units equipped MP3000 microprocessor.
Setpoint Range	-60.0 to -10.0 C (-76.0 to +14.0 F)
Digital Temperature Display	-80.0 to +130.0 C (-112.0 to +266.0 F)
Controller Software (Original Equipment):	See controller identification decal
Defrost Initiation:	
Evaporator Coil Sensor Coil	Coil must be below 18 C (65 F) to initiate defrost by demand, timer or manual switch. -Manual Switch or Demand Defrost Initiation: Defrost cycle starts when technician or controller request defrost initiation. -Timed Defrost Initiation: 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 the temperature difference between the return air sensor and setpoint increases to a preset value and a minimum of 6 hours of compressor ON (running) time have elapsed since the previous defrost; indicating the presence of frost or ice
Defrost Timer: Frozen Mode	Initially every 12 hours of compressor operation. Then defrost interval increases 6 hours each time a timed defrost occurs without a demand defrost in between. Maximum time interval in frozen mode is 36 hours of compressor operation. Defrost timer resets if the unit is Off more than 12 hours or the setpoint is changed more than 5 C (9 F)
Defrost Termination:	
Evaporator Coil Sensor	Frozen mode: Terminates defrost when coil sensor temperature rises to 18 C (64 F) or exceeds 8 C (46 F) for 35 minutes above 440 volts and 45 minutes below 440 volts
Interval Timer	Terminates defrost 90 minutes after initiation if coil sensor has not terminated defrost (120 minutes if power supply is less than 55 Hz)
Time/Temperature Function	If the evaporator coil sensor exceeds 8 C (46 F) for 15 minutes, the controller terminates defrost
Power Off	Turning unit On/Off switch Off terminates defrost

Physical Specifications

Table 8. CRR DF Model - Physical Specifications

Base Unit Weight (net):	
CRR-40 DF MP3000	610 Kg (1344 lb)
Unit Dimensions:	
Width	2025.5 mm (79.75 in.)
Height	2235.2 mm (88.00 in.)
Depth	420.0 mm (16.54 in.) from back of flange

Compressor Torque — 3D Copeland Compressor Bolt Torque

Table 9. CRR DF Model - Compressor 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

Metric Hardware Torque Charts

Bolt Type and Class*	Bolt Size			
	M6 N.m (Ft.-lb.)	M8 N.m (Ft.-lb.)	M10 N.m (Ft.-lb.)	M12 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)
*HH = Hex Head, CL = Class				

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

Unit Description

General Description

Superfreezer Model CRR DF units are all-electric, single-piece, refrigeration units with bottom air supply. Each unit is designed for long distance, shipboard or overland transport of deep frozen or frozen 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 and buffer receiver tanks 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 460-380Vpower 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.

CRR DF MP3000 units feature MP3000 microprocessor controller and a MP3000 Datalogger. Additional features include three evaporator fans; USDA Cold Treatment Temperature Recording; and a Remote Monitoring Modem (RMM). For additional unit feature information, see “CRR DF Model Features” on page v of the Introduction.

Cascade Refrigeration System

The CRR DF unit uses a basic cascade refrigeration system to achieve to frozen and deep frozen cargo temperatures between -10 C and -70 C (+14 F and -94 F). (-70 C is the Lowest possible set-point provided the Box Size is set to 10´ or 20´, -65C would be lowest possible set-point for Box Size of 40´). The CRR DF cascade refrigeration system design allows shippers to economically carry cargo at deep frozen temperatures using proven, reliable transport refrigeration system technology.

The CRR DF cascade systems consists of two separate, single-stage refrigeration systems with different refrigerants. One system is a low temperature stage system that uses a hermetic scroll compressor and R-23 refrigerant. The evaporator of the low temperature stage system cools the cargo air, achieving cargo temperatures down to -70 C (-76 F). (-70 C is the Lowest possible set-point provided the Box Size is set to 10´ or 20´, -65C would be lowest possible set-point for Box Size of 40´).

The second system is a high temperature stage system that uses a semi-hermetic reciprocating compressor and R-134a refrigerant. The evaporator of the high temperature stage system cools the condenser of the low temperature stage system through a special plate heat exchanger. The condenser of the high temperature stage system then transfers the cargo heat to the ambient air.

R-134a Semi-hermetic Reciprocating Compressor

The R-134a high temperature stage circuit features a semi-hermetic reciprocating compressor with forced feed lubrication system, ambient compensated internal overload protection and high temperature protection.

R-23 Hermetic Scroll Compressor

The R-23 low temperature stage circuit features a hermetic scroll compressor (one stationary and one orbiting member) with ambient compensated internal overload protection and high temperature protection.

Microprocessor Controller

MP3000 controller incorporates refrigeration system component control, thermostat, digital thermometer and fault indication capabilities into one self-contained package. Units with a MP3000 controller are also equipped with a separate datalogger

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

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

Each control system consists of a MP3000 microprocessor controller, a main relay printed circuit board and six temperature sensors.

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

Note: *Humidity indicator LED is not used on the CRR DF application. Heat indicator LED is used during Defrost mode only.*

Datalogger

Units with a MP3000 controller are also equipped with a separate datalogger. The datalogger can record sensor temperatures as well as loss of power, alarms, unit operating modes, sensor failure, setpoint change and unit shutdown indications. MP3000 data recordings are stored in a RAM memory that is backed by battery.

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

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

A high speed serial communication port provides data retrieval using a DRU-II or SmartSponge handheld data retriever; or a REFCON power line remote monitoring system.

Three Evaporator Fans

Three evaporator fans operate continuously to circulate air inside the container. Two-speed fans operate continuously on low speed for deep frozen and frozen cargo (setpoints of -10 C [+14 F] and below).

USDA Cold Treatment Temperature Recording

The datalogger includes provisions for the use of three 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. The USDA sensors record temperatures from -80.0 C to +10 C (-112.0 F to +50.0 F).

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.

Operating Modes

Note: *See Microprocessor 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 (return) air sensor temperature.

Frozen Loads

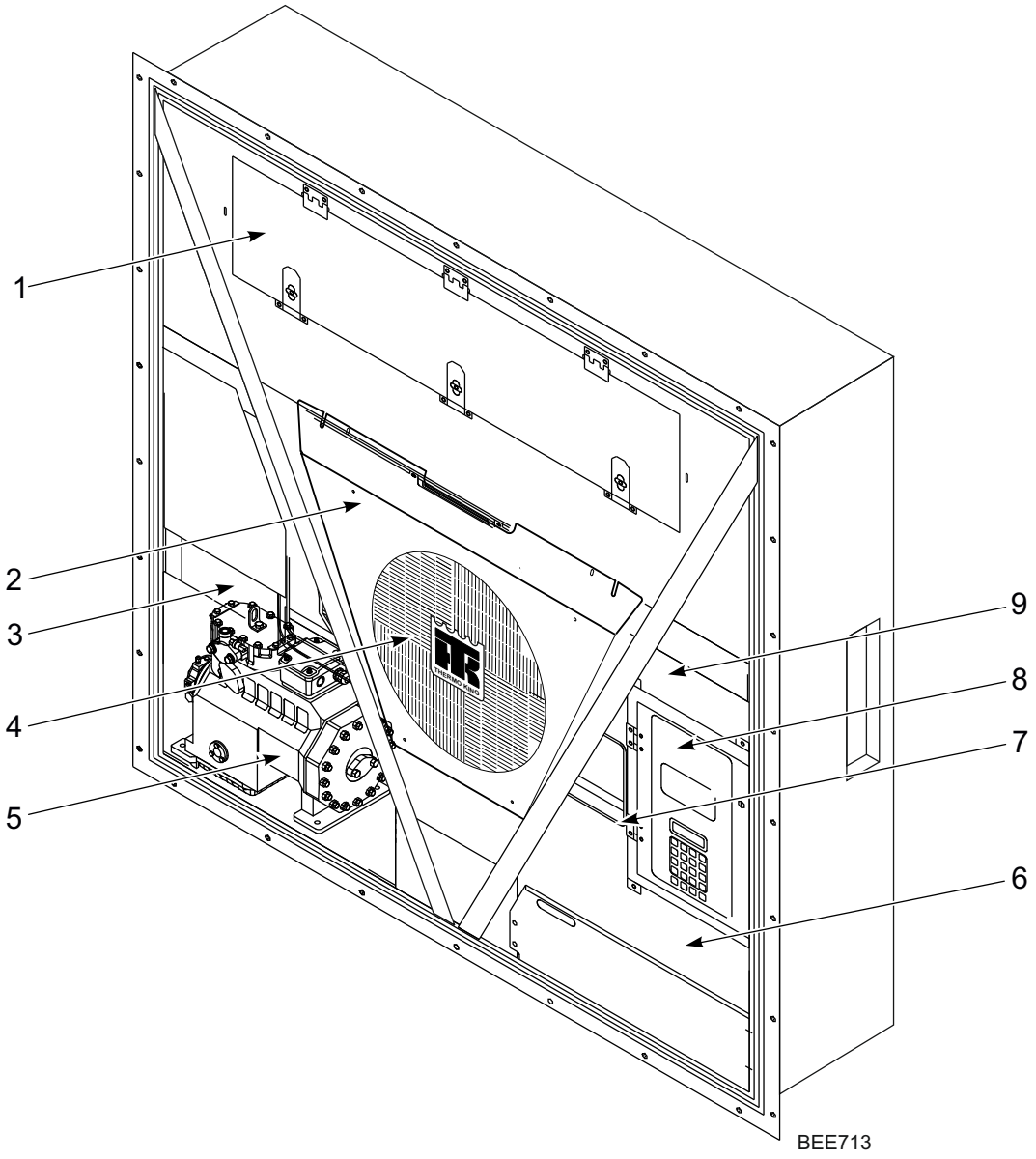
Temperature control by the controller is based on the return air sensor temperature. The evaporator fans operate continuously on low speed (except during defrost).

- Cooling until return air temperature decreases to 1 C (1.8 F) below setpoint. Minimum 15 minute compressor ON (running) time and 10 minute compressor OFF time prevents rapid cycling between Cool and Null modes.
-
- Null until return air temperature increases to 1 C (1.8 F) above setpoint. Both compressors and the condenser fan stop while the evaporator fans operate on low speed during the null mode.
- Defrost: Resistance heaters turn ON during defrost while the evaporator fans stop.

A Demand Defrost can be initiated by the controller when the temperature difference between the return air sensor and setpoint increases to a pre-set value and a minimum of 6 hours of compressor ON (running) time have elapsed since the previous defrost.

A Defrost Timer also initiates defrost every 12 hours. During extended unit operation, timed defrost intervals increase 6 hours each time a timed defrost occurs without a demand defrost in between. Maximum time interval is 36 hours. The Defrost Timer resets if the unit is OFF more than 12 hours or the setpoint is changed more than 5 C (9 F).

Figure 1. Unit Front View



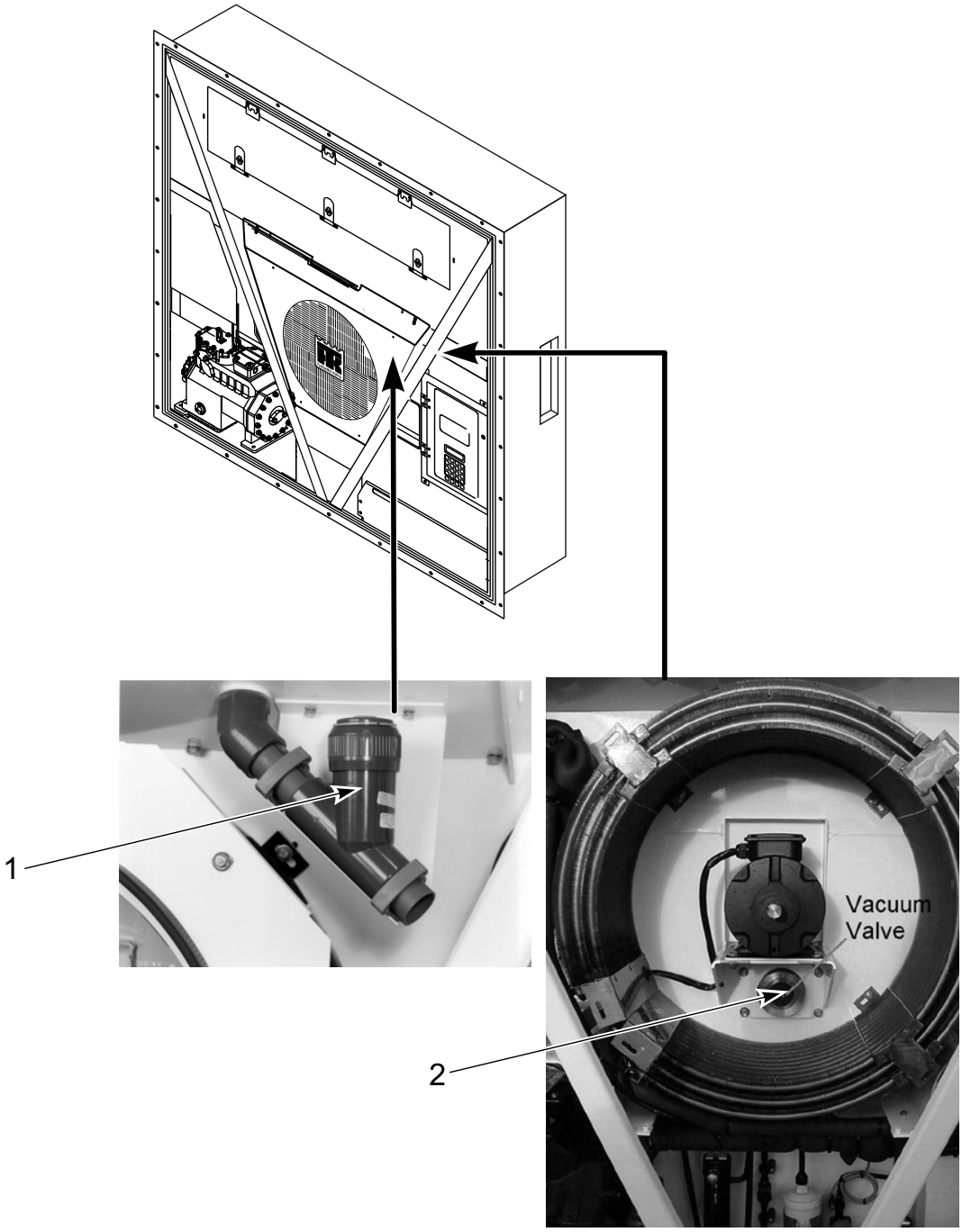
1.	Evaporator Access Door	6.	Power Cord Storage Compartment
2.	Heater Access Panel Location	7.	Supply Air Sensor Probe Holder
3.	Condenser Fan	8.	Control Box
4.	R-23 Compressor Compartment	9.	Vacuum Pressure Valve Location (for Box Ventilation)
5.	R-134a Compressor Compartment		

Figure 2. Evaporator Section — Front View

BEE714

1.	Evaporator Fan Blade	4.	Defrost (Evaporator Coil) Sensor Location
2.	Evaporator Fan Motor	5.	Return Air Sensor Probe Holder
3.	Evaporator Coil		

Figure 3. Vacuum Valve



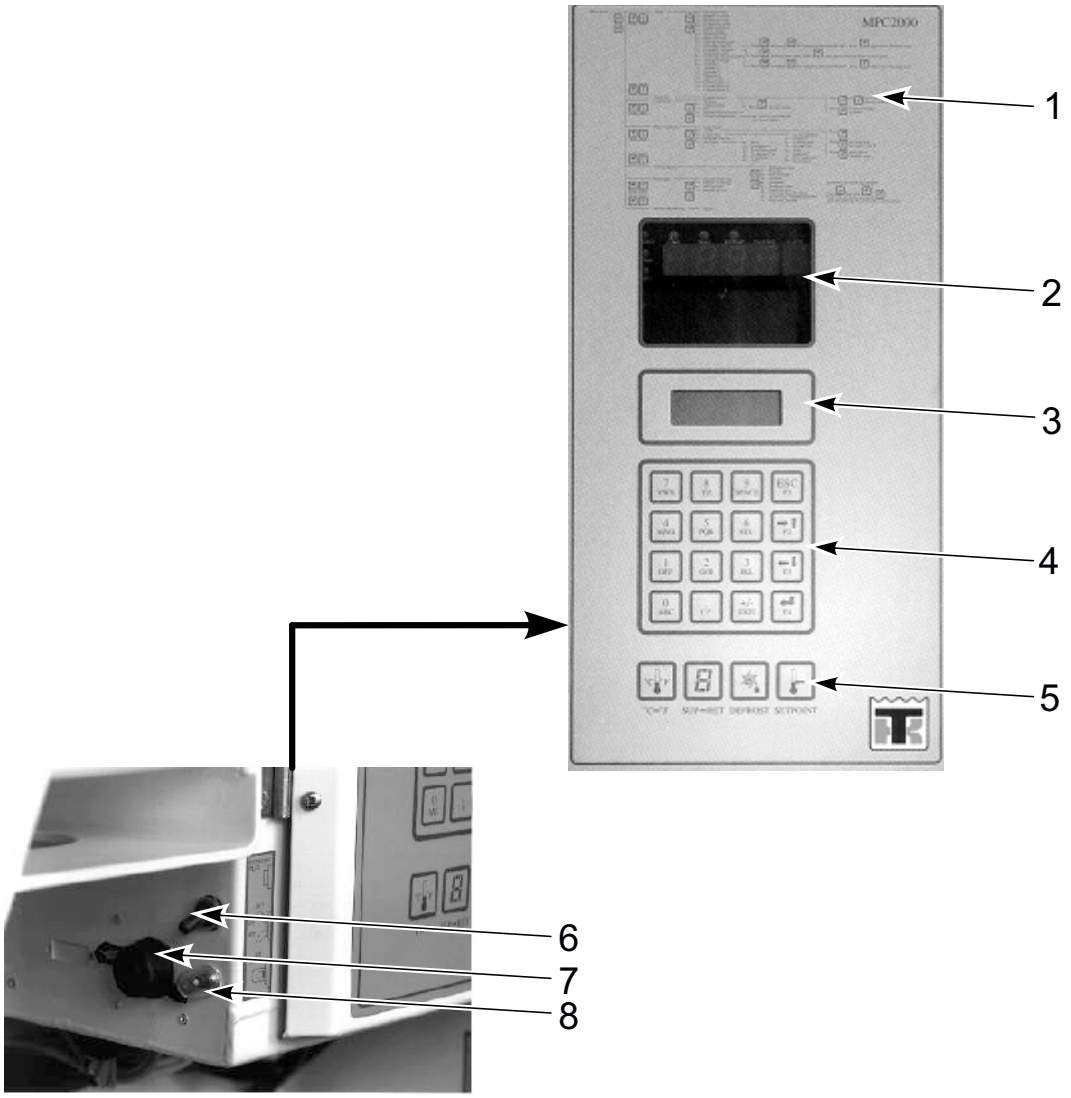
BEE715

1.	Vacuum Valve (located behind condenser grille cover), earlier	2.	Vacuum Valve (located behind condenser grille cover), current

Figure 4. Power Cord Storage Compartment

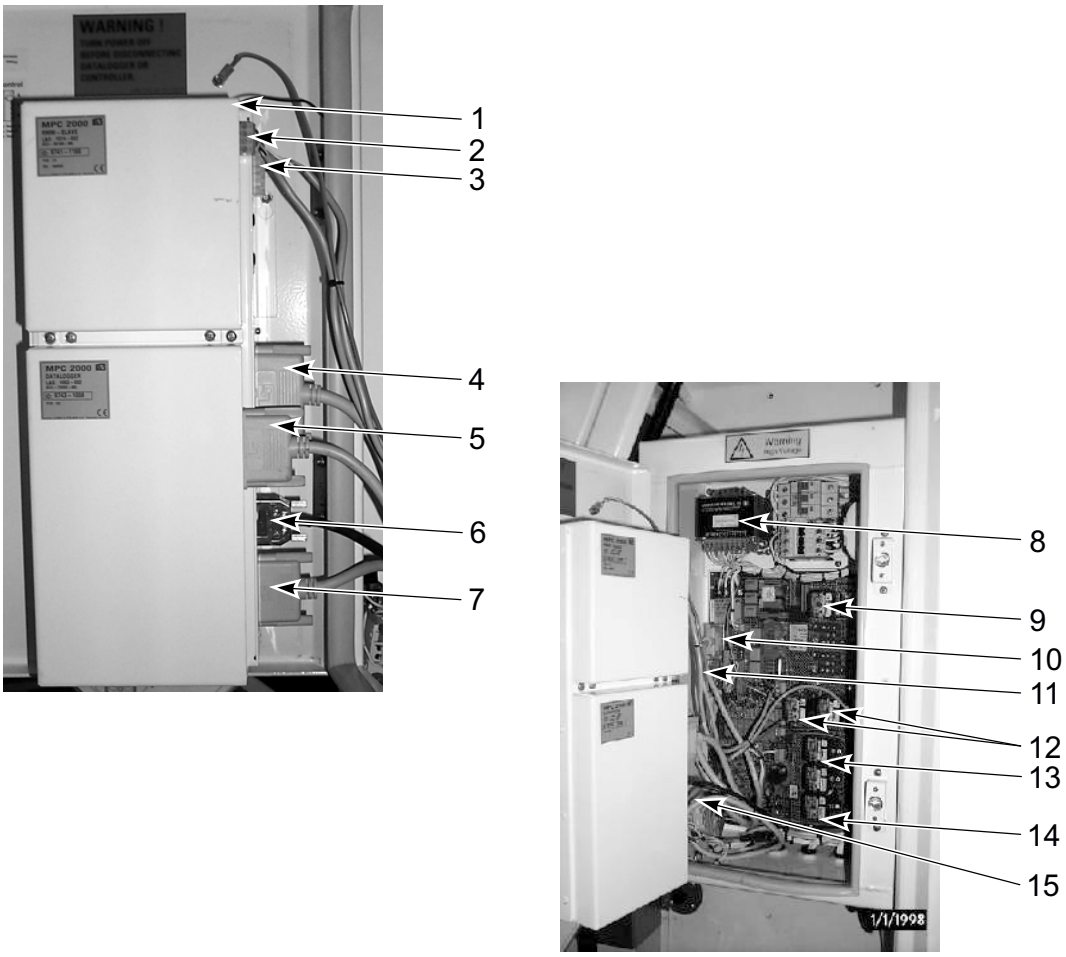
1.	Control Box	4.	Ambient Sensor Location
2.	Thermometer Sampling Port	5.	Power Plug and Cord
3.	Supply Air Sensor Probe Holder		

Figure 5. Control Box and Microprocessor Controller



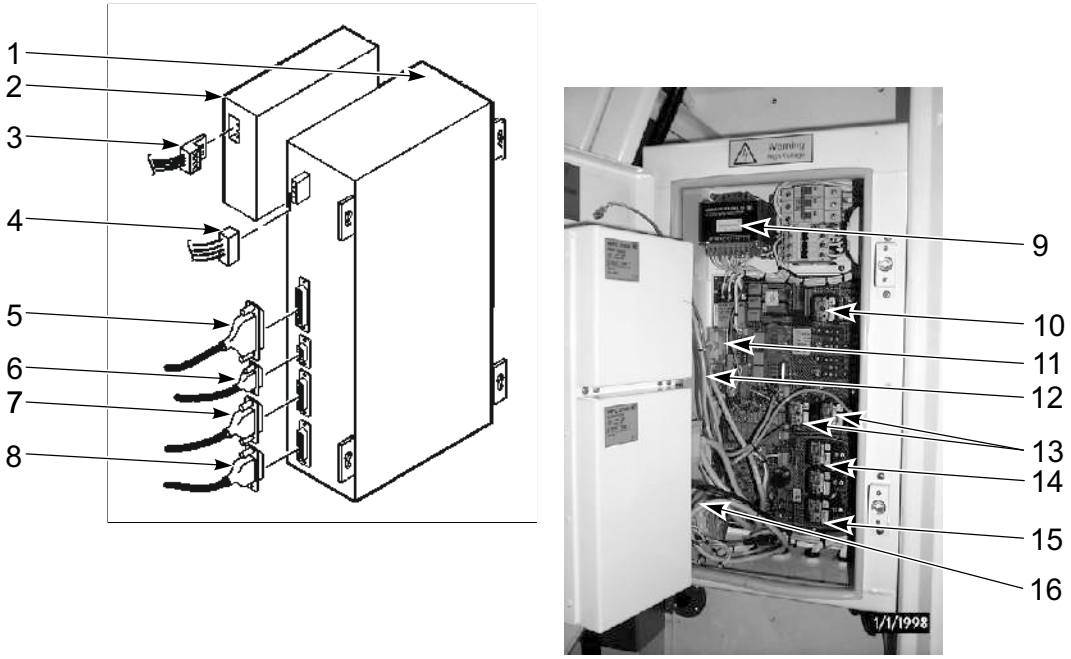
1.	MP3000 Controller	5.	Special Function Keypad
2.	LED Display (Return or Supply Air Temperature Display and Status Indicator LEDs)	6.	Unit On/Off Switch
3.	LCD Display (Setpoint Temperature, Message and Retrieval Controller Main Menu Tree Display)	7.	Communications Connector for Data Retrieval
4.	General Purpose Keypad	8.	Circuit Breaker

Figure 6. Controller and Remote Monitoring Modem



1.	Remote Monitoring Modem	9.	Heat Relay
2.	RMM Connection Cable	10.	Datalogger Cable Connection to Main Relay Board
3.	Battery Cable Connection to Controller	11.	Cable No. 2 Connection to Main Relay Board
4.	Cable No. 2 Connection to Controller	12.	Phase Sensor Relays
5.	Datalogger Cable Connection to Datalogger	13.	Evaporator Fan Relay – Low Speed
6.	Download Cable Connection to Controller	14.	Condenser Fan Relay
7.	Cable No. 1 Connection to Controller	15.	Cable No. 1 Connection to Main Relay Board
8.	Control Power Transformer (28 Vac, 29 Vac, 40 Vac)		

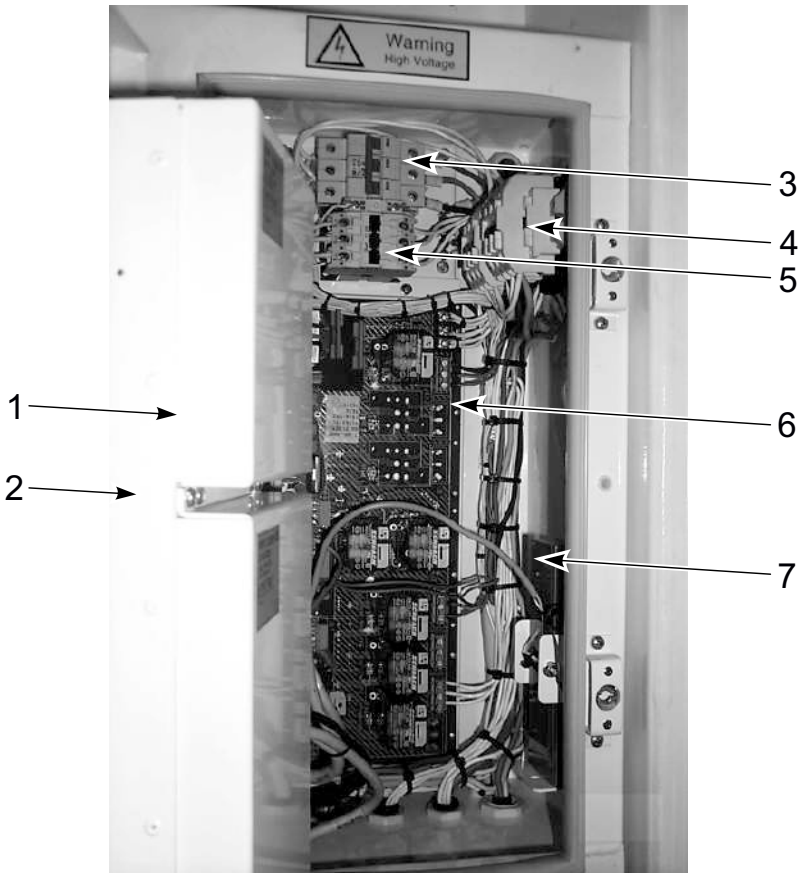
Figure 7. Controller and Remote Monitoring Modem



BEE719

1.	MP3000 Controller with Integral Datalogger	9.	Control Power Transformer (28 Vac, 29 Vac, 40 Vac)
2.	Remote Monitoring Modem	10.	Heat Relay
3.	RMM Connection Cable	11.	Cable No. 3 Connection to Main Relay Board
4.	Battery Cable Connection to Controller	12.	Cable No. 2 Connection to Main Relay Board
5.	Cable No. 2 Connection to Controller	13.	Phase Sensor Relays
6.	Download Cable Connection to Controller	14.	Evaporator Fan Relay – Low Speed
7.	Cable No.3 Connection to Controller	15.	Condenser Fan Relay
8.	Cable No.1 Connection to Controller	16.	Cable No. 1 Connection to Main Relay Board

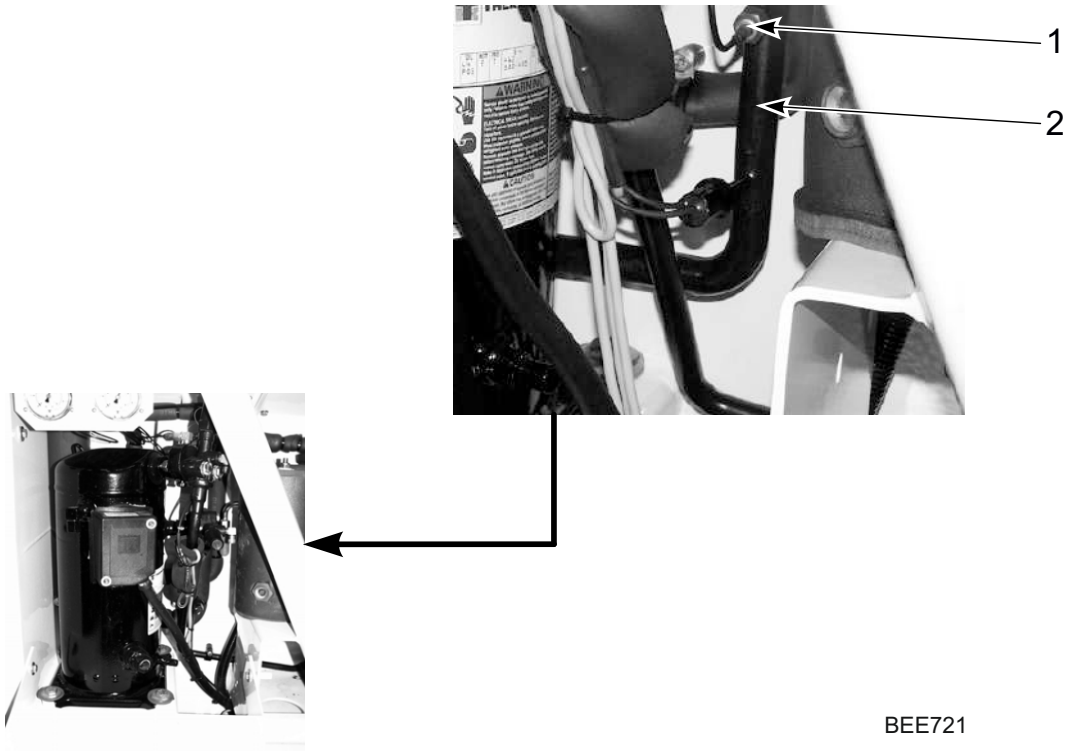
Figure 8. Unit Control Box with Door Open



BEE720

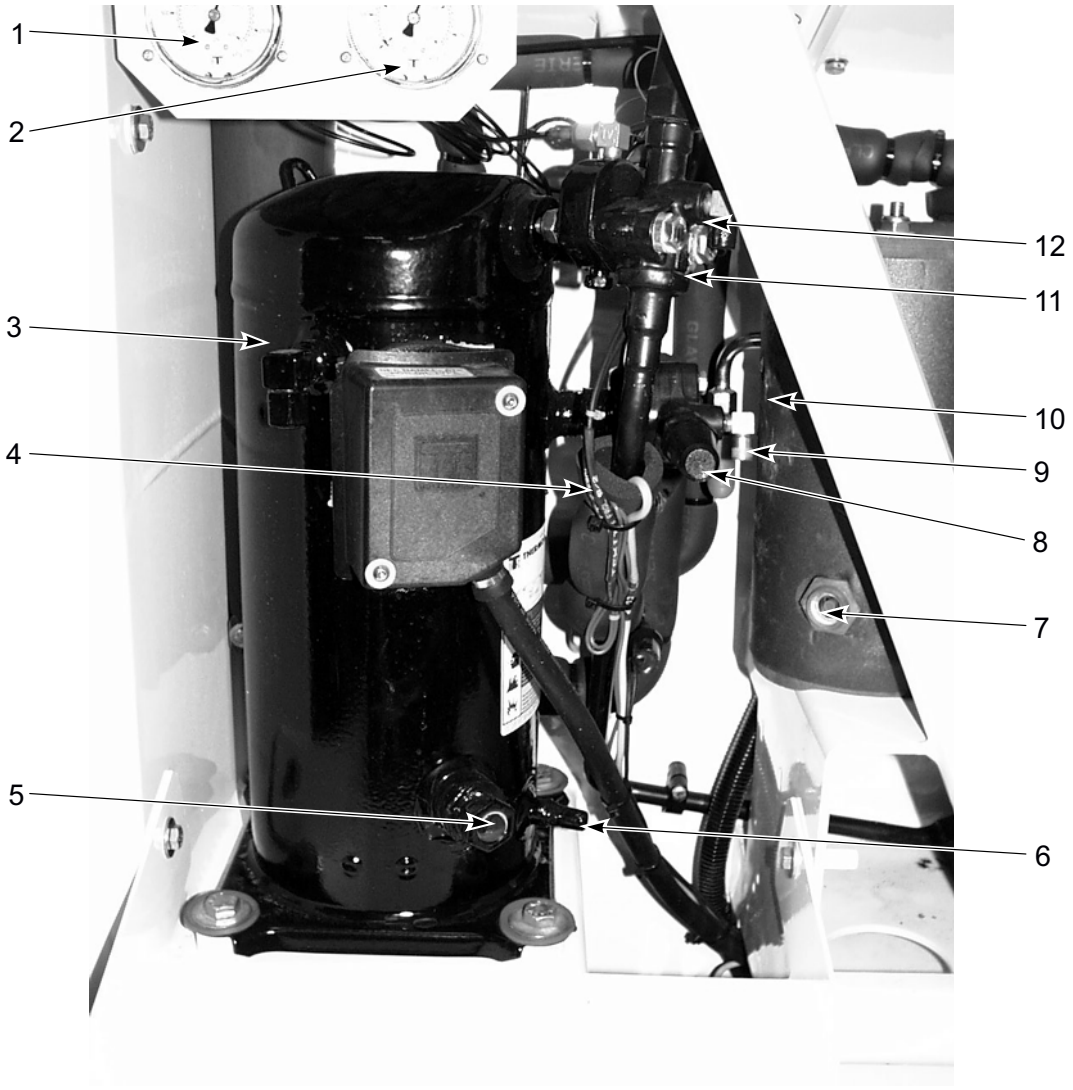
1.	Remote Monitoring Modem	5.	R-134a Compressor Contactor
2.	MP3000 Controller	6.	Main Relay Board
3.	32 Ampere Main Power Circuit Breaker	7.	12 Vdc Battery
4.	R-23 Scroll Compressor Contactors (2)		

Figure 9. Refrigeration System



1.	R-23 Suction Pressure Gauge Line Connection	2.	R-23 Suction Line

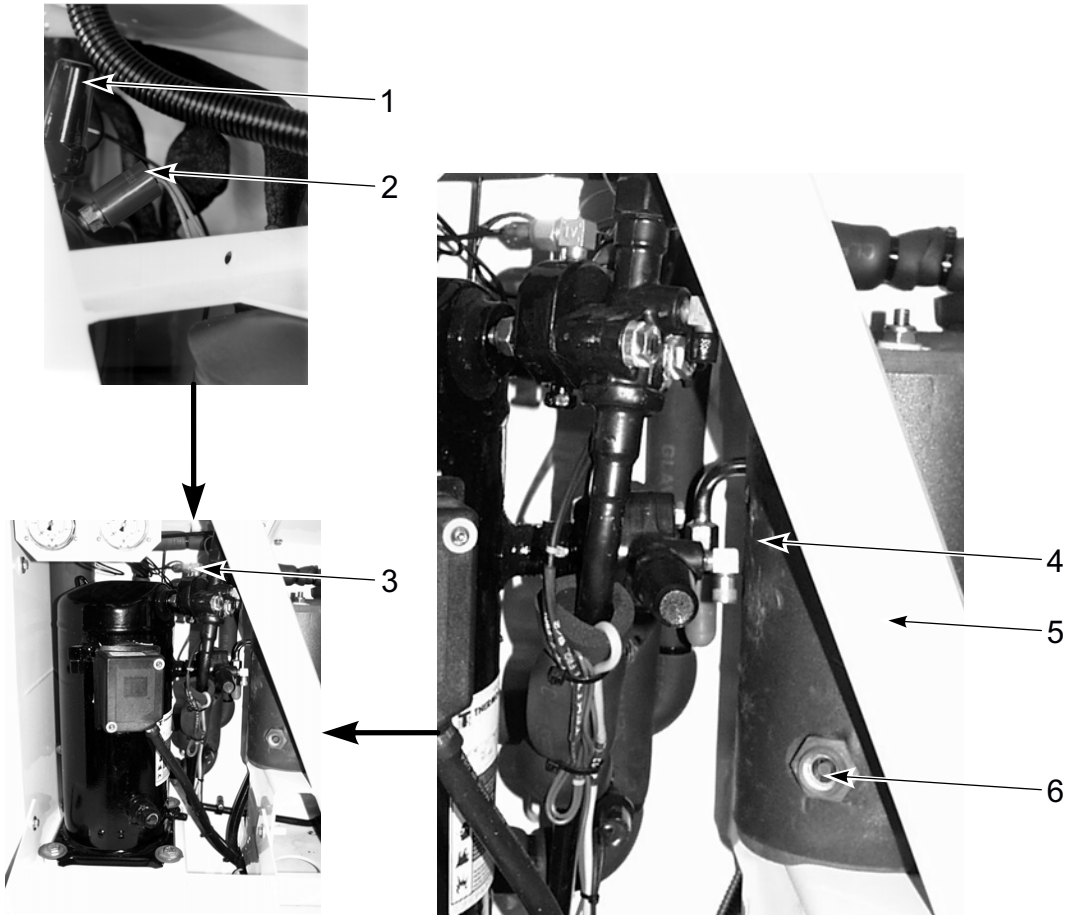
Figure 10. R-23 Compressor Compartment



BEE722

1.	R-23 Discharge Pressure Gauge	7.	R-23 Lower Receiver Tank Sight Glass
2.	R-23 Suction Pressure Gauge	8.	Suction Service Valve
3.	R-23 Scroll Compressor	9.	Suction Service Fitting
4.	Compressor Discharge Temperature Sensor	10.	R-23 Receiver Tank
5.	Compressor Oil Sight Glass	11.	Discharge Service Valve
6.	Oil Fill Fitting	12.	Discharge Service Fitting

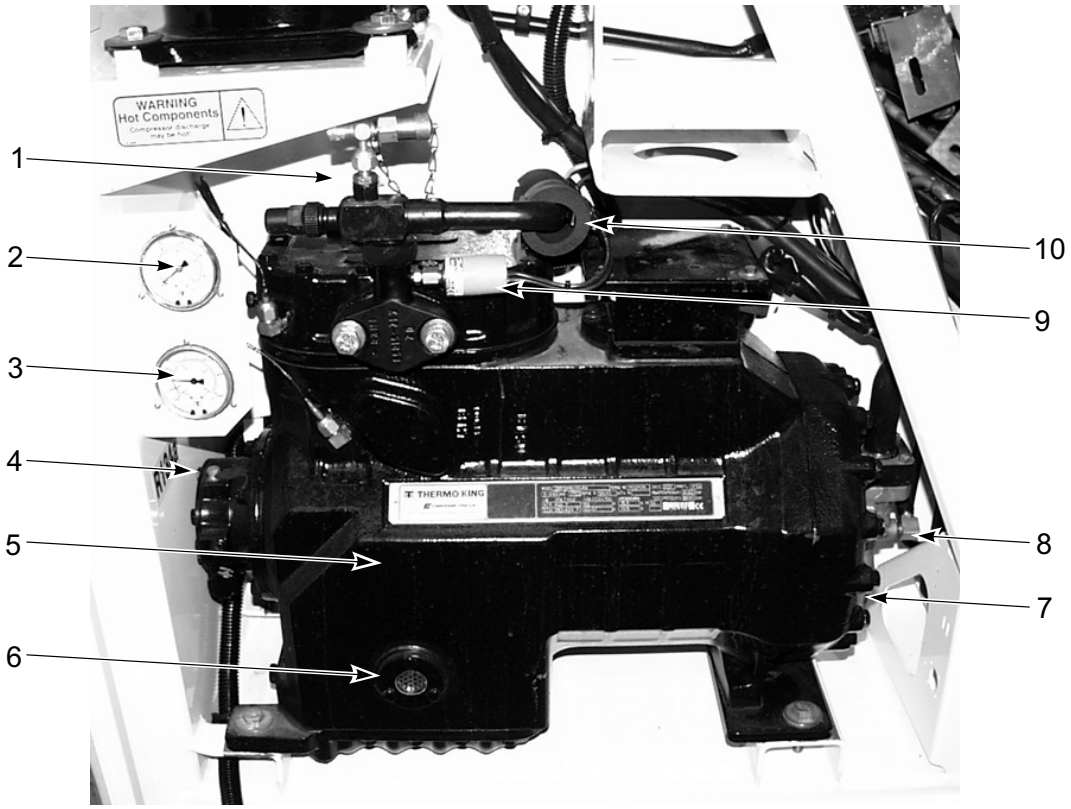
Figure 11. Additional R-23 Refrigeration System Components



BEE723

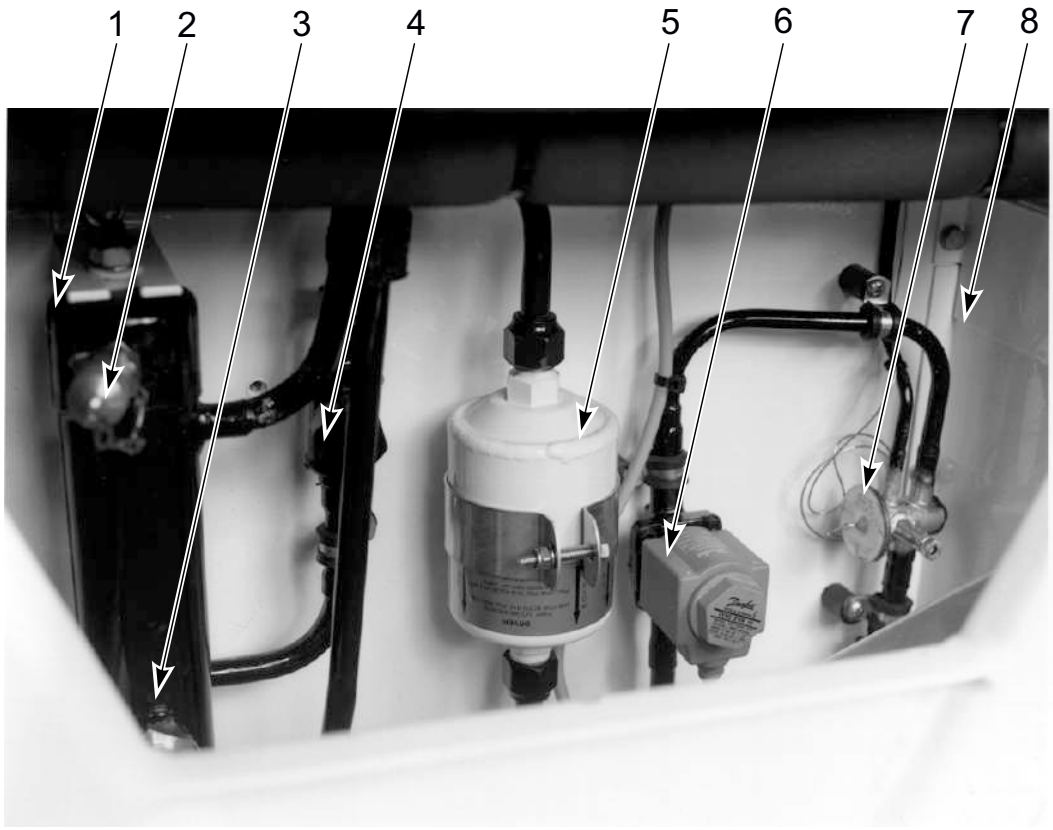
1.	R-23 Compressor Discharge Valve	4.	Receiver Tank
2.	R-23 High Pressure Cutout Switch	5.	Schrader Valve Service Fitting for R-23 Charging
3.	R-23 Expansion Valve	6.	Receiver Tank Sight Glass

Figure 12. R-134a Compressor Compartment



1.	Discharge Service Valve	6.	Compressor Oil Sight Glass
2.	R-134a Discharge Pressure Gauge	7.	Suction Service Valve
3.	R-134a Suction Pressure Gauge	8.	Suction Service Fitting
4.	Compressor Oil Fill Fitting	9.	R-134a High Pressure Cutout Switch
5.	R-134a Compressor	10.	Compressor Discharge Temperature Sensor

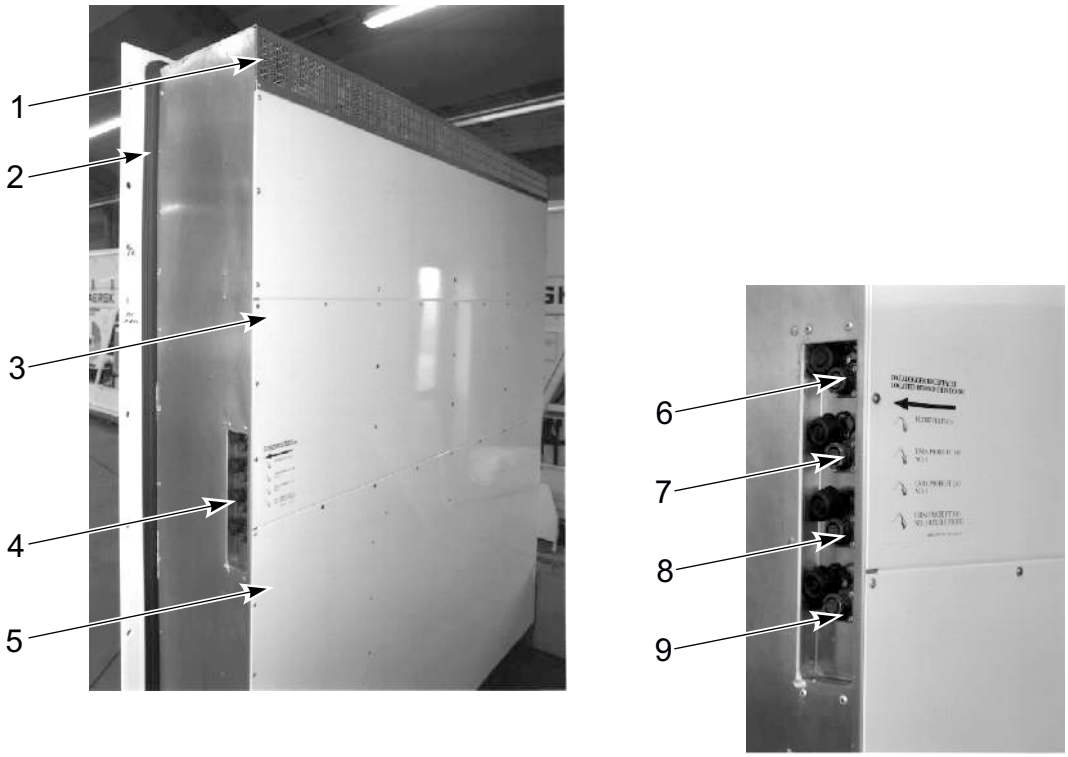
Figure 13. Additional R-134a Refrigeration System Components and Plate Heat Exchanger



BEE725

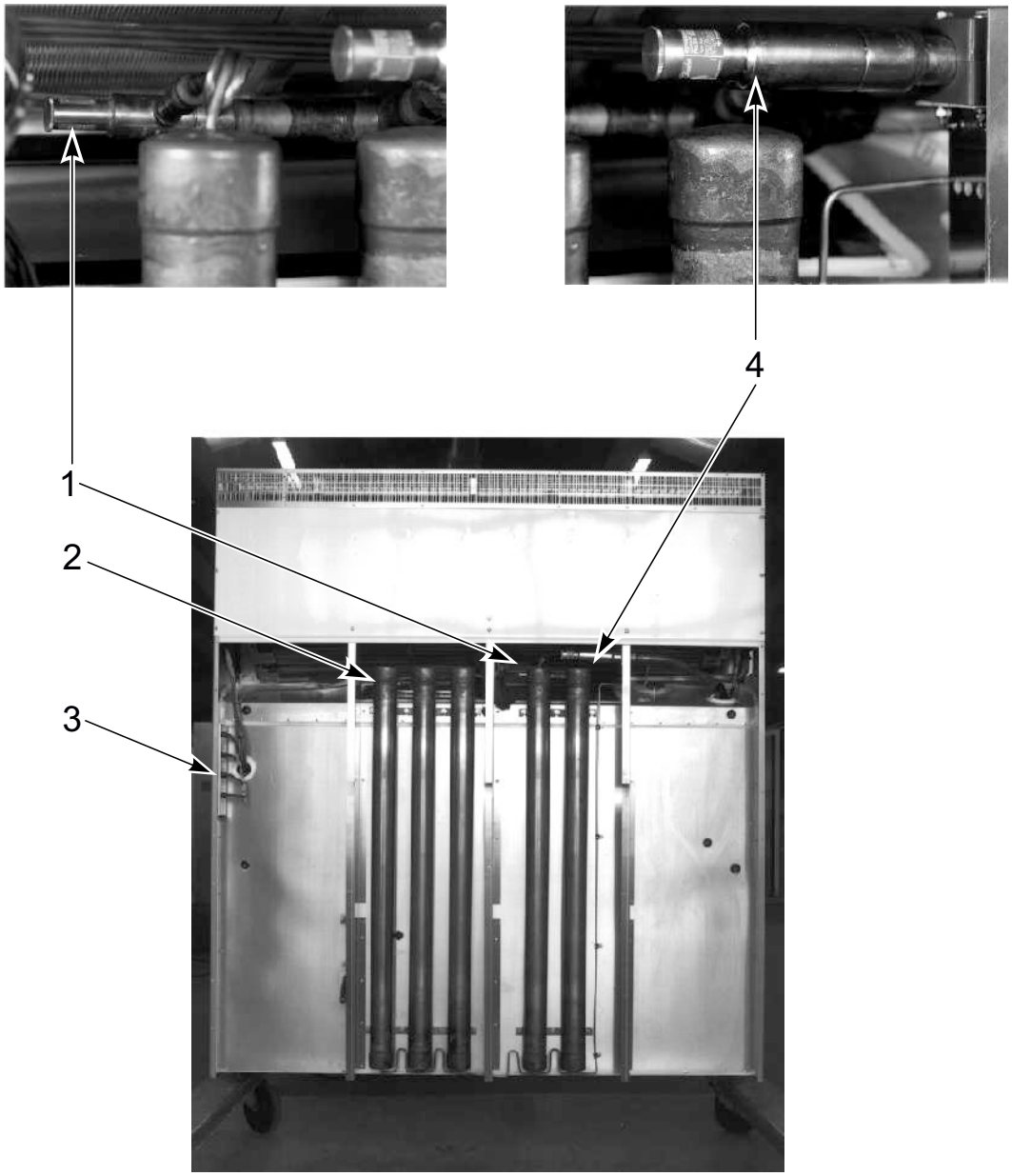
1.	R-134a Receiver Tank	5.	Dehydrator (Filter Drier)
2.	Receiver Tank Service Fitting	6.	Liquid Line Solenoid
3.	Receiver Tank Sight Glass	7.	R-134a Expansion Valve
4.	Liquid Line Ball (Service) Valve	8.	R-23/R-134a Plate Heat Exchanger (behind panel)

Figure 14. Unit Back View



1.	Evaporator Grille	6.	Controller Communications and Data Retrieval Connection
2.	Unit Gasket	7.	USDA1 Sensor Connection
3.	Top Rear Plate	8.	USDA2 Sensor Connection
4.	Sensor Connector Assembly	9.	USDA3 Sensor Connection
5.	Bottom Rear Plate		

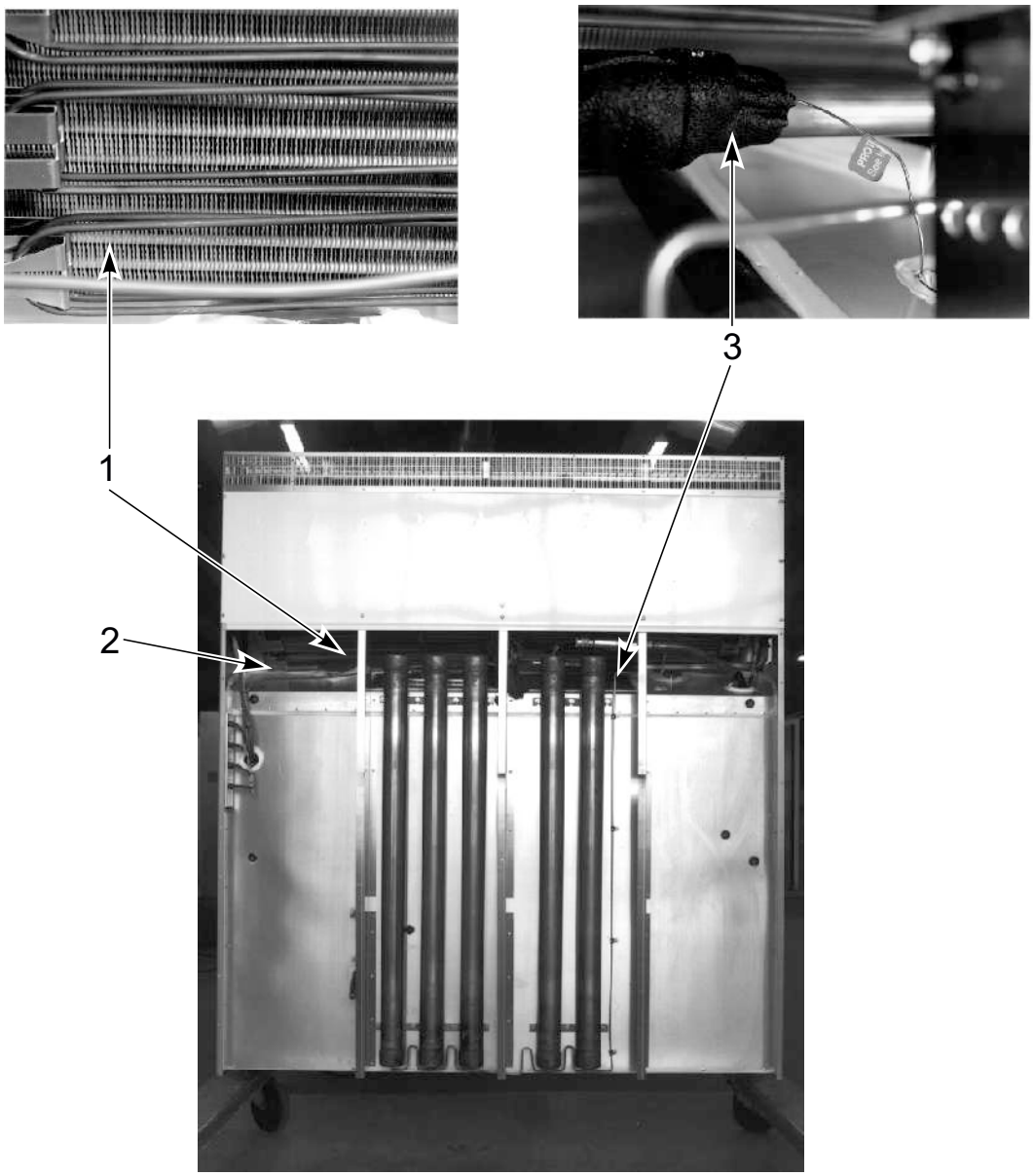
Figure 15. Unit Back View — Pressure Regulators and Buffer Tanks



BEE727

1.	Constant Pressure Regulator (R-23 System)	3.	Sensor Connector Assembly
2.	Buffer Receiver Tanks – 5 Total (R-23 System)	4.	Crankcase Pressure Regulator (R-23 System)

Figure 16. Unit Back View — Electric Heaters and Evaporator Coil



BEE728

1.	Electric Heaters	3.	Expansion Valve Feeler Bulb (R-23 System)
2.	Evaporator Coil (R-23 System)		

Operating Instructions

Basic Unit Controls, Instruments and Protection Devices

Unit Control Box

ON/OFF Switch: ON position. Unit will operate on cool or null depending on the controller setpoint temperature and the container air temperature. OFF position. The unit will not operate.

Control System Circuit Breaker: A 7 ampere manual reset circuit breaker protects the control circuit. This circuit breaker is located in the control box beside the On/Off switch.

Main Circuit Breaker: A 32 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.

Fuses: A number of fuses are located on the main relay board and controller plug to protect unit circuits and components.

- Three 20 amp fuses protect high voltage circuits on the main relay board.
- A 2 amp fuse protects the controller's 28 V system.
- A 2 amp fuse protects the controller's battery charging circuit.

Overload Protection: The condenser fan motor, evaporator fan motors and compressor motors include internal overload protection with automatic reset.

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 fan, evaporator fan and compressor rotation.

MP3000 Controller

A MP3000 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.

Keypad: Sixteen general purpose keys are used to display information, change the setpoint, change programmable features and initiate control tasks.

°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

. **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.

Defrost Key: Press this key to initiate a manual defrost cycle. If the evaporator coil temperature is below 10 C (50 F), the unit will defrost. Otherwise the controller will display "Defrost Not Activated" in the LCD display and the unit will continue normal operation.

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 Microprocessor Controller chapter for complete instructions.

Status Indicator LEDs: located in the large LED display signal:

- Supply (Air Temperature)
- Return (Air Temperature)
- Humidity Mode (Inactive on CRR DF units)
- Compressor (Cooling On)
- Heat (On during defrost)
- Defrost
- In-Range (Temperature)
- Alarm

The In-range LED illuminates when the controlling air sensor temperature is less than 3.0 C (5.4 F) above setpoint (standard). The controller maintains the in-range signal during defrost and after defrost for 60 minutes.

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.

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.

R-134a Refrigeration System Controls, Instruments and Protection Devices

Compressor Discharge Line Temperature Sensor: The controller uses the compressor discharge line temperature sensor to protect the compressor from excessively high operating temperatures. If the discharge gas temperature rises above 130 C (266 F):

- Unit stops immediately; controller activates Alarm LED and records Alarm 56, Compressor Temperature Too High.
- Controller will restart the unit when the sensor temperature is below 90 C (194 F).

High Pressure Cutout (HPCO) Switch: If the compressor discharge pressure rises above 2410 ± 68 kPa, 24.1 ± 0.68 bar, 350 ± 10 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-134a compressor STOPS immediately.
- Evaporator and condenser fans continue normal operation.
- R-23 compressor stops.
- R-134a compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 1640 ± 68 kPa, 16.4 ± 0.68 bar, 238 ± 10 psig
- R-23 compressor will restart 30 seconds after R-134a compressor restarts.

Suction Pressure Gauge: A suction pressure gauge indicates the refrigerant pressure in the suction line returning to the compressor.

Discharge Pressure Gauge: A discharge pressure gauge indicates the refrigerant pressure in the discharge line leaving the compressor. Operating Instructions 49

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).

Fusible Plug For High Pressure Relief: A fusible plug is installed in the R-134a 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.

Compressor Oil Sight Glass: A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.

R-23 Refrigeration System Controls, Instruments and Protection Devices

Compressor Discharge Line Temperature Sensor: The controller uses the compressor discharge line temperature sensor to protect the compressor from excessively high operating temperatures. If the discharge gas temperature rises above 138 C (280 F):

- Unit stops immediately; controller activates Alarm LED and records Alarm 56, Compressor Temperature Too High.
- Controller will restart the unit when the sensor temperature is below 138 C (280 F).

High Pressure Cutout (HPCO) Switch: If the compressor discharge pressure rises above 3250 ± 50 kPa, 32.5 ± 0.5 bar, 470 ± 7 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-23 compressor STOPS immediately.
- Evaporator and condenser fans and R-134a compressor continue normal operation.
- R-23 compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 2590 ± 250 kPa, 25.9 ± 2.5 bar, 375 ± 38 psig.

Note: *R 23 protective device auxiliary contractor mounted on R 134a contractor must supply digital signal to MBR J12 pin 1 and 2 before R 23 compressor is allowed to start.*

Suction Pressure Gauge: A suction pressure gauge indicates the refrigerant pressure in the suction line returning to the compressor.

Discharge Pressure Gauge: A discharge pressure gauge indicates the refrigerant pressure in the discharge line leaving the compressor.

Receiver Tank Sight Glass: Two sight glasses on the R-23 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).

Compressor Oil Sight Glass: A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.

High Pressure Relief Valve: A high pressure relief valve is installed in the receiver tank. The relief valve protects against excessive pressure build-up within the refrigeration system from extraordinary and unforeseen circumstances. The valve is a spring-loaded piston that lifts when refrigerant pressure exceeds 3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig. The valve is located so that refrigerant pressure expelled from the valve would be directed away from anyone servicing the unit. The valve will reset when this pressure drops to 2758 kPa, 27.58 bar, 400 psig. The valve is non-repairable and requires no adjustment. If the valve fails to reseat properly, recover the refrigerant charge and replace the valve.

Note: *Use only Lower R-23 sight glass to check or add refrigerant on unit unable to maintain -50 to -70 setpoint.*

Pretrip Inspection

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. Inspect both refrigeration systems for evidence of oil leaks at all joints and connections.

Note: *With empty box and all components in R23 system always verify correct charge in R23 system according to pressure readings listed below*

5. 5.Check R-23 refrigeration system pressures. Suction and discharge pressure gauges should show 1,600 to 1,800 kPa, 16.0 to 18.0 bar, 232 to 261 psig in both the high and low side with the unit OFF and the container empty.
6. 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

Equipment Damage!

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

7. Check the mounting bolts on the unit, compressor and fan motors. Tighten if necessary.
8. Clean the defrost drains.
9. Check vacuum valve for proper operation.
10. Observe the unit for proper operation and functions during Pre-load Operation.

Power Selection

⚠ CAUTION

Risk of Injury!

Power supply connections from the unit to the power source should always be made with the refrigeration unit On/Off switch and the power supply On/Off switch in the OFF position. Never attempt to start or stop the refrigeration unit using the power cord.

The refrigeration unit is designed to operate on 460/380V, 3 Phase, 60-50 Hz electric power from a 4-wire power source.

- To operate the refrigeration unit on 460/380V power, plug the 460/380V power cord into the proper power source.

Pre-load Operation

Pre-Trip Conditions

To properly perform a Full Pretrip Test, the following conditions must exist:

Pre-Trip Checks

1. With unit connected to the proper power supply, turn the power supply On/Off switch to ON.
2. Switch refrigeration unit On/Off switch to ON position. A sequence start of the required loads occursduring initial start-up on cooling:

- 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 and operate on low speed.
- R-134a compressor and condenser fan then start and the liquid line solenoid energizes (opens).
- R-23 compressor starts 30 seconds later.

Note: *If one or both compressors fail to start, turn the On/Off switch OFF. Then repeat steps 1 and 2. If the unit still does not start, refer to "Alarm Codes, Descriptions and Corrective Actions" in the Microprocessor Controller chapter of this manual. Be sure to wait up to 1 minute for both compressors to start.*

3. Adjust controller setpoint to the desired temperature:

Note: *The setpoint temperature can be set between -10 C and -70 C (14 F and -94 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 setpoint in controller memory and shows new setpoint in LCD display.

Note: *New setpoint must be between -10 C and -70 C (14 F and -94 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 3.*

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

⚠ CAUTION

Service procedure!

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 SmartSponge handheld data retriever.*

8. top the unit by moving the On/Off key to the OFF position.

Loading Procedure

1. Make sure the Unit On/Off key 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. Switch the Unit On/Off key to ON position.
3. Adjust controller setpoint to the desired temperature:

Note: *The setpoint temperature can be set between -10 C and -70 C (14 F and -94 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 setpoint in controller memory and shows new setpoint in LCD display.

Note: *New setpoint must be between -10 C and -70 C (14 F and -94 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 3.*

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 10 C (50 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”.*

Starting the Unit on Ship

⚠ CAUTION

Risk of Injury!

Power supply connections from the unit to the power source should always be made with the refrigeration unit On/Off switch and the power supply On/Off switch in the OFF position. Never attempt to start or stop the refrigeration unit using the power cord.

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 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.
3. Check the controller setpoint to make sure it is correct (agrees with shipping manifest).

Post Trip Procedure

Trip data recorded by the MP3000 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.

Microprcessor Controller

General Description

The MP3000 is advanced microprocessor controller that has been specially developed for control and monitoring of refrigeration units. The ontroller contains the following basic features:

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

- Supply (Air Temperature)
- Return (Air Temperature)
- Humidity Mode (Inactive on CRR DF units)
- Compressor (Cooling On)
- Heat (On during Defrost)
- Defrost
- In-Range (Temperature)
- Alarm

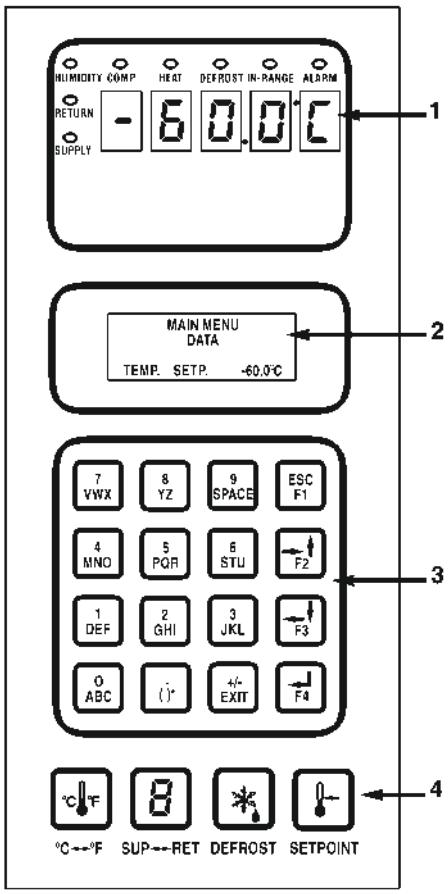
  The Alarm LED flashes ON and OFF continuously when a Check Alarm (Level 2 Alarm) or Shutdown Alarm (Level 1Alarm) occurs. Less serious Log Alarms (Level 3 Alarm) are recorded but do not activate the Alarm LED.

  Check Alarms indicate corrective action should be taken before a problem becomes severe. The unit continues to operate. However, some unit functions may be inhibited.

  Shutdown Alarms indicate the unit operation has been stopped to prevent damage to the unit or cargo. The problem must be corrected and the alarm code acknowledged before the unit can be restarted to resume normal operation.

  Alarm codes are recorded in the controller memory to simplify unit diagnosis procedures. Some alarm codes are only recorded during a Pretrip (PTI) Test. Fault codes are retained by the controller in a non-volatile memory (see alarm codes, type and description below).

Figure 17. MP3000 Controller



1.	LED display with Status Indicator LEDs	3.	General purpose keys
2.	LCD message and menu display	4.	Special function keys

00	Check	Supply Air Sensor Open Circuit	20	Check	Defrost Time Too Long
01	Check	Supply Air Sensor Short Circuit	22	Check	Capacity Test 1 Error
02	Check	Return Air Sensor Open Circuit	23	Check	Capacity Test 2 Error
03	Check	Return Air Sensor Short Circuit	32	Check	Condenser Air Sensor Open Circuit
04	Check	Evaporator Coil Sensor Open Circuit	33	Check	Condenser Air Sensor Short Circuit
05	Check	Evaporator Coil Sensor Short Circuit	34	Check	Ambient Air Sensor Open Circuit
06	Check	R-134a Compressor Current Too High	35	Check	Ambient Air Sensor Short Circuit
07	Check	R-134a Compressor Current Too Low	43	Check	Return Air Temperature Too High
10	Check	Heater Current Too High	52	Check	Probe Error
11	Check	Heater Current Too Low	56	Shutdown	Compressor Temperature Too High
14	Check	Evaporator Fan Low Speed Current Too High	58	Check	Phase Sensor Error
15	Check	Evaporator Fan Low Speed Current Too Low	59	Check	Delta Current Error
16	Check	Condenser Fan Current Too High	97	Log	Compressor Sensor Open Circuit

17	Check	Condenser Fan Current Too Low	98	Log	Compressor Sensor Short Circuit
18	Log	Power Supply Phase Error	112	Check	Zero Current Too High
19	Check	Temperature Too Far from Setpoint			

2. LED display with 20.32 mm high characters:

- Five alpha numeric characters: Numerical hundredths, tens, ones and tenths position, a C for Celsius or F for Fahrenheit for temperature display.
- LED display shows current control temperature (return or supply). Status LEDs signal sensor temperature shown in LED display. 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 is also used to show the current state of a Pretrip (PTI) test.

3. LCD display with 4 line, 20 character message display:

- LCD standard display shows setpoint temperature during normal operation information.
- • LCD display shows controller menu and unit operation information when special keys are pressed.

4. Sixteen general purpose keys are used to enter and scroll through the controller menu tree and message text; initiate a Pretrip test; enter new setpoint temperature; and enter trip information.

   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.*

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.

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 indicate that pressing the K4 key moves the cursor into the next menu level or into a menu item text box.

5. Four special keys:

- 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 show Setpoint temperature line in LCD display for setpoint adjustment.

6. Control Transformer: Low voltage control power and ground is supplied to the microprocessor 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 29 Vdc control circuit.
  - 2 amp fuse protects the 28 Vac 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.

8. Replaceable sensors: Return air, supply air, evaporator coil (defrost), ambient air, R-134a compressor discharge line and R-23 compressor discharge line temperature sensors are field replaceable. Three (replaceable) spare sensor receptacles are also provided for USDA temperature recording.
9. Defrost cycle control (see “Defrost System” in this chapter).
10. Pretrip (PTI) test capability (see “PTI (Pretrip) Test” in this chapter).
11. Data recording capability: The Datalogger can record 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 memory. DRU-II or SmartSponge software downloads and reports the return, supply, ambient and USDA sensor temperatures as standard.

    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 365 days of information. The logging of USDA sensors is fixed at 1 hour intervals to comply with USDA requirements.

    All data logs include the time and date; setpoint temperature; and supply, return, USDA1, USDA2 and USDA3 sensor temperatures. All temperature logs can be viewed from the controller’s LCD message display.

    If the unit power supply is disconnected, the datalogger will continue to register 168 temperature logs. These will be maintained until the unit is re-connected to power, and the battery automatically re-charged.

    Trip data can be retrieved (but not erased) from the datalogger memory using DRU-II or SmartSponge handheld data retriever; or via the REFCON remote monitor system. The datalogger is also equipped with a high-speed parallel communication port. Data transfer time is approx. 25 seconds for event logs and approx. 70 seconds for temperature logs.

    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.
12. Electronic phase selection: The microprocessor controller monitors the phase of the power supply to ensure proper rotation of the condenser and evaporator fans, and the compressor.
13. 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).
14. Hourmeters: The microprocessor controller has multiple built-in hourmeters that can be accessed through the Main Menu.
15. 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).
16. Flash memory: Flash program memory allows the application software to be updated without replacing a EPROM chip on the controller. Application software can be updated in the field using a portable computer and the software 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).

17. Display menus: The microprocessor controller contains an extensive display menu that can be navigated via keypad. The display menu is organized into 7 Main Menus:

- Data Menu: Menu screens in this group are used to display unit operating information including sensor temperatures, voltage, current and frequency information.
- Alarm List Menu: Menu screens in this group display a list of alarm code(s).
- Commands Menu: Menu screens in this group are used to activate defrost, function tests, pretrip (PTI) tests and manual function test.
- Miscellaneous Functions Menu: Menu screens in this group display date/time, C/F, cargo data, program version and run time (hourmeters) information.
- Configuration Menu: Menu screens in this group display refrigerant type, in-range setting, container ID, contrast (screen), language, unit type, reefer type and zero current status.
- Datalogger Menu: Menu screens in this group display temperature log, event log, set log time and PTI log.
- RMM (Remote Monitoring) State: Menu screen show current remote monitoring state (Offline, Zombie or Online).

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
- Evaporator coil sensor
- Ambient sensor
- USDA (Spare) sensors 1, 2 and 3
- R-134a compressor discharge line temperature sensor
- R-23 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
- Electric heaters
- Phase selection

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

Note: *CRR DF units are designed to haul deep frozen cargo only at setpoints between -10 C (14 F) and -70 C (-94F).*

At setpoints of -10 C (14 F) and below, the microprocessor controls unit operation based on the return air sensor temperature and setpoint temperature.

The system operates on Full Cool to provide accurate control of frozen cargo. If the return air sensor becomes disconnected or fails while it is being used to control unit operation, the controller will automatically operate the unit continuously on Full Cool.

Sequence Of Operation

Unit Start-up

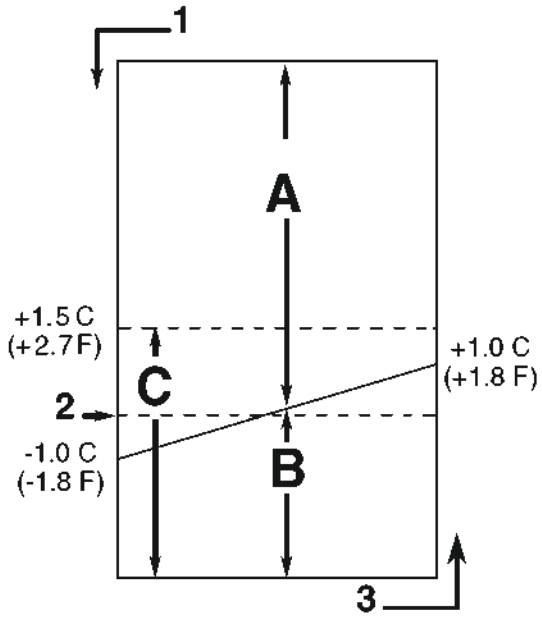
A 60 second sequence start of the required loads occurs during initial start-up of the controller. If cooling is required, the unit operates in the cool mode until the controlling sensor reaches 1.0 C (1.8 F) below setpoint.

- 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. Evaporator fans operate continuously in low speed.
- The R-134a compressor and condenser fan then start and the liquid line solenoid energizes (opens) if the controller calls for cooling.
- The R-23 compressor starts 30 seconds later.
- Unit operates in cool until the controlling sensor reaches 1.0 C (1.8 F) below setpoint on initial pull down.
- Controller turns ON the In-range LED when the controlling sensor temperature reaches 1.5 C (2.7 F) above setpoint on initial pull down.

Figure 18. Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)



BEE730

A.	Cool: Compressors operate a minimum of 15 minutes after startup to prevent rapid cycling between Cool and Null modes.	1.	Decrease Temperature
B.	Null: Compressors are OFF a minimum of 10 minutes to prevent rapid cycling between Cool and Null modes.	2.	Setpoint
C.	n-Range	3.	Increasing Temperature

Continuous Temperature Control Operation

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

The controller regulates compressor operation based the return air sensor and setpoint temperatures to determine operating mode switch points. The controller operates the unit on:

- Cool mode

- Null mode
- Defrost mode
- Evaporator fans operate on low speed to continuously circulate air inside the container (except during defrost).
- Controller LED display shows the return air sensor temperature.
- Controller LCD display shows the setpoint.

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.
- Unit operates in Cool mode for a minimum of 15 minutes to prevent rapid cycling between Cool and Null.
- After initial pull-down to setpoint, the 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 de-energizes the compressor contactors and condenser fan contactor, stopping the both compressors and the condenser fan.
- Units remains in Null mode for a minimum of 10 minutes to prevent rapid cycling between Cool and Null.
- The evaporator fans continue to operate in low speed.

Defrost

During the Cool or Null modes, the controller initiates the Defrost mode when the evaporator coil sensor temperature is below 18 C (65 F) and:

- Demand defrost function determines that defrost is required when the temperature difference between the return air sensor and setpoint increases to a preset value and a minimum of 6 hours of compressor ON (running) time have elapsed since the previous defrost.
- A manual defrost is initiated by pressing the Defrost special function key or by Refcon Remote Monitoring Modem (RMM).

  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.*
- 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 Frozen Loads, the initial time interval is 12 hours. Six (6) hours are added to the time interval each time a timed defrost interval occurs without a demand defrost in between. Maximum accumulated time interval is 36 hours. Time interval resets to 12 hours when setpoint is changed more than 5 C (9 F); or if the unit is turned OFF for 12 hours.

When the defrost mode is initiated:

- The controller de-energizes both the R-134a and R-23 compressor contactors, the condenser fan contactor and the evaporator fan contactors; stopping the compressors, condenser fan and evaporator fans.
- When the compressors stop, 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:

- Frozen mode: Evaporator coil sensor temperature reaches 18 C (65 F).
- Time/temperature function: If the evaporator coil sensor exceeds 8 C (47 F) for 15 minutes, the controller terminates defrost.
- Interval timer: Controller terminates defrost 90 minutes after initiation if the coil sensor temperature has not terminated defrost (120 minutes if power supply is less than 55H). Alarm code 20 will be generated if this occurs.
- When the controller terminates Defrost, the heater contactor is de-energized. The controller starts the condenser fan and the R-134a compressor. After 30 seconds, the controller starts the R-23 compressor and the evaporator fans to minimize heat energy release into the container.

Changing the Setpoint

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 DATA menu appears with the cursor flashing 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 briefly in the LED display.

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

Note: *If the F4 key is not pressed within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat steps 1 through 4.*

5. Controller returns to the standard LED Display (shows return temperature) within 5 seconds and the standard LCD display (showing new setpoint) within 60 seconds.

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 10 C [50 F]), the unit enters defrost as the Defrost LED turns ON.
- If unit operating conditions do NOT allow defrost, the LCD message display shows “DEFROST NOT ACTIVATED”.

2. The defrost cycle automatically terminates.

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 (return air sensor at setpoints of -10 C [14 F] and below).
2. To view the supply air temperature, press and hold the SUP/RET key. The controller will show the supply air temperature as long as the SUP/RET key is depressed.
3. The display then returns to the return air temperature when the SUP/RET key is released.

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

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 the LED display temperature in the alternate temperature scale (Fahrenheit or Celsius) from the temperatures shown on the display 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 scale display, see "Changing the Temperature Display Value (C/F)" under MISC. FUNCTIONS in the Menu Operating Instructions section in this chapter.*

Menu Operating Instructions

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.*

Controller Menu

Navigating the Controller Menu:

The controller Main Menu is divided into seven major menus:

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

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

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

or

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

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

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.

2.

- Setpoint Temperature
- Supply Air Temperature
- Return Air Temperature
- Evaporator Coil (Defrost) Temperature
- R-23 Compressor Discharge Line Temperature
- Ambient Temperature
- High Pressure Temperature (R-134a Compressor Discharge Line Temperature)
- Battery Voltage
- Voltage Average (380/460V Power Supply)
- Voltage 1 (Main Power Supply)

- Voltage 2 (Main Power Supply)
- Voltage 3 (Main Power Supply)
- Frequency (Main Power Supply)
- Zero Current
- Current Phase 1 (Main Power Supply)
- Current Phase 2 (Main Power Supply)
- Current Phase 3 (Main Power Supply)

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.*

Alarm List Menu

The Alarm List menu displays alarm codes. If the Alarm LED is ON or flashing ON and OFF, enter the ALARM LIST to view the alarm code(s).

Alarm Types

There are three types of alarms:

Shutdown Alarm (Level 1): Alarm LED flashes and unit stops. Shutdown alarms indicate the unit has been stopped to prevent damage to the unit or cargo. The condition must be corrected before restarting the unit. Alarm code 56 (Compressor Temperature Too High) is a shutdown alarm.

Check Alarm (Level 2): Alarm LED flashes until alarm is acknowledged. Check alarms indicate corrective action should be taken before a problem becomes severe. Alarm codes 00-17, 18, 19, 20, 22, 23, 34, 35, 43, 52, 58, 112 are Check alarms.

Log Alarm (Level 3): Alarm is recorded in datalogger only (inspect event log). Alarm LED does not flash or turn on. Alarm codes 59, 97, 98 are Log alarms.

Alarm Code States

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

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

Viewing the Alarm List menu:

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

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

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

2. Write down the first alarm code. Then press F2 key to view the next alarm code when more than one alarm code has been recorded.
3. Repeat step 4 until all alarm codes have been recorded. To scroll backward to return to a previous alarm code, press F3 key.

4. To clear all alarm codes from the current display list and turn off the Alarm LED, all problems must be corrected and the alarm code "acknowledged" in the Alarm List menu.

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

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

Commands Menu

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

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

⚠ CAUTION

Service procedure!

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

- Manual Function Test: Controller tests individual components selected by the technician for diagnosis. LCD display will show expected and actual current of the component being tested.

Viewing the Commands menu:

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

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

- Defrost
- PTI (Pretrip)
- Manual Function Test

5. Press F4 key to activate the command selected.

- Defrost: LCD display shows DEFROST ACTIVATED, NOT ACTIVATED (evaporator temperature above 18 C [50 F]) or ALREADY ACTIVATED (defrost in progress). Defrost cycle ends automatically.
- PTI (Pretrip): LCD display shows PTI Test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.
- Manual Function Test:
  a. Controller displays the first component that appears in the Manual Function submenu list: CONDENSER OFF.
  b. Press F2 or F3 key to scroll to desired component test:
  - Condenser Fan:
  - Compressor:
  - Evaporator Fan:
  - R-23 Compressor
  - Sensor Check.
  - Heat:
  - Zero Current (View value only):
  - Sensor Check:
  - ·Sensor Check low speed (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.

c. Component Test:

- Press F4 key to start the component test. LCD display will change the component state from OFF to ON and show expected current and actual current on phase 1, 2 and 3.
- Press F4 key again to stop test. LCD display will change component state from ON to OFF.

d. System Test (Multiple Components): More than one component can be turned ON at a time to perform a functional test of the unit.

- Press F4 key to start the component. LCD display shows component ON.
- Press F3 key to scroll to select next component. Press F4 to start the component. LCD display shows component ON.
- Repeat component start procedure until all required components are ON. For example, to operate unit in Full Cool mode, start the following components:
  - Condenser Fan
  - R-134a Compressor
  - R-23 Compressor
  - Evaporator Fans
- Observe current draw and system performance.
- When diagnosis is complete, press F4 key to turn OFF components individually. Press ESC key to exit Manual Function Test menu and turn ALL components OFF.

e. Press ESC key to exit the Manual Function Test submenu.

Manual function Test, DF units

Menu list:

- Condenser Fan:
- Compressor:
- Evaporator Fan:
- R23 Compressor:
- Sensor Check.
- Heat:
- Zero Current (View value only):
- Sensor Check:
- Sensor Check low speed (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.

Misc. Functions Menu

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

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

  Note: *The program version serial numbers should be written down on the Controller decal located on the side of the control box.*

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

Viewing the Misc. Functions menu:

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

1. Press the F3 key to enter the Main Menu. Press F2 key to scroll through Main Menu until “MISC. FUNCTIONS” appears in LCD display.
2. Press F4 key to access the Misc. Functions menu. The first command in the submenu appears in the LCD display: Date Time.
3. Press F2 or F3 key to scroll to the desired function:

- Date Time
- C/F Mode
- Cargo Data
- Program Version
- Run Time

4. Press F4 key to access the function selected.

Setting the Date and Time

1. Press the F3 key to entering Main Menu. 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.

Changing the Temperature Display Value (C/F)

1. Press the F3 key to enter the Main Menu.
2. Press F2 key to scroll to “MISC. FUNCTIONS”.
3. 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”.
4. 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 of” where C = Celsius and F = Fahrenheit.
5. To change the temperature value, press F4 key. Cursor moves to end of menu line and flashes.
6. Press F2 key to toggle temperature value in the menu line between C and F.
7. 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.
8. Press ESC key to exit the C/F Mode screen.

Setting Cargo Data

1. Press the F3 key to enter the Main Menu.

2. Press F2 key to scroll to “MISC. FUNCTIONS”.
3. Press F4 key to access the Misc. Functions menu. “Date Time” appears in the LCD display. Press F2 key to scroll to “CARGO DATA”.
4. Press F4 key to access the Cargo Data screen. Cargo Data screen appears with cursor in LOC. BRT menu line.
5. 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

6. 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.

7. 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.
8. Repeat steps 5 through 7 until all information has been entered in the Cargo Data screen.
9. Press ESC key to exit the Cargo Data screen.

Viewing or Setting Run Time

1. Press the F3 key to enter the Main Menu.
2. Press F2 key to scroll to “MISC. FUNCTIONS”.
3. Press F4 key to access the Misc. Functions menu. “Date Time” appears in the LCD display. Press F2 key to scroll to “RUN TIME”.
4. Press F4 key to access the Run Time screen. The Run Time screen appears with cursor in HEAT menu line.
5. Press F3 key to scroll cursor down through cargo data list: - HEAT

- R-134a COMPRESSOR
- EVAPORATOR LOW
- CONDENSER
- SCROLL (R-23) COMPRESSOR
- TOTAL

6. 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.
7. Repeat steps 5 and 6 to reset additional hourmeters.
8. Press ESC key to exit the Cargo Data screen.

Configuration Menu

The Configuration menu displays a list of functions that identifies unit operating features and current settings. The following functions are available:

MP-3000 Configuration List, DF Units

Text	Description	Default	Range
IN RANGE	In range limit	1,5°C	0,5°C - 5°C
CONT ID	Container Id	LOSUxxxxxxx	Must be valid
CONTRAST	The LCD contrast	45	0 - 255
LANGUAGE	The used language	GB	GB
ZERO CURR	Zero current measuring	On	On/Off
USDA TYPE	Usda probe set up	3 PT100	3 PT100 / 3 THERM / 4 THERM
CHART R.	Chart recorder option	Not Present	Not Present/ +/-25C 31dy
AUTO CONFIG	Auto configuration wanted	On	On/Off
UNIT #	Reefer unit identification	————————	9x any char

Viewing or Setting Functions in the Misc. Functions 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 “CONFIGURATIONS” appears in LCD display.
3. Press F4 key to access the Configurations screen. Configurations screen appears with cursor in the In-Range menu line.
4. Press F3 key to scroll cursor to view or reset the desired function:
   - In-Range: Sets the temperature value for the controller’s In-range LED and datalogger functions (factory default = 1.5 C [2.7 F]). Enter a value from 0.5 to 5.0 C (0.9 to 8.9 F).
   - Container ID: Sets the container identification number. Enter up to 11 characters (numbers or letters).
   - Contrast: Controller automatically regulates black and white contrast value on LCD display according to display temperature. Standard setting is 45. Resetting this value is not recommended.
   - 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.
5. To set a new Configuration screen value:
   a. Press F4 key with cursor in the desired menu line. The Password screen appears.
   b. Press F2 key, “A” key (password is “A”), F4 key and then EXIT key. An Enter Arrow appears in the hourmeter line.
   c. Use the general purpose keypad to enter the desired value; or press the F3 key to toggle the value to the desired setting.
   d. When the entry is complete, press and hold the F4 key until the cursor stops flashing. The new value appears in the menu line.
6. Repeat steps 4 and 5 to reset additional configuration values.
7. Press ESC key to exit the Cargo Data screen.

Datalogger Menu

The Datalogger menu contains a list of functions that display unit operating information recorded in the MPC3000 . The following functions are available:

Inspect Temperature Log: Displays temperature logs by time and date for the Setpoint; and the Supply, Return, USDA1, USDA2, USDA3 and Ambient sensors.

Inspect Event Log: Displays important event logs by time and date for events such as unit alarms, power On/Off, setpoint change, clock reset, trip start, defrost, etc.

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 Frozen Mode test.

Set Log Time: Sets the data log interval (1 minutes or 1/2, 1, 2 or 4 hours).

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 "DATALOGGER" appears in LCD display.
3. Press F4 key to access the Datalogger menu. The first function appears in the LCD display: Inspect Temp Log.
4. Press F2 or F3 key to scroll to the desired function:

- Inspect Temp Log
- Inspect Event Log
- Inspect PTI Log
- Set Log Time

5. Press F4 key to access the function selected.

- Inspect Temp Log: The Log Time and the Setpoint, Supply, Return, USDA1, USDA2 and USDA3 temperatures appear in the first screen.
- Press the F4 key to view additional sensor log screens: Ambient sensor temperature and flags.
- Press the F3 key to scroll through previous logs of the sensor temperatures currently in the display. All temperature logs recorded in the datalogger memory may be viewed on the LCD display.

Note: *Logging temperature range is -90 C to +10 C (-130 F to +50 F). If temperature is greater than +10 C (+50 F), LED display shows "+Err" and LCD display shows "Sensor Short" message. If temperature is less than -90 C (-130 F), LED display shows "-Err" and LCD display shows "Sensor Open" message.*

- Inspect Event Log: The Log Time and most recent Event appear in the first screen.
- Press the F3 key to scroll previous event log screens.
- Inspect PTI Log: The Start Time and PTI test results appear in the first screen.
- Press the F3 key to scroll through additional test results items in the log.
- Set Log Time: The current Log Time interval appears in the screen. To enter a new log interval:
  a. Press F4 key with cursor in Log Time menu line. Cursor moves to the end of the menu line and flashes.
  b. Press F3 key to scroll through a list of log time intervals:
     - 1 Minute
     - 1/2 Hour
     - 1 Hour
     - 2 Hour
     - 4 Hour
  c. 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.

6. Press ESC key to exit any screen in the Datalogger menu.

RMM State Menu

- Offline: No communication between Controller-RMM and REFCON system.
- Zombie: The controller has detected a REFCON system master module and is waiting for communication.
- Online: The Controller-RMM is logged-in on a REFCON system for online viewing.

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

Viewing the RMM State screen:

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

1. Press the F1 key to retrieve current unit performance data before entering Main Menu.
2. Press F2 key to enter the menu list. 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 Online.
4. Press ESC key to exit the RMM State screen.

PTI (Pretrip) Test

⚠ CAUTION

Service procedure!

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

The CRR DF controller contains a special PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, temperature control and individual components including the controller display, contactors, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values.

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.*

During the PTI test, the LED display screen will show:

- “P1” for PTI test and the current step of the test (e.g. “01”).
- Alarm LED flashes if an alarm condition occurs during the test.

Note: *Detailed PTI test results are stored in the 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.*

Note: *Auto PTI test omits HPCO test on R134a and R23 compressor, and cooling capacity is not verified by minimum temp difference between supply and return. Manually verify function HPCO functions and full cooling capacity.*

Table 10. Model CRR DF - CRR Pretrip (PTI) Test Procedure

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.00	Display Test Activated 0.1 A 0.0 A 0.1 A	Event Log for PTI begins. All alarms are turned OFF. Alarm list is cleared. All lights and bars in display turn ON.	None	10 Seconds
P1.01	Sensor Test Activated 0.1 A 0.0 A 0.1 A	All sensors must have values within their measuring range. Power supply voltage and frequency must be Ok.	00, 01, 02, 03, 04, 05, 32, 33, 34, 35, 97, 98, 112	10 Seconds
P1.02	Heat Test Activated 10.4 A 10.3 A 10.4 A	Electric heaters are turned ON. Amp draw is measured and compared to voltage: • 8.8 Amps approx. at 400V; • 10.2 Amps approx. at 460V.Amperes are recorded in PTI log.	10, 11	10 Seconds
P1.03	Defrost Activated 10.4 A 10.3 A 10.4 A	If evaporator sensor is below +10 C (50 F), heat remains on until evaporator sensor reaches +18 C (65 F).	20	1 Hour Maximum
P1.04	Evaporator Fan HighActivated 1.6 A 1.5 A 1.6 A	Condenser fan and compressor are turned OFF. With evaporator fan on high speed, Amp draw is measured and compared to voltage and frequency: • 1.2 Amps approx. at 50 Hz, 1.6 Amps approx. at 60 Hz Amperes are recorded in PTI log.	12, 13	10 Seconds

Table 10. Model CRR DF - CRR Pretrip (PTI) Test Procedure (continued)

P1.05	Probe Test Activated 1.6 A 1.5 A 1.6 A	Evaporator fans operate until temperature difference between the return and evaporator sensors, and return and supply sensors is less than 3.0 (5.4 F). Return sensor temperature must be 0.5 C (1.0 F) above both the evaporator and supply sensor temperatures.	52	60 to 600 Seconds
P1.06	Condenser Fan Activated 2.2 A 2.1 A 2.2 A	Condenser fan is turned ON. Amp draw is measured and compared to voltage and frequency: Condenser fan amperes are recorded in PTI log.	16, 17	10 Seconds
P1.07	Reverse Phase Activated 2.2 A 2.1 A 2.2 A	Condenser fan stops. Reverse phase selector relay is energized and condenser motor is started in reverse for 2 seconds. Amp draw difference between correct and wrong motor rotation must be less than 0.2 amps.	58	30 Seconds
P1.08	Compressor Test Activated 9.2 A 9.1 A 9.2 A	Condenser fan and compressor are turned ON. Amp draw is measured and compared to voltage. Evaporator temperature and 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
Return Temp.	PTI Running Setpoint: -30 C (-22 F)	Unit operates in normal cool mode with -30 C (-22 F) setpoint. When return air temperature decreases to setpoint sensor temperatures are recorded in PTI log.	22	4 Hours Maximum
Return Temp.	PTI Running Defrost activated: -55 C (-67 F)	Unit operates in normal mode with -55 C (-67 F). When return temperature decreases to -55 C (-67 F), defrost is activated. When evaporator temperature increases to 18 C (65 F), defrost terminates and sensor temperatures are recorded in PTI log.	20	90 Minutes Maximum
Return Temp.	PTI Running Setpoint: -55 C (-67 F)	Unit operates in normal mode with -55 C (-67 F) setpoint. When return air temperature decreases to setpoint, sensor temperatures are recorded in PTI log. "PTI End" event is recorded in the PTI log. A Trip Start is automatically activated. Alarms (if any) are cleared from data logger. However, alarms (if any) remain in alarm list as not active until acknowledged.	23	6 Hours 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	—

Temperature Sensors

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

- Supply Air
- Return Air
- Evaporator Coil
- R-134a Compressor Discharge Line
- R-23 Compressor Discharge Line
- Ambient Air

⚠ CAUTION

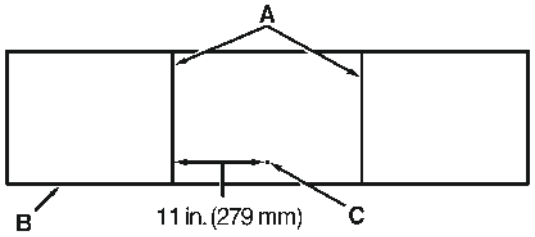
Service procedure!

It is important that the temperature sensors are properly mounted. Sensors are permanently calibrated and can be checked using an ohmmeter. Ohm readings should agree with specific data as shown in the following Sensor resistance tables.

When positioning the evaporator coil (defrost) sensor in the coil, make sure it is placed at least 75 mm deep and in the middle of the evaporator coil.

Note: *K ohm sensors used in standard CSR & CRR units are not interchangeable with 1K ohm type sensors used as supply, return and Evap sensors in DF units.*

Figure 19. Fan Evaporator: Evaporator (Defrost) Sensor Location



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A.	Coil support brackets
B.	Unit front.
C.	Insert sensor at least 75 mm into coil between tube rows 2 and 3

Table 11. Model CRR DF - Resistance Values for R-134a or R-23 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

Table 11. Model CRR DF - Resistance Values for R-134a or R-23 Compressor Discharge Line Sensor (continued)

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

Table 12. Model CRR DF - 1K Sensor Resistance Values for Supply, Return, Evaporator Coil and Air Sensors for MP3000 Controller

Temp. °F	Temp. °C	OHMS	Temp. °F	Temp. °C	OHMS
-40	-40	21309	53.6	12	1680
-31	-35	16099	57.2	14	1547
-22	-30	12266	60.8	16	1426
-13	-25	9425	64.4	18	1316
-4	-20	7309	68	20	1215
5	-15	5691	71.6	22	1173
10.4	-12	4919	75.2	24	1040
14	-10	4470	78.8	26	962
17.6	-8	4066	82.4	28	893
21.2	-6	3703	86	30	828
24.8	-4	3376	89.6	32	770
28.4	-2	3082	93.2	34	715
32	0	2817	96.8	36	665
35.6	2	2577	100.4	38	619
39.2	4	2360	104	40	577
42.8	6	2165	107.6	42	538
46.4	8	1953	111.2	44	502
50	10	1826	113	45	485

Table 13. Model CRR DF - 2K Sensor Resistance Values for Ambient Air Sensors for MP3000 Controller

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

Table 13. Model CRR DF - 2K Sensor Resistance Values for Ambient Air Sensors for MP3000 Controller (continued)

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

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 three fixed operating functions:

- Cooling (frozen): Both compressors, the condenser fan and the evaporator fans operate continuously. The liquid line solenoid is energized with the R-134a compressor.
- Defrost: Heaters are activated for defrost (evaporator fans off).
- Evap Fan: Evaporator fans are activated.

⚠ CAUTION

Service procedure!

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

To select Manual Control:

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

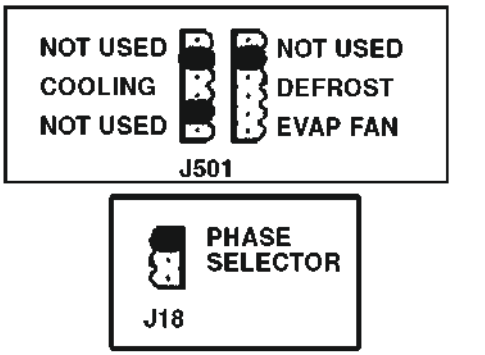
⚠ WARNING

Risk of Injury!!

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).
4. Disconnect the 2-pin plug from J501 (see decal on main relay board). Re-locate plug according to the function required: Defrost or Cool.
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 backwards, the power supply phase must be changed.

Figure 20. Manual Emergency Control Connections



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Replacing the EPROM Chip (MP3000)

To replace the EPROM chip in the controller:

1. Turn the unit On/Off switch OFF. Then unplug the unit power cord from the power supply.

⚠ WARNING

Risk of Injury!!

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.

2. Disconnect battery power connection from the controller (top plug on the controller).
3. Do one of the following:

- MP3000 Controller: Remove the datalogger from the back of the controller by loosening the 4 screws.

  The EPROM chip will become visible. Do NOT remove the connection between controller and datalogger.

Note: *An anti-static wrist strap and EPROM chip insertion tool should be used during this procedure.*

4. Cut the EPROM security strip and carefully remove EPROM chip.
5. Replace security strip. Then carefully mount new EPROM chip and tighten security strip.
6. Place new EPROM chip ID label over old label on the side of the controller to identify new EPROM.
7. Install datalogger (or back cover) mounting screws.
8. Connect battery power plug to top of controller.

Note: *The EPROM replacement will lead to a total loss of the software, thus software has to be downloaded.*

⚠ CAUTION

Service procedure!

EPROM chip replacement will lead to a total loss of software. Immediately proceed to procedure for "Loading Controller Software" in this chapter.

Replacing the Microprocessor Controller

Note: *There are several programmable features that may need to be set to completely configure the unit to customer specifications. Customer requirements may include features such as the container identification number. Adjust any additional programmable settings to customer requirements before releasing the unit for service.*

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, datalogger and remote monitoring modem.
4. Remove the screws that secure the datalogger and 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 datalogger and remote monitoring modem to back of the controller.
9. Connect the communication cables to the datalogger, remote monitoring modem and controller.

Note: *Be certain that all connector plugs are fully seated.*

⚠ CAUTION

Service Procedure!

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

⚠ CAUTION

Service Procedure!

Immediately proceed to procedure for "Loading Controller Software" in this chapter.

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

Table 14. Model CRR DF - MP 3000, Super Freezer "Error message list"

#	Error Message	Controller Action
1	Power Error, Check 20A Fuses Indicates: • One or more phases are missing • Compressor is able to draw amps on allphases while heater lacks amps on one or more phases	• Controller activates alarm 18 • Controller will try to restart unit after 60 minutes.
10	Cond probe found, please change type Indicates: • Controller is set for CRR40 DF and start-up is initiated on a KVQ/CRR PS, CSR PS or CSR Magnum unit. Correct by turning Un it On/Off switch Off. Then set controller software switch to correct position. See controller software selection.	• None. On CRR40 DF units, condenser sensor input must be left open.

Table 14. Model CRR DF - MP 3000, Super Freezer "Error message list" (continued)

11	Scroll Compressor, High Temperature Indicates: • Compressor stops because discharge temperature is above 140 c (284 F). Message remains in display until discharge temperature decreases to normal.	• Controller clears message after compressor start up.
12	Scroll Compressor, Low Pressure Indicates: • Low pressure cutout switch is open.• Possible causes include stepper motor valvewill not open, warm gas bypass valve wil not open, low refrigeratn charge, defective low pressure cutout switch, open circuit, etc.	• Controller activates Alarm 31 after 5 minutes. • Controller clears message after compressor start up.
13	R134a Compressor, High Temperature Indicates: • Compressor stops because discharge temperature is above 130 C (266 F). Compressor remains Off until discharge temperature decreases to 90 C (194 F)	• Controller actrivates Alarm 56. • Controller clears message when compressor temperature decreases below 130 C (266 F). However, compressor remains off until discharge temperature decreases to 90 C (194 F).
14	Evaporator High Temperature Switch Open Indicates: • Controller disables electric heaters due to open high temperature switch circuit. • Possible causes include evaporator temperature over 54 C (130 F), defective heater, defective evaporator overheat switch, open circuit, etc.	• Controller clears message when hightemperature switch closes. • NO alarm is set until Controller determines that heater current draw is too high (alarm 10), unit current draw is too high (alarm36), or defrost time is too long (alarm 20).
15	R134a Compressor Fault • Feedback from 134a Compressor is Missing	• Check to be certain 134a compressor is running • Check continuity through 134a auxiliarycontactor on Main Relay Board plug J12.

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 each compressor. If a high pressure cutout switch is suspected of being defective, replace it with a known good switch.

R-23 High Pressure Cutout Switch

If the R-23 compressor discharge pressure rises above 3250 ± 50 kPa, 32.5 ± 0.5 bar, 470 ± 7 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-23 compressor STOPS immediately.
- LCD Display Message: No response to R-23 high pressure cutout.
- Evaporator and condenser fans and R-134a compressor continue normal operation.
- R-23 compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 2590 ± 250 kPa, 25.9 ± 2.5 bar, 375 ± 38 psig.

R-134a High Pressure Cutout Switch

If the R-134a compressor discharge pressure rises above 2410 ± 68 kPa, 24.1 ± 0.68 bar, 350 ± 10 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-134a compressor STOPS immediately.
- LCD Display Message: R-134a high pressure cutout feedback missing.
- Evaporator and condenser fans continue normal operation.
- R-23 compressor stops.
- R-134a compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 1640 ± 68 kPa, 16.4 ± 0.68 bar, 238 ± 10 psig.
- R-23 compressor will restart 30 seconds after R-134a compressor restarts.

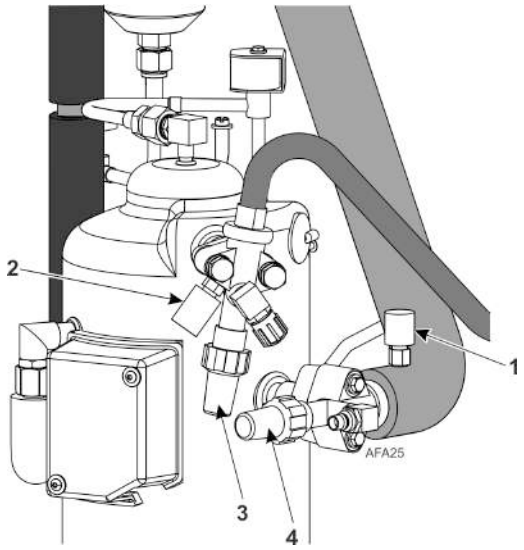
Low Pressure Cutout Switch

A low pressure cutout switch is located on the compressor suction line. The low pressure cutout switch opens: -33 to -54 kPa, -0.33 to -0.54 bar, 10 to 16 in. Hg vacuum; closes: 24 to 58 kPa, 0.24 to 0.58 bar, 3.5 to 8.5 psig. If the suction pressure becomes too low, the switch 3opens to stop the compressor.

- Compressor stops immediately.
- Evaporator and condenser fans continue normal operation.
- Compressor will restart if the low refrigerant condition is corrected (switch closes) as long as power is available. The low pressure switch resets (closes) when the pressure increases to 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig.

Removal

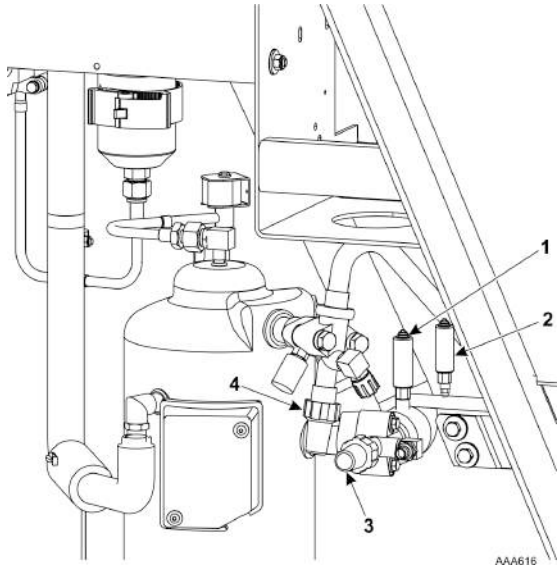
1. Disconnect the low pressure cutout switch wires from the control box.
2. Remove the low pressure cutout switch from the suction line. The fitting on the suction line has a shrader valve which will prevent refrigerant leakage.



1	Low Pressure Cutout Switch
2	High Pressure Cutout Switch
3	Discharge Service Valve
4	Suction Service Valve

Installation

1. Install low pressure cutout switch in the suction line.
2. Route wires into the control box and connect to proper terminals.
3. Perform a controller pretrip test to verify system operation.



1	Suction Transducer
2	Discharge Transducer
3	Suction Service Valve
4	Discharge Service Valve

Low Pressure Cutout Switch or Suction Transducer Configuration

These units could have either a Low Pressure Cutout switch or a Suction Transducer installed.

Low Pressure Cutout Switch Installed

Suction Transducer Installed

The Low Pressure Cutout Switch or Suction Transducer will have the same function, since the unit only has one fitting on the suction tube, the unit can have either a Low Pressure Cutout Switch or Suction Transducer but not both.

The following procedure is to replace a Low Pressure Cutout Switch (LPCO) with a Suction Transducer. To replace a Suction Transducer with a Low Pressure Cutout Switch follow instructions in reverse.

1. Remove LPCO switch from suction tube. Fitting on the suction tube has a Schrader valve in it, unscrew the LPCO.
2. Disconnect the LPCO wires from J9 pins 5 and 6, remove switch and harness from unit.
3. Install a jumper wire on J9 pins 5 to 6.
4. Screw the Suction Transducer on the fitting on the suction tube.
5. Route wire harness into control box.
6. Connect wires to J1 pins 7, 8, 9.
   a. White wire to pin 7.
   b. Red wire to pin 8.
   c. Black wire to pin 9.
7. Secure harness.

Alarm 31 LOW PRESS CUTOUT OOCL only, logged in the data logger

Alarm 120 SUCTION PRESSURE SENSOR ERROR output of sensor outside limits

Alarm 136 TRANSDUCER CIRCUIT ERROR detects no 12V output to sensor

Message 32 LOW PRESS CUTOUT- PLEASE WAIT Suction pressure < 5-11 in. vacuum Message 33 LPCO TIMER HOLD – PLEASE WAIT Suction pressure > 4-7 psig with 30 second delay

NOTICE

Equipment Damage!

Repair when parts are available. Do not run without low pressure protection.

If no LPCO or transducer is available for repair, add jumper wire for LPCO or configure transducer NONE.

Condenser Fan and Evaporator Fan Rotation

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

Check Condenser Fan Rotation

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.

Check Evaporator Fan Rotation

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

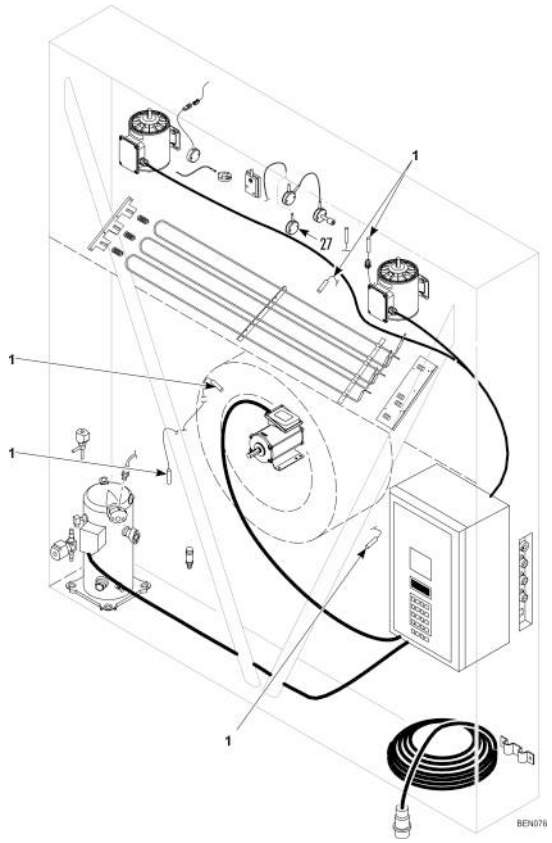
Check both high and low speed evaporator fan rotation by performing Evaporator High and Evaporator Low tests from the Manual Function Test menu.

If an evaporator fan is rotating 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.

Temperature Sensors

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

- Supply Air
- Return Air
- Evaporator Coil
- Condenser Coil
- Compressor Discharge Temperature Sensor
- Ambient Air



1	Temperature Sensors

Sensor Installation

All sensors should be properly installed as follows:

- Supply air sensors must be inserted to the bottom of the sensor tube and completely sealed by the grommet connection.
- Return air sensor installs in a grommet between the evaporator fans.
- Evaporator coil (defrost) sensor must be placed in the middle of the coil and 75 mm deep between the fins.
- Condenser sensor must be placed on the upper left side of the condenser coil and 70 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor discharge temperature sensor is attached to compressor head by adhesive. Refer to (“,”).

Sensor Testing

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 the last 90 minutes, the controller initiates a probe test to check for a defective sensor.

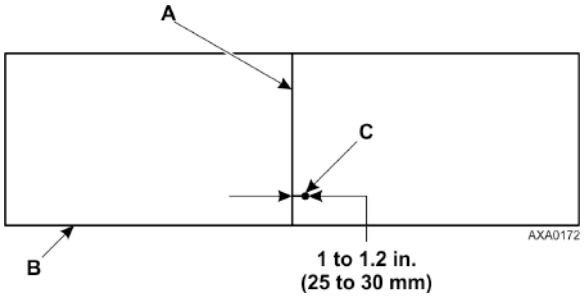
During a Probe test, the VGA display shows [PROBE TEST PLEASE WAIT]. The controller operates the unit on high speed evaporator fans only for five minutes. All sensor temperatures are then compared.

- 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).

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

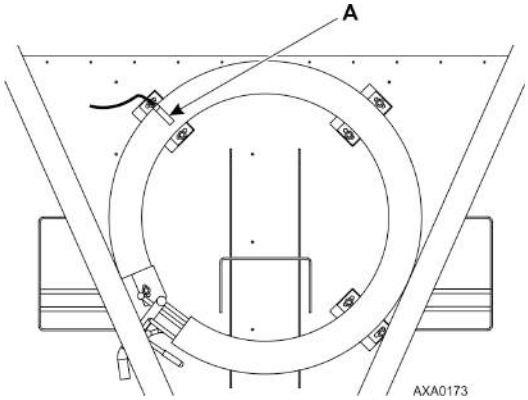
Note: *A manual probe test can be performed by a technician by selecting “SENSOR CHECK” from the Manual Test Function menu.*

Evaporator Coil (Defrost) Sensor Location



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

Condenser Coil Sensor Location



A	Insert sensor into condenser coil between tube Rows 1 and 2.

Resistance Values for Temperature Sensors

Sensors are permanently calibrated and can be checked using an ohmmeter. Ohm readings should agree with the data shown in the following sensor resistance tables.

Table 15. Supply, Return, Evaporator Coil, Condenser Coil, and Ambient Air Sensors

°F	°C	Ohms	°F	°C	Ohms
-40	-40	842,9	53.6	12	1046,8
-31	-35	862,5	57.2	14	1054,6
-22	-30	822,2	60.8	16	1062,4
-13	-25	901,9	64.4	18	1070,2
-4	-20	921,6	68	20	1077,9
5	-15	941,2	71.6	22	1085,7
10.4	-12	956,9	75.2	24	1093,5
14	-10	960,9	78.8	26	1101,2
17.6	-8	968,7	82.4	28	1109,2
21.2	-6	976,5	86	30	1116,7
24.8	-4	984,4	89.6	32	1124,5
28.4	-2	992,2	93.2	34	1132,2
32	0	1000,0	96.8	36	1139,9
35.6	2	1007,8	100.4	38	1147,7
39.2	4	1015,6	104	40	1155,4

Table 15. Supply, Return, Evaporator Coil, Condenser Coil, and Ambient Air Sensors (continued)

°F	°C	Ohms	°F	°C	Ohms
42.8	6	1023,4	107.6	42	1163,1
46.4	8	1031,2	111.2	44	1170,8
50	10	1039,0	113	45	1174,7

Table 16. Compressor Discharge Sensors

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

Refrigeration Maintenance

Introduction

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.

Note: *In the USA, EPA Section 608 Certification is required to work on refrigeration systems, using approved equipment and complying with all Federal, State, and Local laws. In the EU, local F-gas Regulations must be observed when working on refrigeration systems.*

Tools

NOTICE

System Contamination!

When servicing Thermo King R-134a, R-23, R-404A, R-452A or R-513A units, use only those service tools certified for and dedicated to R-134a/R-23/R-404A/R-452A/R-513A refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-23/R-404A/R-452A/R-513A systems.Please check serial# plate for type and volume of Refrigerant charged. Please do not blend with other refrigerants than the original charged refrigerant

Vacuum Pump

A two-stage, 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.

Filters and Cartridges

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 Equipment

Use only refrigerant recovery equipment approved for and dedicated to HFC refrigeration recovery

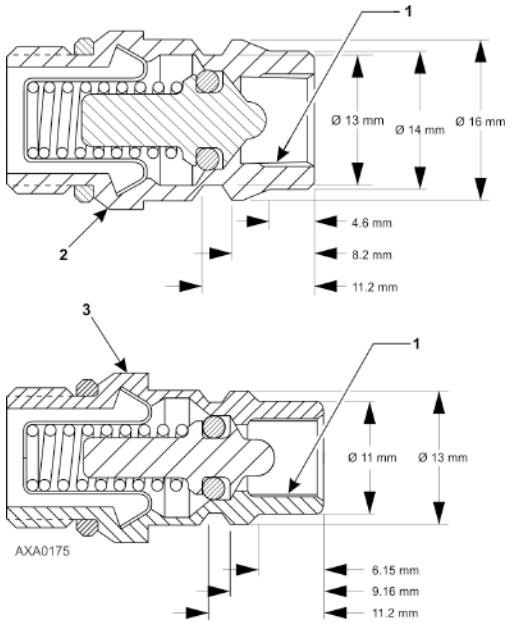
Detecting Leaks

Leaks can be detected with the use of soap bubbles and with Halogen leak detectors such as model H10G or model H10N (portable).

Special Service Fittings

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

- Low side near the compressor suction service valve (or suction adapter)
- High side near the compressor discharge service valve (or discharge manifold)
- Receiver Tank



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

Oil Acid Test

Perform an oil acid test (refer to Tool Catalog for oil test kit) whenever a unit has a substantial refrigerant loss, a noisy compressor or dark/dirty oil.

Checking Compressor Oil

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.

Checking the Compressor Oil Level

Operate the unit on full COOL. After 15 minutes, observe the compressor oil level. The oil level should be 1/2 to 3/4 full in the sight glass of both compressors.

Adding Compressor Oil

1. Install gauge manifold set (refer to “Gauge Manifold Set Attachment and Purging”).
2. Do one of the following:
   a. R-134a Compressor: Pump the compressor down (refer to “Low Side Pump Down”).
   b. R-23 Compressor: Do NOT pump down a scroll compressor. Proceed to step 4 to add oil to a scroll compressor.
3. 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.)
4. Remove the cap from oil pressure fitting on compressor.
5. 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,
6. 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.
7. R-134a Compressor: 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.

Isolate Compressor

The discharge suction and digital ball service valves isolate the compressor from the high and low sides of the refrigeration system. Compressor isolation is needed for system diagnosis, service, and repair.

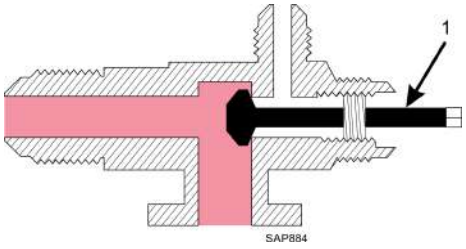
Note: *The valves are a permanently assembled unit and must be replaced in total if defective. The only maintenance possible on the discharge or suction service valve is to periodically tighten the packing nut or to replace the packing.*

⚠ WARNING

Hazard of Explosion!

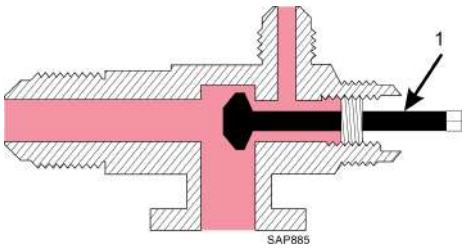
Do not start unit with discharge valve in front seated position.

Service Valve Back Seated (Operating Position)



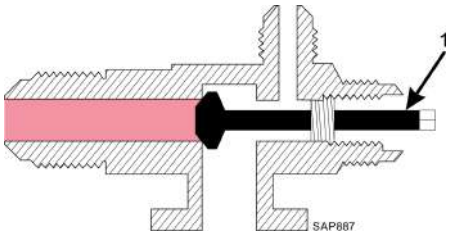
1	Full Counterclockwise

Service Valve Open to Port (Servicing Position)



1	1/2 Turn In

Service Valve Front Seated (Check or Remove Compressor)



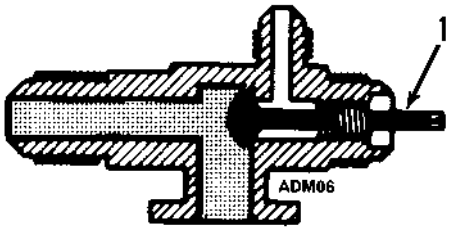
1	Full Clockwise

Service Valve Positions

The suction and discharge service valves provide connections for the gauge manifold to the compressor for system diagnosis, service, and repair. Familiarize yourself with these valve positions:

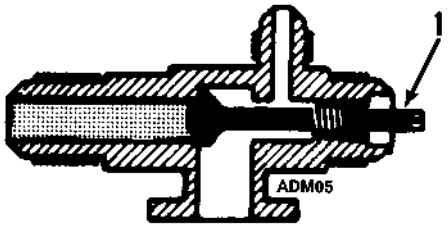
Back-seated: Normal operating position. The service valve is fully closed:

Figure 21. Valve Fully Counterclockwise (Back-seated)



Front-seated: Checking and removing the compressor. The service valve is open, and access to the system is closed:

Figure 22. Valve Fully Clockwise (Front-seated)



⚠ DANGER

Risk of Injury!

Anytime the suction service valve or the discharge service valve is front seated (closed), take precautions to ensure the unit and the bus will not accidentally start while you are servicing the system.

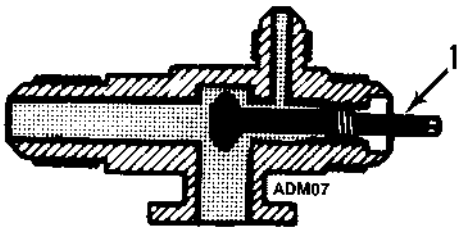
⚠ DANGER

Risk of Injury!

If the compressor is operated with the service valves closed, an explosion may occur that could result in serious injury or death.

Open to Service Port: Servicing position. Access to the system and the service ports:

Figure 23. Valve Turned Half Way In (Open to Service Port)



Gauge Manifold Connections

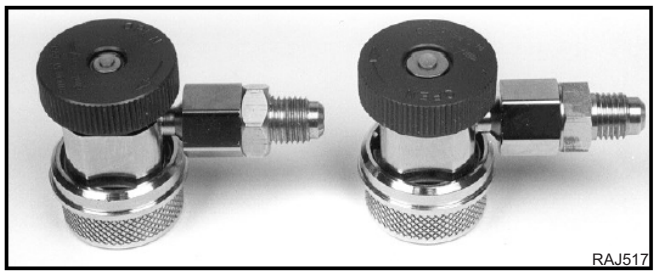
Before You Proceed

Note: *This procedure is only for units that contains R134a refrigerant.*

Note: *To minimize refrigerant loss, use sealing-type quick connectors. These fittings restrict flow during evacuation.*

Read the following before you proceed with a gauge manifold connection.

- If a procedure requires the compressor to operate at a suction pressure below 5 inch vacuum (-17 kPa), place a jumper across the low pressure cutout switch to prevent compressor shutdown.
- Use of the quick disconnect access valve during evacuation increases the time required to reach the correct micron level.



2040791	Coupler - discharge, w/red knob
2040792	Coupler - suction, w/blue knob

Gauge Manifold Positions

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

Figure 24. Hand Valves Open to Center Port

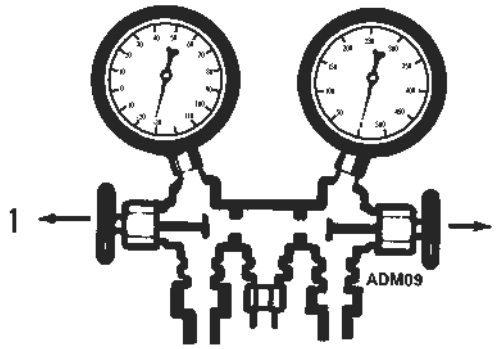
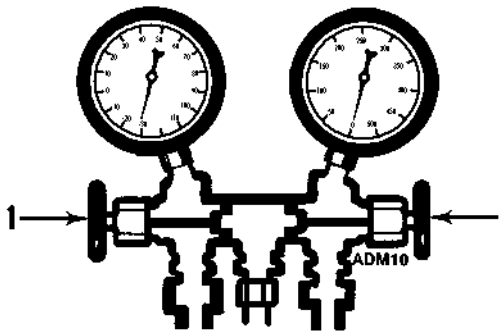


Figure 25. Hand Valves Closed to Center Port



Gauge Connections: Balancing Pressure, Removing Refrigerant, and Charging System

Figure 26. Balancing Pressure

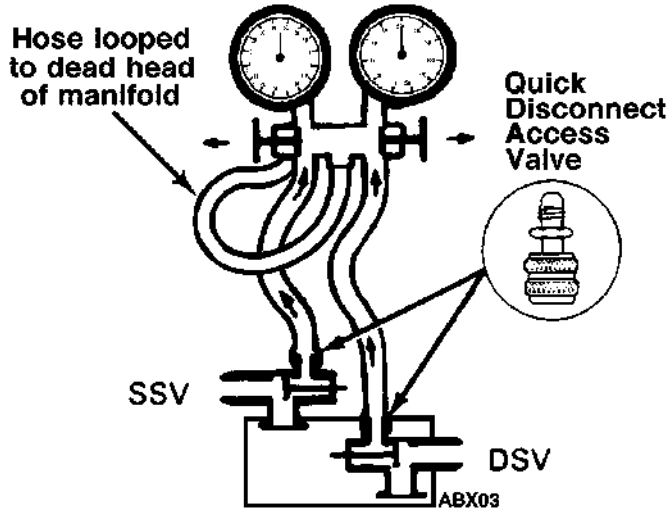


Figure 27. Removing Refrigerant

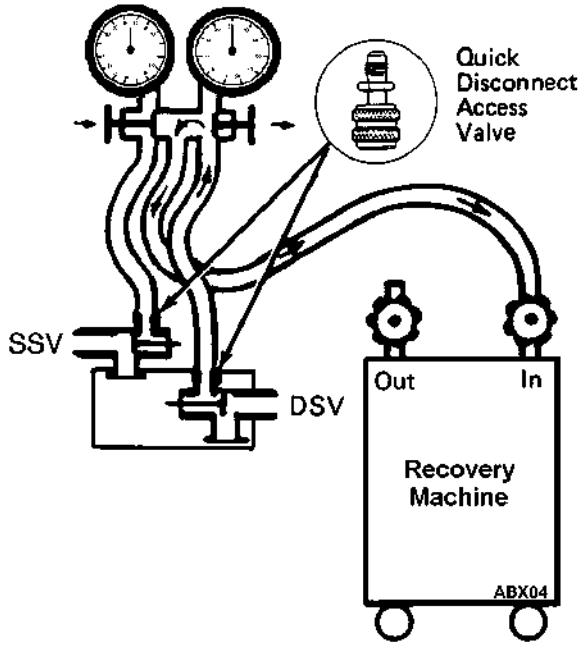
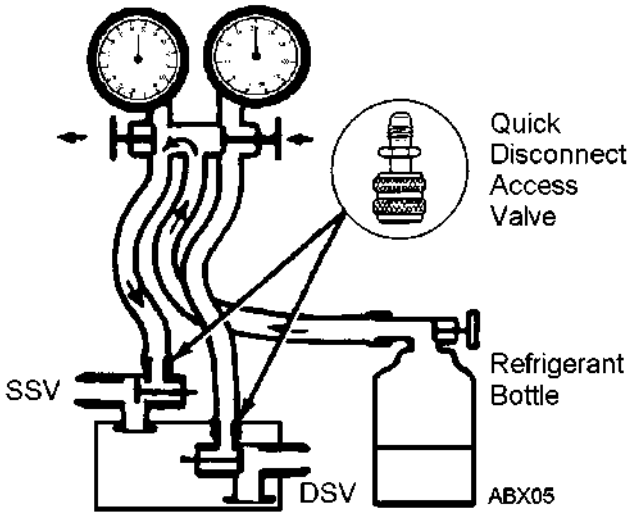


Figure 28. Charging the System



Low Side Pump Down (R-134a Compressor Only)

Note: *Do NOT pump down a scroll compressor. Reclaim the refrigerant when servicing the low side or high side of the R-23 refrigeration system.*

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 receiver tank outlet 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.

NOTICE

Equipment Damage!

To prevent air and moisture contamination, do not open the low side of system while in vacuum.

4. To place the unit back in service, open the receiver tank outlet valve and turn the On/Off switch ON.

Gauge Manifold Set

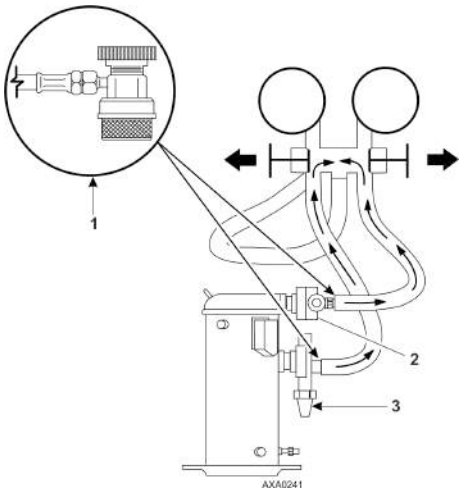
Using a New Gauge Manifold Set

A new gauge manifold set and gauge hoses (refer to Tool Catalog) should be dedicated for use with only R-134A refrigerant.

Gauge Manifold Valve Positions

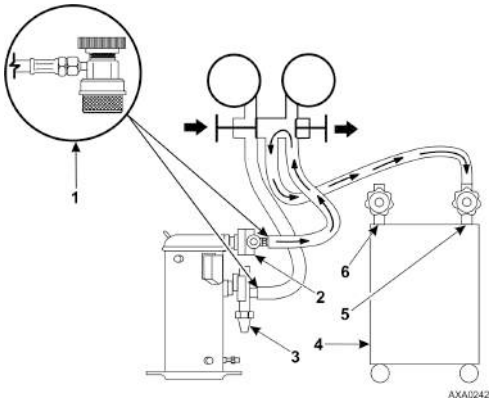
The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations.

Balancing the Pressure



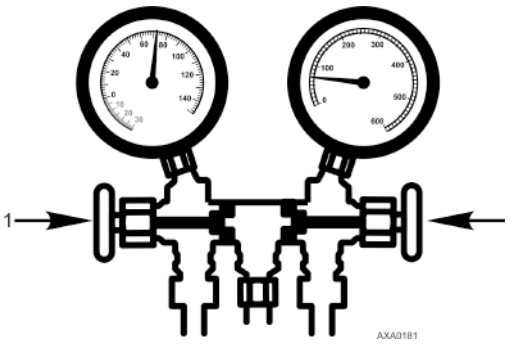
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)

Removing Refrigerant



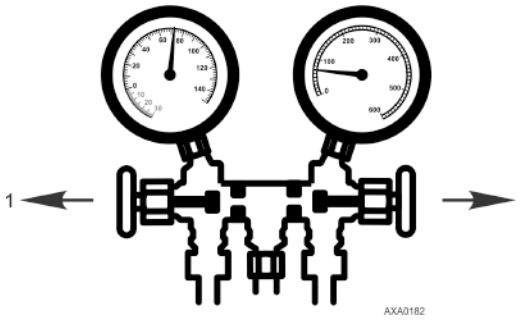
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)
4	Reclaimer
5	In
6	Out

Gauge Manifold Closed to Center Port



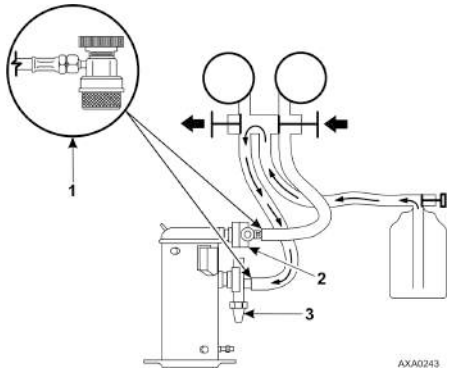
1	Close Hand Valves

Gauge Manifold Open to Center Port



1	Open Hand Valves

Charging the System



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

Gauge Manifold Set Installation & Removal

Thermo King recommends the use of access valves or self-sealing, quick disconnect fittings. This limits the loss of refrigerant into the atmosphere. A separate gauge manifold set with low loss fittings (refer to Tool Catalog) should be dedicated for use with R-134A only. Gauge hoses should also be dedicated to R-134A.

Note: *Carefully check to verify that access connections are functioning properly when any of these devices are used.*

Installation

The following procedure purges the gauge hoses.The procedure 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.

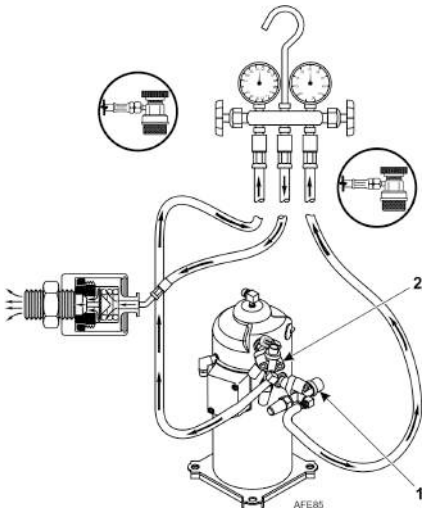
1. Inspect gauge manifold for proper hose and fitting connections.
2. Clean dirt and moisture from around service ports.
3. Remove small service port caps from suction and discharge service fittings. Save and reuse the caps and sealing washers or gaskets.
4. Rotate both hose coupler hand wheels counterclockwise to back the stem out of the high and low hose fittings. Attach low hose (compound gauge) to the suction line valve port.
5. Open the suction service manifold hand valve fully with 69 kPa, 0.69 bar, 10 psig or greater pressure in the low side (unit operating on Cool). 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.
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. 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.*

Purging Gauge Manifold



1	Suction Connection
2	Discharge Connection

Removal

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Protect your eyes from contact with refrigerant oil. The oil can cause serious eye injuries. Protect skin and clothing from prolonged or repeated contact with refrigerant oil. To prevent irritation, wash your hands and clothing thoroughly after handling the oil. Rubber gloves are recommended. When working with or around hazardous chemicals, ALWAYS refer to the applicable Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

Note: *THE SYSTEM SHOULD BE RUNNING to verify minimum refrigerant release to the atmosphere,. 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. Operate the unit on Cool using the "CAPACITY 100 percent" test from the Manual Function Test menu of the controller.
3. Rotate the suction hose coupler hand wheel counterclockwise to withdraw the fitting stem from the suction line port valve. Then turn the unit off.
4. Remove the gauge lines from the suction and discharge service fittings and cap the service ports.
5. Secure all manifold lines to manifold hose anchors when the manifold is not in use.

Checking 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. All units are charged with 4.0 kg (8.0 lbs) refrigerant at the factory. The refrigerant charge can be checked by inspecting the receiver tank sight glass.

1. Inspect the receiver tank sight glass with the unit operating in cool or modulation cool. If the ball floats in the bottom receiver tank sight glass when the compressor is engaged, the refrigerant charge level is correct.

NOTICE

Cargo Loss!

When adjusting the controller setpoint to check refrigerant charge, return controller to the setpoint indicated on the shipping manifest.

2. If the ball is not floating in the sight glass, the unit may be low on refrigerant charge. Adjust the controller setpoint to operate the unit on cool. Operate the unit on cool for five minutes. If the ball floats in the receiver tank sight glass, the refrigerant charge level is correct.
3. If the ball in the receiver tank sight glass does not float after operating the unit on cool for five minutes, the unit is low on refrigerant charge. With the unit operating on cool, add liquid refrigerant charge. With the unit operating in cool, add liquid refrigerant until the ball in the receiver tank sight glass floats in the sight glass.

   Note: *Inspect the unit for refrigerant leaks with a reliable leak detector if the unit is low on refrigerant charge.*

Checking the R-134a Refrigerant Charge

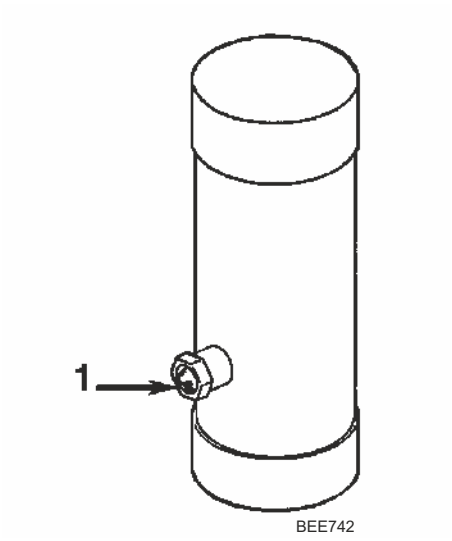
1. Inspect the receiver tank sight glass with the unit operating in COOL. If the balls FLOAT in the receiver tank sight glass, the R-134a charge level is correct.
2. If the balls are NOT FLOATING in the sight glass, the unit MAY be low on R-134a charge. Operate the unit on COOL for 5 minutes. If the balls float in the receiver tank sight glass, the R-134a charge level is correct.
3. If the balls do NOT FLOAT in the receiver tank sight glass after operating the unit on COOL for 5 minutes, the unit is low on R-134a charge. With the unit operating on COOL, add liquid R-134a until the balls FLOAT in the sight glass.

⚠ CAUTION

Service procedure!

When adding R-134a to the unit, STOP adding refrigerant when the balls float near the TOP of the sight glass. Continuing to add refrigerant after the balls float at the top of the sight glass will OVERCHARGE the unit. If necessary, recover refrigerant until the balls no longer float at the top of the sight glass.

Figure 29. R-134a Refrigeration System Receiver Tank



1.	Refrigerant charge is OK if the ball floats at any time: • If the ball does NOT float, the R-134a refrigeration system is unit is low on refrigerant		

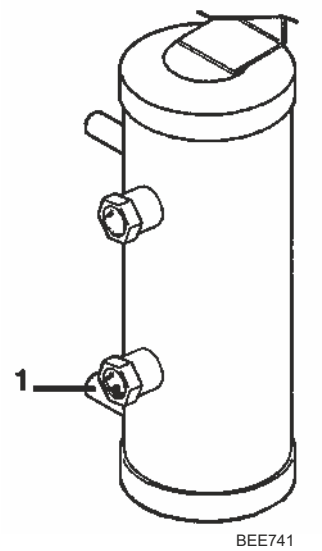
Checking the R-23 Refrigerant Charge

The R-23 refrigerant charge should be checked with the container empty, the unit OFF and all refrigeration system components above -5 °C (23 °F). The R-134a compressor must not have been operated within the past 30 minutes and there must not be frost on the plate-type R-134a / R-23 heat exchanger tubing.

Observe both the suction and discharge pressures. With the unit OFF, the suction and discharge readings should be equal. The R-23 refrigerant pressure in a fully charged system with the unit OFF will vary with the ambient temperature:

Ambient Temperature	R-23 System Pressure
O °C (32 °F)	1600 kPa, 16 bar, 232 psig
20 °C (68 °F)	1700 kPa, 17 bar, 247 psig
38 °C (100 °F)	1800 kPa, 18 bar, 261 psig

Figure 30. R-23 Refrigeration System Receiver Tank



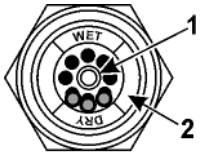
1.	The bottom sight glass ball will rarely float on a fully charged system during normal operation. • Check the refrigerant charge based on the R-23 system pressure with the container empty, the unit OFF and all refrigeration system components above ***Note:*** *Use the lower sight glass to check or add refrigerant only on a operating unit that is unable to maintain a -55 C to -65 C (-62 F to -94 F) low temperature.*		

- Correct Refrigerant Charge: If the R-23 system pressure stabilizes between 1500 and 2000 kPa, 15 and 20 bar, 220 and 290 psig, the unit will be fully functional. The R-23 refrigerant charge requires no adjustment.
- Low Refrigerant Charge: If the R-23 system pressure stabilizes between 1000 and 1500 kPa, 10 and 15 bar, 145 and 220 psig, the unit cooling capacity will be reduced but the unit should be able to maintain a -55 C to -70 C (-62 F to -94 F) load temperature. Additional R-23 should be added if possible, but do NOT add by operating the unit.
- Over Charge of Refrigerant: If the R-23 system pressure stabilizes above 2000 kPa, 20 bar, 290 psig, the R-23 system is overcharged and may cause the compressor to stop on high pressure cutout when started to precool a warm container. Remove refrigerant until the system pressure stabilizes at 2000 kPa, 20 bar, 290 psig or below.

Note: *Use the lower receiver tank sight glass to check or add refrigerant only on an operating unit that is unable to maintain a -55 °C to -70 °C (-62 °F to -94 °F) load temperature.*

Receiver Tank Sight Glass

The receiver tank contains a sight glass which has 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).



AXA0371

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

Leak Testing Refrigeration System

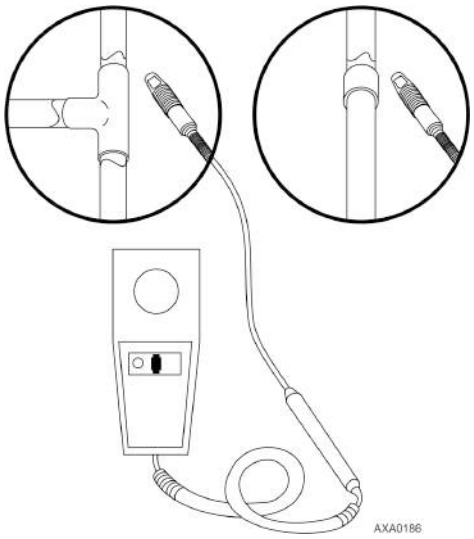
Use a reliable Halogen leak detector such as model H10G (refer to Tool Catalog), to leak test the refrigeration system. Inspect carefully for signs of compressor oil leakage which is the first sign of a leak in the refrigeration system.

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," p. 85 for proper procedures).
3. Attach refrigerant bottle charging hose to center of gauge manifold and purge charging hose of air.
4. Pressurize the system with refrigerant (gas only) until 345 kPa, 3.45 bar, 50 psig vapor pressure is achieved.
5. Leak check the system with an electronic leak detector to inspect all joints and connections (Use soap solution as an alternative test component). If no leaks are found but the system has lost its refrigerant charge, proceed to the next step.
6. Close both hand valves on gauge manifold (front seated).
7. Disconnect the refrigerant charging hose.
8. Connect the charging hose to a source of nitrogen. Adjust the pressure regulator to 1380 kPa, 13.80 bar, 200 psig. Refer to ("Using Pressurized Nitrogen," p. 93).
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.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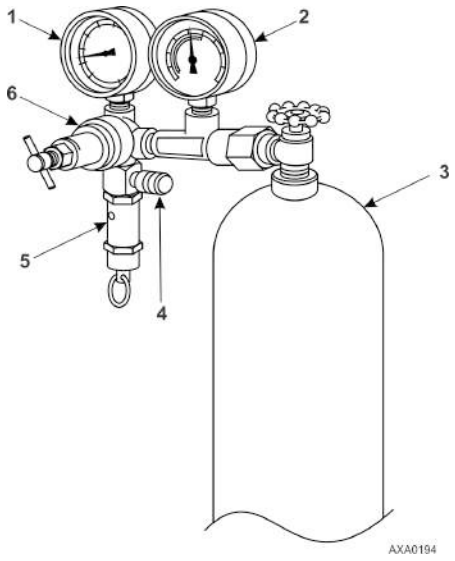
Using Pressurized Nitrogen

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.

Typical Pressurized Gas Bottle



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

Safety Precautions

Observe the proper handling of cylinders:

- Always keep protective cap on cylinder when not in use.
- Secure cylinder in proper storage area or fastened to cart.
- Do not expose to excessive heat or direct sun light.
- Do not drop, dent, or damage cylinder.
- 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.
- Open valve slowly; use regulators and safety valves that are in good working order.
- 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

Risk of Injury!

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 (N2). The proper equipment and application of equipment is of greatest importance.

Purge High Side to Low Side

1. Attach gauge manifold set (Refer to "Gauge Manifold Set," p. 85 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.

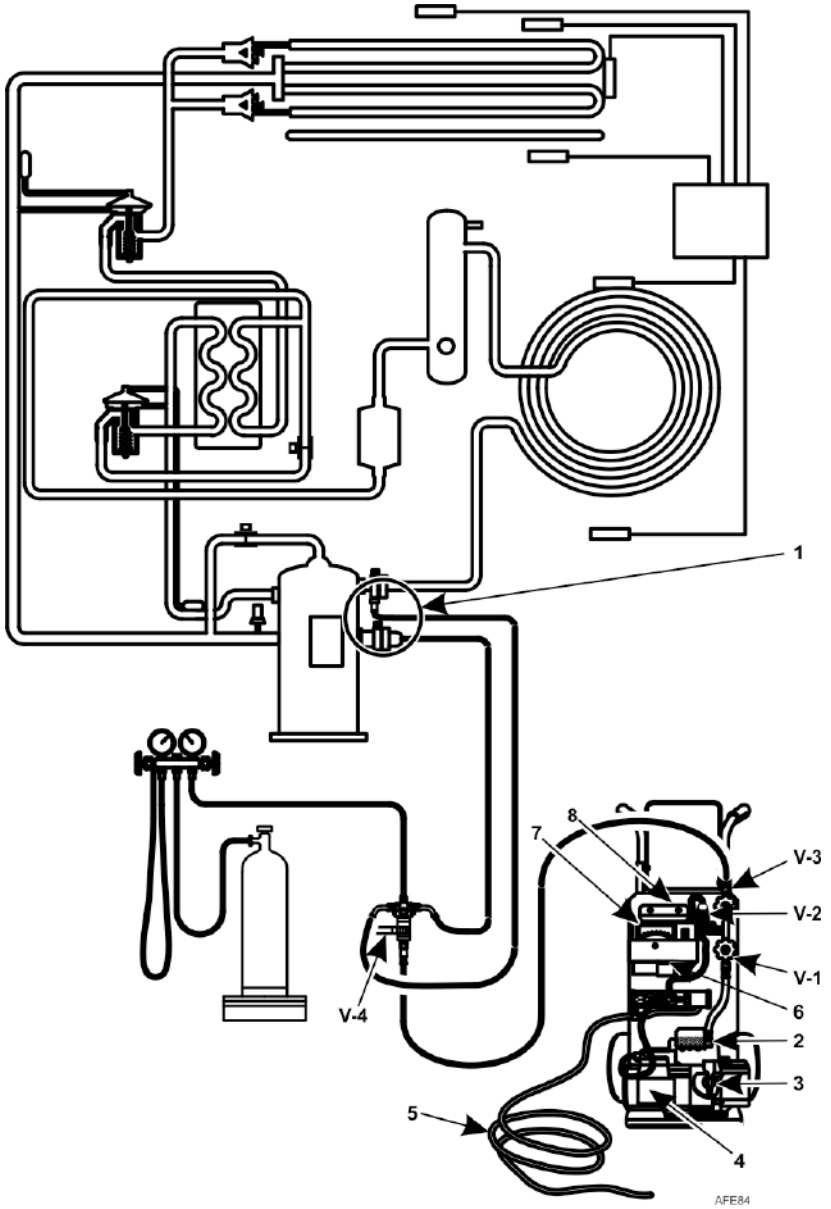
4. Purge system high side to low side.

Maximum Gas Pressures

The following procedures should utilize the following maximum gas pressure:

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

Figure 31. Evacuation Station and Unit Hook-up



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

Recovering Refrigerant from System

NOTICE

Risk of Injury!!

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 escaping to the atmosphere. Typical service procedures that require removal of refrigerant from the unit includes the following:

- Reduce the refrigerant pressure to a safe working level when maintenance must be performed on high-pressure side components.
- Empty the unit of refrigerant when an unknown amount of charge is in the system and a proper charge is required.
- Empty the unit of contaminated refrigerant when the system has become contaminated.

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

Perform the following steps to recover vapor from the system.

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

Recovery for System Repair

Because R-23 has high working pressures, it must be recovered from the refrigeration circuit before any component, except the compressor, suction pressure gauge and discharge pressure gauge, can be repaired or replaced. Also, because of the high pressure in R-23 refrigerant bottles, the recovery of R-23 for re-use in the unit requires an empty refrigerant bottle at least 40 liters (42 quarts) in volume. The refrigerant bottle must be clean or dedicated to use with HFC refrigerants only.

Note: *Due to extremely high pressure in normal ambient R-23 cannot be reclaimed by use of reclaim station.*

1. Prepare an empty refrigerant bottle at lease 40 liters (42 quarts) in volume. Evacuate bottle if necessary to ensure it is clean.
2. Connect a refrigerant hose from the bottle to the R-23 compressor discharge service valve.
3. Midseat the discharge service valve. Then open the service valve on the bottle. Wait for 5-10 minutes to allow the pressures to equalize between the refrigeration system and the bottle. This will remove approximately 1/2 of the refrigerant charge from the unit.
4. Start the unit and use the Manual Test function submenu of the controller to start and operate the R-23 compressor only for approximately 2 minutes. This will quickly transfer most of the remaining R-23 refrigerant charge to the bottle.

⚠ CAUTION

Equipment Damage!

Do not allow the compressor suction pressure to decrease below 100 kPa, 1.00 bar, 15 psig.

⚠ WARNING

Equipment Damage!

Do not allow the pressure of the bottle to exceed 2500 kPa, 25 bar, 362 psig.

5. After approximately 2 minutes of R-23 compressor operation, slowly close the compressor suction service valve. When the compressor suction pressure decreases below 100 kPa, 1.00 bar, 15 psig, stop the R-23 compressor and turn the unit OFF.
6. Close the service valve on the R-23 recovery bottle.
7. Backseat the discharge service valve. Disconnect the refrigerant hose from the discharge valve.
8. With system pressures below 100 kPa, 1.00 bar, 15 psig, the R-23 system components can be serviced.

If necessary, set a recovery machine for vapor recovery. Connect the recovery machine to a separate, empty recovery bottle. Keep unit OFF and mid-seat the discharge service valve. Turn ON the recovery machine and open the service valve on the recovery machine. Operate the recovery machine until system pressures drop to 0 kPa, 0 bar, 0 psig pressure.

R-134a Vapor Recovery

1. Install a gauge manifold set on the R-134a refrigeration system. 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 system pressures drop to 0 kPa, 0 bar, 0 psig pressure.

R-134a Liquid Recovery

1. Install a gauge manifold's low-pressure line to the Schrader suction service valve on the suction service valve of the R-134a compressor. Attach the manifold's high-pressure line to R-134a receiver tank service valve port. Attach the service line to the recovery machine and purge the lines.
2. Set recovery machine for liquid recovery and turn it ON.
3. Open (back seat) high-pressure valve on gauge manifold.
4. Operate the recovery machine until the unit system pressures reach approximately 0 kPa, 0 bar, 0 psig.

Evacuation and Cleanup of Refrigeration System

A thorough clean up is required whenever contaminants have entered the system. This will prevent damage to the compressor.

The purpose of evacuation is to remove moisture and air from the refrigeration system after a system has been opened to the atmosphere. Evacuation must occur before recharging a system with new refrigerant. 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.

The presence of moisture, oxygen, and heat can create many forms of damage. They can create corrosion, sludge, copper plating, oil breakdown, carbon formation, and eventual compressor failure.

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.

Unit Preparation and Hookup

⚠ CAUTION

Risk of Injury!

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

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

   Note: *Replace the one-piece filter drier when major system contamination requires evacuation and cleanup of the refrigeration system.*
3. Confirm that the evacuation station functions properly. 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. The operator can be confident that the pump and oil are in good condition, if a vacuum pump (isolated from a system) is started and the micron meter responds quickly by going to a deep vacuum. 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 as indicated in Figure 31, p. 94. Connect evacuation hoses to the compressor suction and discharge service fittings.
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 hours or more.
   c. Close valve V1 to isolate the vacuum pump from the system.
   d. Observe the vacuum level on the micron meter.

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

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

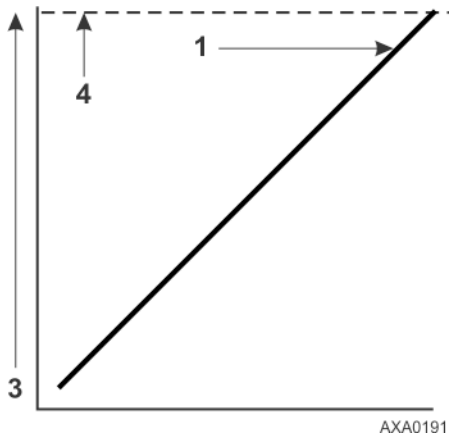
- A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
- A system that continues to rise without stabilizing has a leak and must be repaired.

5. If the vacuum level remained below 2000 microns for five minutes, the unit is ready to charge. Refer to ("Charging System with Refrigerant," p. 100).

Pressure Rise Test

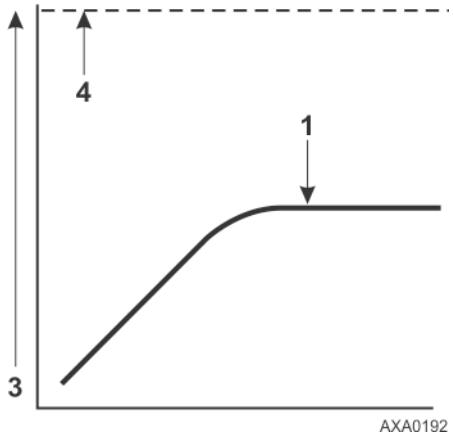
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- 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. Refer to figure shown below.



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

- 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. Refer to figure shown below.



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

Factors Affecting Speed of System Evacuation

The time needed to evacuate a system can vary. Some factors that can influence evacuation time are listed below.

- System size
- Amount of moisture contained in the system
- Ambient temperature

- Internal restrictions within the system
- External restrictions between the system and the vacuum pump

Hose size, both diameter and length, affect evacuation times. Laboratory tests show that the evacuation time can be significantly reduced by larger diameter hoses and shorter hoses. 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

⚠ WARNING

Hazardous Gases!

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

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

Charging System with Refrigerant

Unit Charging by Weight (from an Evacuated Condition)

1. Close valve V4.
2. Open the gas ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. Mid-seat the discharge valve.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (Refer to "Unit Preparation and Hookup," p. 98).
6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge. 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. Turn the unit off.
10. Open the gauge manifold hand valve and charge liquid refrigerant into the system.
11. Close the refrigerant tank hand valve when the correct amount (by weight) of refrigerant has been added or if the system will take no more liquid. The unit is now ready to have the evacuation station removed.

Evacuation Station Removal

1. Back seat the discharge service valves.
2. Close the high pressure hand valve on the gauge manifold.
3. Close the refrigerant tank hand valve.
4. Open the hand valve at the gauge manifold and read suction pressure.
5. Operate the unit in Cool mode until the suction pressure decreases below 385 kPa, 3.85 bar, 50 psig.
6. Back seat the suction line access service valve.
7. Stop the unit.
8. Remove the hoses from the suction and discharge line access service valves.
9. Start the unit and perform a controller pretrip test to verify correct refrigerant charge and unit operation.

R-134a Final Charging Procedure for Partially Charged Units

Note: *Final charge the R-23 system first when both the R-134a and R-23 systems require charging.*

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.

⚠ CAUTION

Service Procedure!

Be sure to add the correct refrigerant to the system.

4. Set the R-134a refrigerant tank for liquid charging. Open the refrigerant tank hand valve.
5. Start and operate the unit in the COOL mode.

⚠ CAUTION

Equipment Damage!

Do NOT operate the unit on cooling unless: R-23 refrigeration system contains a FULL charge of refrigerant. R-134a refrigeration system contains a partial charge of refrigerant.

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 R-134a refrigerant until the receiver tank balls float at the top of the 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

Service Procedure!

Be sure to add the correct refrigerant to the system.

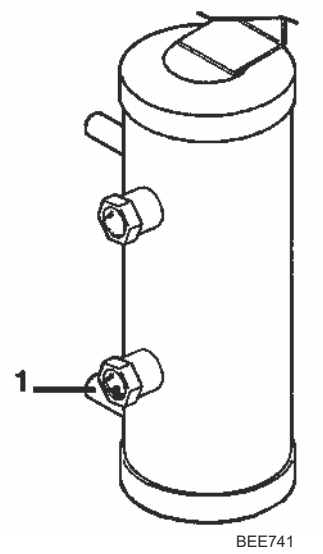
Checking the R-23 Refrigerant Charge

The R-23 refrigerant charge should be checked with the container empty, the unit OFF and all refrigeration system components above -5 °C (23 °F). The R-134a compressor must not have been operated within the past 30 minutes and there must not be frost on the plate-type R-134a / R-23 heat exchanger tubing.

Observe both the suction and discharge pressures. With the unit OFF, the suction and discharge readings should be equal. The R-23 refrigerant pressure in a fully charged system with the unit OFF will vary with the ambient temperature:

Ambient Temperature	R-23 System Pressure
O °C (32 °F)	1600 kPa, 16 bar, 232 psig
20 °C (68 °F)	1700 kPa, 17 bar, 247 psig
38 °C (100 °F)	1800 kPa, 18 bar, 261 psig

Figure 32. R-23 Refrigeration System Receiver Tank



1.	The bottom sight glass ball will rarely float on a fully charged system during normal operation. • Check the refrigerant charge based on the R-23 system pressure with the container empty, the unit OFF and all refrigeration system components above ***Note:*** *Use the lower sight glass to check or add refrigerant only on a operating unit that is unable to maintain a -55 C to -65 C (-62 F to -94 F) low temperature.*		

- Correct Refrigerant Charge: If the R-23 system pressure stabilizes between 1500 and 2000 kPa, 15 and 20 bar, 220 and 290 psig, the unit will be fully functional. The R-23 refrigerant charge requires no adjustment.
- Low Refrigerant Charge: If the R-23 system pressure stabilizes between 1000 and 1500 kPa, 10 and 15 bar, 145 and 220 psig, the unit cooling capacity will be reduced but the unit should be able to maintain a -55 C to -70 C (-62 F to -94 F) load temperature. Additional R-23 should be added if possible, but do NOT add by operating the unit.
- Over Charge of Refrigerant: If the R-23 system pressure stabilizes above 2000 kPa, 20 bar, 290 psig, the R-23 system is overcharged and may cause the compressor to stop on high pressure cutout when started to precool a warm container. Remove refrigerant until the system pressure stabilizes at 2000 kPa, 20 bar, 290 psig or below.

Note: *Use the lower receiver tank sight glass to check or add refrigerant only on an operating unit that is unable to maintain a -55 °C to -70 °C (-62 °F to -94 °F) load temperature.*

Final Charging Procedure for Partially Charged Units on Empty Containers R-23

Note: *The R-23 refrigerant should be charged with the container empty, the unit OFF and all refrigeration system components above -5 C (23 F). The R-134a compressor must not have been operated within the past 30 minutes and there must not be frost on the plate-type R-134a / R-23 heat exchanger tubing.*

1. Before attempting to add R23 refrigerant with loaded container check for good cooling capacity by verifying if Suction discharge pressure is in line with specification.
2. Connect a refrigerant hose to a R-23 refrigerant tank.
3. Connect the refrigerant hose to the suction line service port. Be sure to purge the air from the refrigerant hose.
4. Mid-seat the suction service valve.
5. Set the R-23 refrigerant tank for gas charging. Open the refrigerant tank hand valve.
6. Observe both the suction and discharge pressures on the unit gauges. When the unit pressure reaches 1700 kPa, 17 bar, 247 psig, close the hand valve on the refrigerant tank. With the unit OFF, the suction and discharge readings should be equal.

   The R-23 refrigerant pressure in the unit during charging with the unit OFF will vary with the ambient temperature:

Ambient Temperature	R-23 System Pressure
O °C (32 °F)	1600 kPa, 16 bar, 232 psig
20 °C (68 °F)	1700 kPa, 17 bar, 247 psig
38 °C (100 °F)	1800 kPa, 18 bar, 261 psig

7. Remove the gauge manifold set.
8. Cap all service ports and valve stems.

Charging Procedure for Partially Charged Units on Loaded Containers R-23

R-23 refrigerant should be added to an operating unit on a loaded container only if the unit is unable to maintain a -55 C to -70 C (-62 F to -94 F) load temperature. The risk of overcharging the system with R-23 is too large.

1. Connect a refrigerant hose to a R-23 refrigerant tank.
2. Connect the refrigerant hose to the receiver tank service fitting. Be sure to purge the air from the hose.
3. Set the R-23 refrigerant tank for gas charging. Open the refrigerant tank hand valve.
4. Observe the bottom receiver tank sight glass. When refrigerant is visible in the bottom of the lower sight glass, close the hand valve on the refrigerant tank.

Immediately stop adding refrigerant when refrigerant is visible in the bottom of the lower sight glass. Under normal operating conditions, R-23 refrigerant will rarely be visible in the lower sight glass on a fully charged system.

5. Remove the refrigerant hose from the receiver tank
6. Cap the receiver tank service port.
7. Check and correct the refrigerant charge level after the cargo has been unloaded and the unit is OFF.

Compressor Replacement

Removal

1. Close the suction service valve and pump down the compressor:

- R-134a Compressor: Pump down the compressor to -35 kPa, -0.35 bar, 10 in. vacuum.
- R-23 Compressor: Pump down the compressor to 0 to 21 kPa, 0.0 to 0.2 bar, 0 to 3 psig.

⚠ CAUTION

Equipment Damage!

Do NOT allow the R-23 scroll compressor to operate for more than 10-20 seconds.

2. 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.*

3. Front seat the discharge valve.

⚠ CAUTION

Equipment Damage!

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

4. Remove discharge service valve and suction service valve from the compressor.
5. Disconnect the wire connector for the high pressure cutout switch.
6. Remove the three-phase electric power connection.
7. Remove the compressor mounting tray bolts and nuts.
8. Slide the compressor from the unit.
9. 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 high pressure cutout switch. Install the switch and connect the wire connectors.
4. Connect three-phase electric power to the compressor.
5. Pressurize the compressor with refrigerant gas:

- R-134 compressor with R-134a refrigerant.
- R-23 compressor with R-23 refrigerant.

⚠ CAUTION

Equipment Damage!

Be sure to add the correct refrigerant to the compressor.

6. 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 compressor, connection the evacuation equipment.
9. Evacuate the compressor (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
10. Back seat the discharge service valve and open the suction 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.

⚠ CAUTION

Equipment Damage!

Do NOT operate the unit on cooling unless both the R-134a and the R-23 refrigeration systems contain a partial charge of refrigerant.

12. Check the refrigerant charge and add refrigerant if needed.

Condenser Coil Replacement

Removal

1. Recover the refrigerant charge from the unit.
2. Remove the condenser fan grille, condenser fan blade and condenser fan shroud.
3. Remove condenser coil support brackets from coil.
4. Unsolder coil inlet and liquid line connections.
5. Support the coil and unbolt the condenser coil mounting brackets. Slide 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.

Important: *It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 93).*

4. Perform a controller pretrip test to verify system operation. Check compressor oil level.
5. Pressurize the system and test for leaks (Refer to "Leak Testing Refrigeration System," p. 91). Repair leak if required.
6. Recover the leak test gas if no leaks were found.
7. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 97).
8. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
9. Recharge the unit with R-134A (Refer to "Charging System with Refrigerant," p. 100).

Filter Drier Replacement

Removal

1. Do one of the following:

- R-134a System: 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.
- R-23 System: Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).

2. Place the new dehydrator near the unit for immediate installation.
3. Remove the filter bracket clamping nuts and bolts.
4. Do one of the following:

- R-134a System: Using two wrenches, "crack" both filter drier line mountings. Use two wrenches on flare fittings to prevent line damage. Separate the dehydrator line mountings.
- R-23 System: Unsolder filter drier from liquid line.

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

5. Remove the old dehydrator from the line.

Installation

1. Remove the sealing caps from the new dehydrator.
2. Do one of the following:

- R-134a System: Apply clean compressor oil to dehydrator threads. Assemble new dehydrator to lines. Finger tighten mounting nuts.
- R-23 System: Clean tubes for soldering. Position filter drier in liquid line. Solder filter drier in liquid line.

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

3. Reinstall dehydrator clamping brackets, nut and bolts. Tighten the bolts.
4. Do one of the following:

- R-134a System:
  a. Tighten the dehydrator inlet line mounting nut. Open the liquid line service valve on the inlet side of the dehydrator 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: *R-134a — When removing or replacing the o-ring nuts on the dehydrator, always hold the body of the dehydrator near the flange fittings to prevent twisting the tubing when the nuts are being loosened or tightened.*

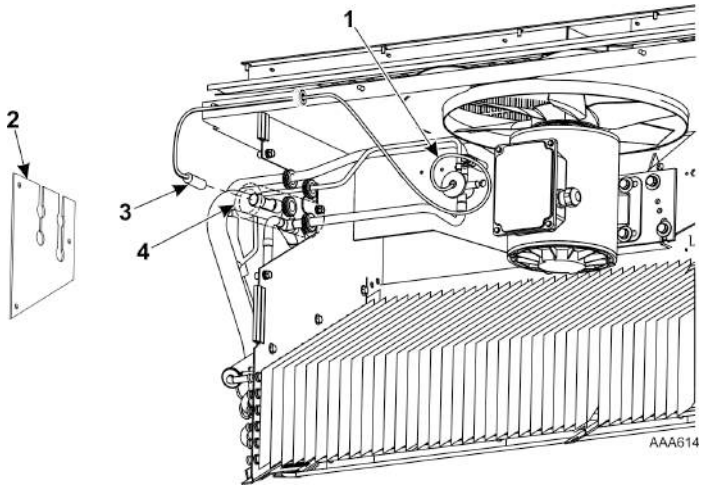
  b. Back seat (open) the liquid line service valve on the inlet side of the dehydrator.
  c. Test refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 91). Repair leaks if required.
  d. If no leaks are found, place the unit in operation.
- R-23 System:
  a. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 91). Repair leaks if required.
  b. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in this chapter)

c. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 97).
v
d. Recharge the unit with R-23 (Refer to "Charging System with Refrigerant," p. 100).

Evaporator Expansion Valve (TXV) Replacement

Note: *TXV can be accessed through the evaporator access door.*

1. Perform a low side pump down or reclaim charge depending on the unit. Release the 2-3 lbs pressure from the low side.
2. Open the evaporator access panel.
3. Install plywood or heavy cardboard on top of coil on the left and right side. This will protect the coil from damage.
4. Remove the left side motor and fan and position in right side opening. Do not unwire the motor the harness is long enough.
5. Remove TXV standoff mount.
6. Remove the panel to gain access to the TXV element.
7. Cut the one ty band off the insulation around the element. Peel back the insulation to expose the clamp holding the element. Loosen the clamp and remove the element from the tube.
8. Unsolder the three tubes to the TXV and remove the valve from the unit.
9. Prepare the tubes in the unit and on the new TXV for installation.
10. Solder in the new TXV. Use 15% silver solder 203-364.
11. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 91). Repair leak if required.
12. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 97).
13. Install element in tube on suction line. Tighten clamp. Reapply insulation around bulb and secure with a ty band.
14. Install the element access panel and install grommets. Install TXV mount.
15. Install left side motor and fan.
16. Open service valves or recharge unit with R-134A (Refer to "Charging System with Refrigerant," p. 100).
17. Perform a controller pretrip test to verify system operation.



1	TXV Mount
2	Access Panel
3	Element
4	Tube on Suction Line

Expansion Valve Replacement

Removal

1. Do one of the following:

- R-134a System: 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.
- R-23 System: Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).

2. Remove insulating tape and encamp feeler bulb from the suction line. 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. Do one of the following:

- R-134a System:
  a. Open the liquid line service valve and pressurize the low side. Test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
  b. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
  c. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
  d. Cover expansion valve outlet line with insulating tape.
  e. Open the liquid line service valve and place the unit in operation.
  f. 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.
- R-23 System:
  a. Pressurize the system with R-23 and test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
  b. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
  c. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
  d. Cover expansion valve outlet line with insulating tape.
  e. Recharge the unit with R-23 refrigerant and check the compressor oil level. Add oil if necessary.
  f. 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. Recover the refrigerant charge from the both refrigeration systems (see “Refrigerant Recovery” in this chapter).
2. Remove the panel that protects the heat exchanger assembly in the power cord storage compartment.
3. Heat and unsolder all system inlet and outlet line connections.
4. Remove the heat exchanger assembly from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the unit and position in refrigeration system tubing.

3. Solder all refrigerant 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

Equipment Damage!

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

4. Do one of the following:

- Pressurize the R-134a system on the low side and check for leaks
- Pressurize the R-23 system on the high side and check for leaks.

5. If no leaks are found, recover the leak test gas from both systems (see "Refrigerant Recovery" in this chapter).
6. Evacuate both systems (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
7. Recharge both refrigerant systems (see "Refrigerant Charge" in this chapter).

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 outlet valve from the receiver 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

Equipment Damage!

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 suction service valve and pump down the compressor:

- R-134a Compressor: Pump down the compressor to -35 kPa, -0.35 bar, 10 in. vacuum.
- R-23 Compressor: Pump down the compressor to 0 to 21 kPa, 0.0 to 0.2 bar, 0 to 3 psig.

2. Open the suction service valve slightly to equalize the pressure between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
3. Front seat the discharge service valve.
4. Purge the high pressure from the compressor head through the service port on the discharge line.
5. 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 suction service valve and compressor discharge service valve and place the unit in operation.

Liquid Line Solenoid Valve Replacement (R-134a System Only)

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.

NOTICE

Equipment Damage!

Use a heat sink, P/N 204-584, or wrap the vibrasorber with wet rags to prevent damaging the vibrasorber.

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.

Low Pressure Cutout Switch Replacement

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in this chapter).
2. Disconnect the leads from the wire harness.
3. Unsolder the low pressure cutout switch from the unit.

Installation

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

NOTICE

Equipment Damage!

Use a heat sink, P/N 204-584, or wrap the vibrasorber with wet rags to prevent damaging the vibrasorber.

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).
6. Reconnect the electrical wires to the switch.

Servicing the Unit

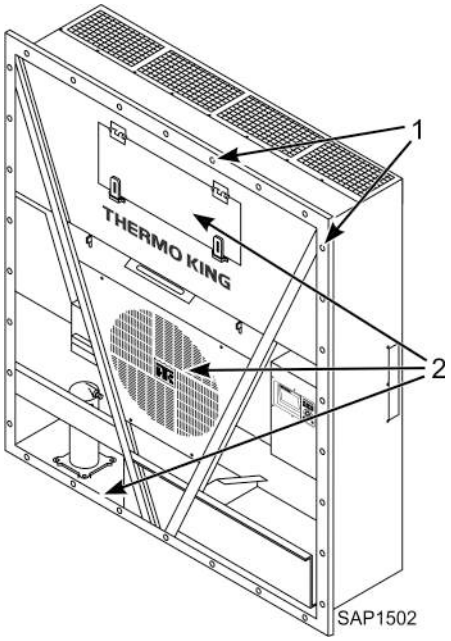
Taking Care of the Structure

Inspecting Unit

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.

Checking 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).



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

Cleaning the Condenser Coil

NOTICE

Equipment Damage!

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

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.

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 percent 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.

Cleaning the Evaporator Coil

NOTICE

Equipment Damage!

The air pressure should not be high enough to damage coil fins.

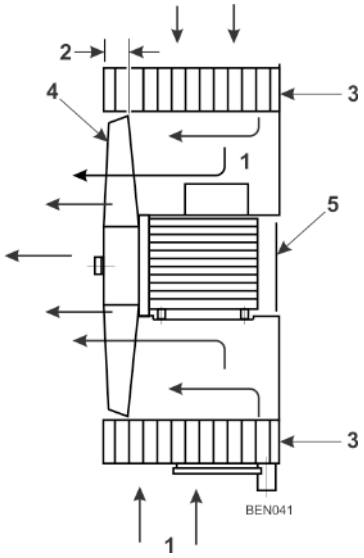
Clean the evaporator coil by blowing low pressure compressed air from the bottom side of the coil upward (opposite direction of normal airflow). Inspect coil and fins for damage and repair if necessary.

Cleaning the Defrost Drains

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

Positioning the Condenser Fan Blade

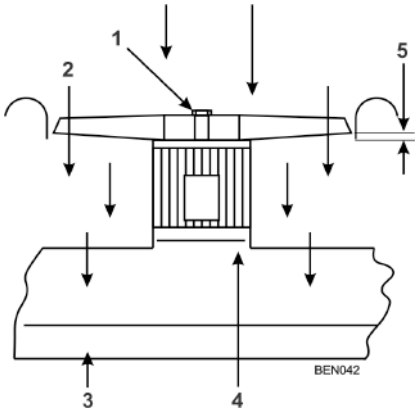
Place fan blade on motor shaft with hub located on the outside of the blade for proper airflow direction. When mounting the fan blade and hub assembly on the fanshaft, center the assembly in the orifice. Position the front of the fan blade 10 mm (0.4 in.) in from the outer edge of the fan orifice.



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

Positioning the Evaporator Fan Blade

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.

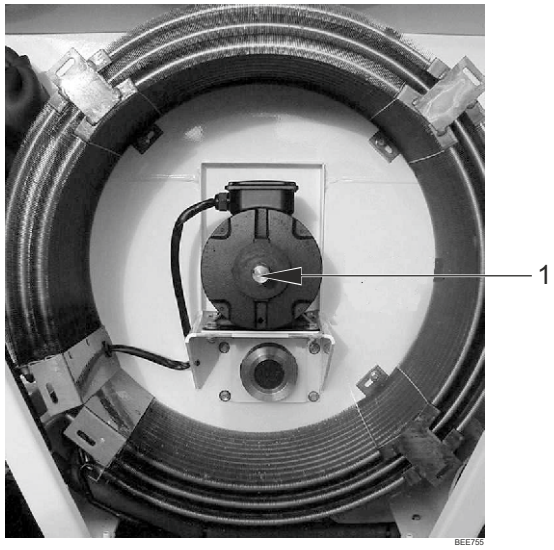


1	Evaporator Fan Blade
2	Airflow Direction
3	Evaporator Coil
4	Evaporator Motor
5	13 mm (0.5 in)

Vacuum Valve

The vacuum valve draws outside air into the container to prevent the container from developing negative atmospheric pressure as the cargo temperature decreases toward -70 °C (-94 °F). Check the vacuum valve during the pretrip inspection to make sure the ball inside the valve moves freely.

Figure 33. Vacuum Valve



1.	Vacuum valve (Located behind the condenser grille cover)		

Diagnostics

Introduction

This section includes the following:

- Mechanical Diagnostics
- Refrigeration Diagnostics

The tables shown will help identify and fix unit problems.

Mechanical Diagnostics

Condition	Possible Cause	Remedy
Compressor does not operate - no amperage draw.	Controller on; unit start sequence still timing.	Wait up to two minutes for compressor start-up.
	No power to unit (condenser and evaporator fans do not operate).	Locate fault and repair: power source, power plug, CB1 main circuit breaker, motor solid state, motor terminals, motor, fuses on power module.
	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 power module or controller.
	Unit on defrost.	Turn Unit On/Off switch Off and then On again.
	Detective high pressure or low pressure cutout switch.	Replace defective switch.
	High condenser head pressure causing high pressure cutout.	Check refrigeration system and correct fault.
	Defective compressor.	Replace compressor.
	Controller shut unit down on Compressor Over Temperature.	Let compressor cool and controller will reset automatically. Check vapor 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.	Rotating scroll stuck. Piston Stuck.	Replace compressor.
	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.
	Refrigerant overcharge or high side restriction causing cycling on high pressure cutout.	Check for restricted filter drier, in-line filter or high side; or refrigerant overcharge.
	Inefficient condenser operation causing cycling on high pressure cutout.	Check condenser airflow, condenser fan motor, fan blade, condenser grille, condenser coil temperature sensor, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option).
R 23 compressor not running	Auxiliary contact on R134a open	Check curcuit, replace contact.

Condition	Possible Cause	Remedy
Compressor contactor burned out.	Low line voltage.	Increase line voltage to at least 90 percent of compressor motor rating.
	Excessive line voltage.	Reduce line voltage to at least 110 percent of compressor motor rating.
	Short cycling.	Eliminate cause of short cycling.
Unit short cycles.	Controller out of calibration	Check controller software program version; load new software in controller and recheck unit performance, replace controller
	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, condenser fan pressure switch, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option).
Noisy compressor	Insufficient compressor oil	Check compressor oil level on R-134a and R-23 system. Add oil to proper level.
	Loose mounting bolts.	Tighten mounting bolts.
	Oil slugging or refrigerant flooding back.	Perform controller pretrip test to check refrigerant charge. Check expansion valve adjustment. Check compressor for compressor oil.
	Scroll rotating backwards.	Check phase correction system and check unit wiring.
	Worn fan motor bearings	Replace bearings or motor.
	Defective compressor.	Repair or replace compressor.
Condenser fan motor does not operate.	Unit in Heat or Defrost.	Check indicator. If unit is in Heat or Defrost, unit operation is normal (no remedy required).
	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.
	Detective condenser fan contactor.	Replace defective contactor
	No condenser fan output signal from controller.	Diagnose and replace condenser fan relay, power module or controller.
Evaporator fan motor(s) does not operate.	Unit on defrost.	Check operating mode indicator LEDs.
	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 speed evaporator fan contactor	Replace defective contactor
	No low or high speed evaporator fan output signal from controller output module.	Diagnose and replace output module or controller.

Refrigeration Diagnostics

Condition	Possible Cause	Remedy
R-134a or R-23 System Compressor operating in a vacuum (unit not cooling)	Shortage of refrigerant	Repair leak and recharge
	Compressor motor contacts frozen (R-134a compressor only)	Clean points or replace contactor
	Defective liquid line solenoid valve	Repair or replace liquid line solenoid valve
	Compressor inefficient	Repair or replace liquid line solenoid valve
	(R-134a compressor only)	Check valve reeds and pistons
	Partial obstruction in low side or dehydrator	Locate obstruction and repair
	Iced or plugged evaporator coil	Defrost or clean evaporator coil
	Expansion valve partially closed by ice, dirt or wax	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
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact	Correct feeler bulb installation
Load temperature too high - unit not cooling.	One or both compressors do not operate	Refer to ("Mechanical Diagnostics," p. 115).
	Controller setpoint too high.	Adjust controller setpoint.
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Shortage of refrigerant.	Repair leak and recharge.
	Overcharge of refrigerant.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Vapor injection valve open.	Check vapor injection valve circuit and compressor discharge temperature sensor.
	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 filter drier/in-line filter.	Change filter drier.
	Compressor inefficient (R-134a system only)	Perform compressor efficiency test. Check valve reeds and pistons
	Condenser coil dirty or airflow restricted.	Clean condenser coil, clear restriction, or repair or replace fan motor or condenser fan blade.
	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 digital 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.	Repair leak and recharge.
	Low ambient air temperature. (R-134a system only)	No remedy.
	Service gauge out of calibration.	Replace gauge.
	Compressor suction or discharge valve inefficient (R-134a system only)	Replace suction reeds and gaskets. Clean valve plate. If defective/restricted then replace.
Head pressure too high.	Refrigerant overcharge.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Dirty or restricted condenser coil.	Clean condenser coil.
	Condenser fan not operating.	Refer to "Condenser Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 115).
	Condenser fan grille damaged or missing.	Repair or replace grille.
	Condenser fan blade damaged.	Replace fan blade.
	High ambient air temperature.	No remedy.
	Restricted dehydrator or high side.	Replace filter drier or clear restriction.
	Defective service gauge.	Replace gauge.
Compressor loses oil.	Refrigerant leak.	Repair leak and recharge.
Compressor oil migrates to system.	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 115).
Rapid cycling between Cool, Null, and Heat modes.	Air short cycling through evaporator.	Check and correct cargo load.
	Defective controller or power module.	Diagnose power module and controller. Replace defective component.
	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 115).
Hot liquid line.	Shortage of refrigerant.	Repair or recharge.
	Expansion valve open too wide.	Adjust or replace expansion valve.
Frosted liquid line.	Liquid line restricted.	Remove restriction.
	Restricted filter drier.	Replace filter drier.
Frosted or sweating suction line.	Expansion valve admitting excess refrigerant.	Check feeler bulb and adjust expansion valve.
	Evaporator coil needs defrosting. (R-134a system only)	Check defrost circuit including controller and evaporator coil sensor.
	Evaporator fan does not operate. (R-23 system only)	Refer to "Evaporator Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 115).
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 power module.	Diagnose power module and controller. Replace defective component.
	Service gauge out of calibration.	Adjust or replace service gauge.

Condition	Possible Cause	Remedy
Low suction pressure. ***Note:*** *This unit has a digital 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.	Repair leak and recharge.
	Low ambient air temperature. (R-134a system only)	No remedy.
	Iced or dirty evaporator coil. (R-134a system only)	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 power module.	Diagnose power module and controller. Replace defective component.
	Service gauge out of calibration.	Adjust or replace gauge.

Alarm Codes, Descriptions and Corrective Actions

Note: *Sensors used with the MP 3000 Controller do not require calibration. Check sensor resistance with an ohmmeter.*

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

Table 17. Model CRR DF - Alarm Codes, Descriptions and Corrective Actions

Code	Description	Corrective Action
00	**Supply Air Sensor Open Circuit (Check Alarm)** • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -80 C (-112 F). • Indicates: – Open circuit to sensor – Defective or wrong sensor – Defective relay board – Defective cable No. 1 – Defective controller	• Check sensor resistance between pins 1 and 2 on plug J15. Resistance must be 1,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board. • Check evaporator airflow.
01	**Supply Air Sensor Short Circuit (Check Alarm)** • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: – Open circuit to sensor – Defective or wrong sensor – Defective relay board – Defective cable No. 1 – Defective controller	• Check sensor resistance between pins 1 and 2 on plug J15. Resistance must be 1000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
02	**Return Air Sensor Open Circuit (Check Alarm)** • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -80 C (-112 F). • Indicates: – Open circuit to sensor – Defective or wrong sensor – Defective relay board – Defective controller	• Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 1000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
03	**Return Air Sensor Short Circuit (Check Alarm)** • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • 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 1000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.

Table 17. Model CRR DF - Alarm Codes, Descriptions and Corrective Actions (continued)

04	**Evaporator Coil Sensor Open Circuit (Check Alarm)** • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -80 C (-112 F). • 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 1,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board. • Check evaporator airflow.
05	**Evaporator Coil Sensor Short Circuit (Check Alarm)** • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: – Open 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 1,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
06*	**R-134 Compressor Current Too High (Check Alarm)** • Occurs during Pretrip (PTI) only. • Compressor power consumption is higher than approximately 13 amps. • Indicates: – Defective compressor or valve plate – Defective volt or amp meter on relay board – Inaccurate ambient temperature measurement – Out of range power supply	• Start "Manual Function Test". Make sure the compressor and condenser fan are operating. Check compressor volts and amps. • Check power supply volts. • Check ambient sensor.
07*	**R-134 Compressor Current Too Low (Check Alarm)** • Occurs during Pretrip (PTI) only. • Compressor power consumption is higher than approximately 7 amps. • Indicates: – Defective or open fuse CB 6A, 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 R-134a refrigerant charge – Defective R-134a compressor or valve plate	• Start "Manual Function Test". Make sure the compressor relay energizes. 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 on R-134a system. Evaluate readings based on current cargo and ambient temperatures. • Check compressor volts and amps. • Check power supply volts.
*If both alarms 06 and 07 are activated, the alarms are caused by a large difference in measured amps. Start "Manual Function Test" and start the R-134a compressor and condenser fan. Check the compressor amps measurement. If necessary, check the resistance of the compressor motor windings.		
10*	**Heater Current Too High (Check Alarm)** • Occurs during Pretrip (PTI) only. • Heater power consumption is higher than approximately 9 amps and lower than 13 amps. • Indicates: – Incorrect heaters or heater connections – Defective volt or amp meter on relay board – Defective heater element	• Start "Manual Function Test" and turn heaters ON. Check current draw on each phase. Current draw should be about 9.0 amps on each phase at 380V (10.4 amps at 460V).

Table 17. Model CRR DF - Alarm Codes, Descriptions and Corrective Actions (continued)

11*	**Heater Current Too Low (Check Alarm)** • Occurs during Pretrip (PTI) only. • Heater power consumption is lower than approximately 6 to 9 amps, depending on voltage. • Indicates: – Incorrect heaters or heater connections – Defective heater elements or heat relay – Defective wire connections – Defective high evaporator temperature switch	• Start "Manual Function Test" and turn heaters ON. Check current draw on each phase. Current draw should be 4.5 amps on each phase at 380V. • If heat relay fails to energize, check evaporator high temperature switch. Switch should be closed at temperatures below 54 C (130 F); there should be continuity between pins 5 & 6 in plug J19. • Check power supply volts and amps. • Check heater element resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance readings should be equal (approximately 50 ohms).
*If both alarms 10 and 11 are activated, the alarms are caused by a large difference in measured amps. Start "Manual Function Test" and energize the heaters. Check the heater amps measurement. If necessary, isolate and check the resistance of each individual heater element.		
14*	**Evaporator Fan Low Speed Current Too High (Check Alarm)** • Occurs during Pretrip (PTI) only. • Evaporator fan power consumption is higher than approximately 2.6 to 2.9 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. • Start "Manual Function Test" and set evaporator motors to low speed. Make sure all fans start on low speed. • Check fan motor volts and amps. • Check power supply volts and amps.
15*	**Evaporator Fan Low Speed Current Too Low (Check Alarm)** • Occurs during Pretrip (PTI) only. • Evaporator fan power consumption is lower than approximately 1.0 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. • Start "Manual Function Test" and set evaporator motors to low speed. Make sure all fans start on low speed. • Check fan motor volts and amps. • Check power supply volts and amps.
*If both alarms 14 and 15 are activated, the alarms are caused by a large difference in measured amps. Start "Manual Function Test" and start the evaporator fans. Check the evaporator fan amps measurement. If necessary, check the resistance in the motors between L1, L2 and L3, and L1 and L3. Resistance readings should be equal (approximately 30 Ohms, total of 3 motors).		
16*	**Condenser Fan Current Too High (Check Alarm)** • Occurs during Pretrip (PTI) only. • Condenser fan power consumption is higher than approximately 1.25 amps, depending on voltage • Indicates: – Defective or stuck condenser fan motor – Defective volt or amp meter on relay board – Incorrect motor or motor connections	• Start "Manual Function Test" and set condenser fan motor to ON. Make sure the fan starts. • Check fan motor volts and amps.
17*	**Condenser Fan Current Too Low (Check Alarm)** • Occurs during Pretrip (PTI) only. • Condenser fan power consumption is lower than approximately 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	• Start "Manual Function Test" and set condenser fan motor to ON. Make sure the fan starts. • Check fan motor volts and amps. • Check power supply volts and amps.

Table 17. Model CRR DF - Alarm Codes, Descriptions and Corrective Actions (continued)

18	• 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	• Enter "Data" menu and view voltage reading on each phase. • Check all fuses. Check cable No. 1 on relay board. • Replace relay board. Check voltage reading on each phase.
*If both alarms 16 and 17 are activated, the alarms are caused by a large difference in measured amps. Start "Manual Function Test" and start the condenser fan. Check the condenser fan amps measurement. If necessary, check the resistance in the motor between L1 and L2, L2 and L3, and L1 and L3. Resistance readings should be equal (approximately 10 Ohms).		
19	**Temperature Too Far from Setpoint (Check Alarm)** • After 80 minutes of operation, return air temperature is not in-range and does not approach setpoint by 0.1 C/hr. • Indicates: – Ice or frost on evaporator coil – Low refrigerant charge – 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 ice or frost and initiate manual defrost if necessary.Check refrigerant charge of R-23 and R-134a systems. ***Note:*** *This alarm can be activated if the supply or temperature does approach setpoint.*
20	**Defrost Time Too Long (Check Alarm)** • Heat signal has been on for more than 90 minutes (120 minutes if power supply below 55 Hz) during Defrost. • Indicates: – Defective heater elements – Defective heat relay – 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 pre-trip (PTI) test only. • Return air temperature does not reach -30 C (22 F) within 4 hours. • Indicates: – Incorrect refrigeration system operation – Container door is open – Container is not empty – Incorrect connection of return air sensor	• Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low speed. • Operate unit on Cool and check discharge and suction pressure gauge readings on both the R-23 and R-134a refrigeration systems. Check the refrigerant charge of the R-23 and R-134a systems. • Check the return sensor connections.
23	**Capacity Test 2 Error (Check Alarm)** • Occurs during pre-trip (PTI) test only. • Return air temperature does not reach -55 C (-67 F) within 6 hours. • ndicates: – Incorrect refrigeration system operation – Container door is open – Container is not empty – Incorrect connection of return air sensor	• Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low speed. • Operate unit on Cool and check discharge and suction pressure gauge readings on both the R-23 and R-134a refrigeration systems. Check the refrigerant charge of the R-23 and R-134a systems. • Check the return sensor connections.
34	**Ambient Air Sensor Open Circuit (Check Alarm)** • Sensor circuit resistance is higher than 100,000 ohms. • Temperature is 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 1,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.

Table 17. Model CRR DF - Alarm Codes, Descriptions and Corrective Actions (continued)

35	**Ambient Air Sensor Short Circuit (Check Alarm)** • Sensor circuit resistance is lower than 200 ohms. • Temperature is 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 1,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
43	**Return Air Temperature Too High (Check Alarm)** • Return air temperature increases above 35 C (95 F) during defrost. • Indicates: – Defective return air or evaporator coil sensor – Return air and evaporator coil sensor connections are reversed	• Check for sensor alarm codes. • Check supply and return sensor connections and locations.
52	**Probe Error (Check Alarm)** • Occurs during Pretrip (PTI) test only. • Temperature difference between supply air, return air or evaporator coil sensor is too high (3 C maximum) • Indicates: – Indication error on one of the sensors – Supply air sensor not placed in airflow stream	• Check sensor connections. Check sensor resistance of each sensor. Resistance must be 1,000 ohms at 25 C (77 F). • Check supply air sensor locations.
56	**Compressor Temperature Too High (Shutdown Alarm)** • R-134a compressor discharge line temperature is above 130 C (266 F). R-134a compressor operation should resume when discharge line temperature decreases below 90 C (194 F); or R-23 compressor discharge line temperature is above 138 C (280 F). R-23 compressor operation should resume when discharge line temperature decreases below 138 C (280 F). • Indicates: – Air in refrigeration system – Low refrigerant charge in R-134a system – R-134a Only: Defective compressor or valve plate – Wrong or defective sensor	• Operate unit on Cool and check discharge and suction pressure gauge readings on R-134a refrigeration system. Check refrigerant charge of R-134a system and R-23 system. • Check 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" showing in the View submenu of controller for both the R-134a compressor and the R-23 compressor.
58	**Phase Sensor Error (Check Alarm)** • Occurs during Pre-trip (PTI) test only. • During Phase Sensor Test, amperage difference between correct and wrong condenser fan rotation is more than 0.2 amps. • Indicates: – Defective relay board – Defective relay board cable No. 2 – Defective phase relay	• Start "Manual Function Test" and view current display for each phase to determine if each phase sensor relay is receiving a signal. Change incoming power phase. Verify that the phase relays respond correctly.
59	**Delta Current Error (Log Alarm)** • Power consumption is More than 50% above or below (Min 0,8 Amp). • Indicates: – Open connection on one phase of power supply to a 3-phase unit component including R-134a compressor or R-23 compressor.	• Start manual function test one by one to verify correct current draw for all components and current draw reading of 0 Amp when component is disengaged.

Table 17. Model CRR DF - Alarm Codes, Descriptions and Corrective Actions (continued)

97	Compressor Sensor Open Circuit (Log Alarm) • Sensor circuit resistance is higher than 10,000,000 ohms on R-134a or R-23 compressor. • Temperature below -30 C (-22 F). • 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 for R-134a compressor sensor and between pins 11 and 12 on plug J15 for R-23 compressor. Resistance must be 100,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board. ***Note:*** *Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.*
98	**Compressor Sensor Short Circuit (Log Alarm)** • Sensor circuit resistance lower than 200 ohms. • Temperature above 180 C (356 F). • 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.
112	**Zero Current Too High (Check Alarm)** • Ground (zero current) circuit 30 milliamps. • Indicates: – Defective motor or heater insulation to ground	• Start "Manual Function Test" and operate each motor and heater separately. Note when alarm occurs.

Diagrams

Diagram Index

Figure 34. CRR DF MP3000A Controller Diagram

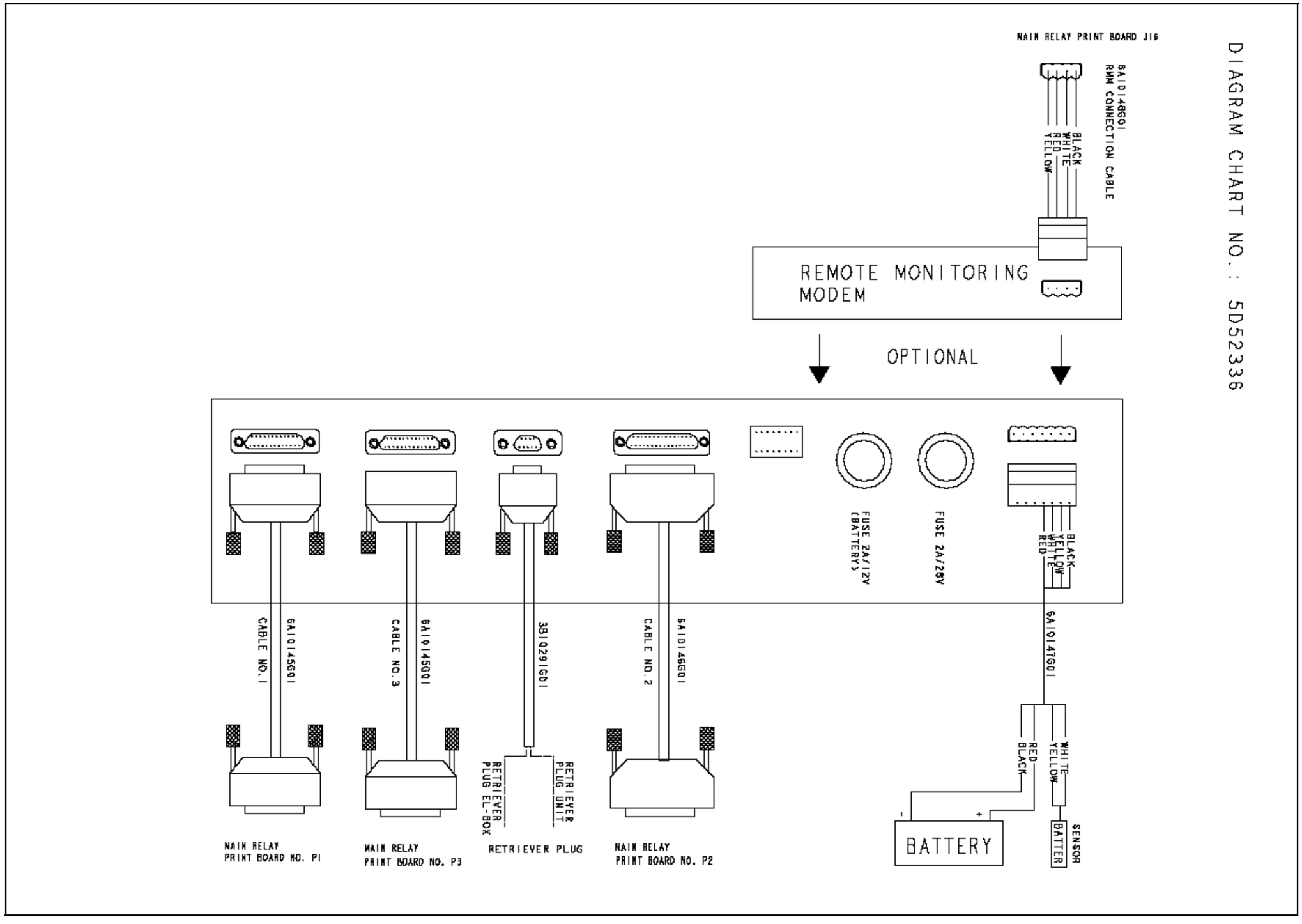
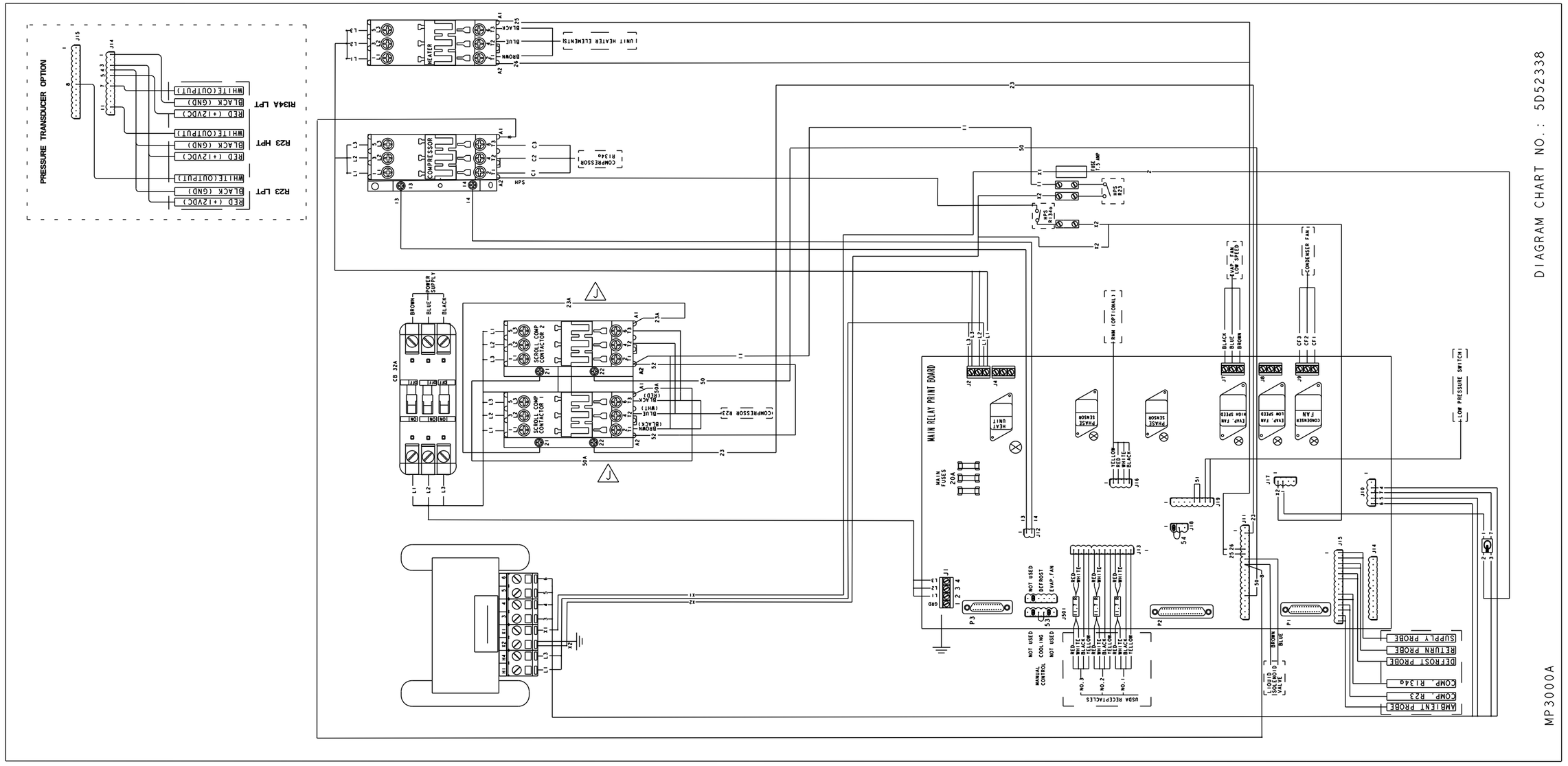


Figure 35. CRR DF MP3000A Main Relay Board Electrical Diagram



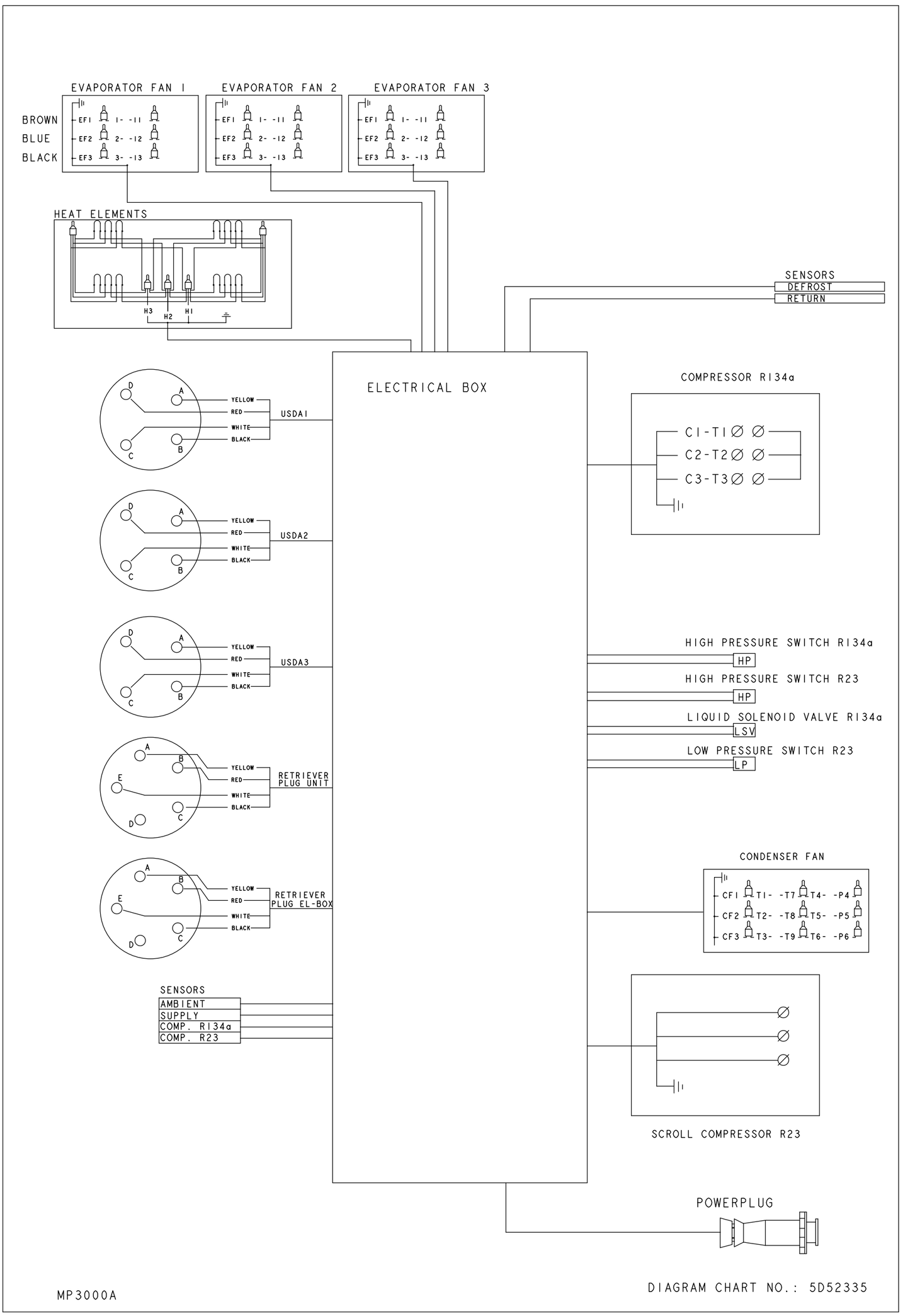


Figure 36. CRR DF MP3000A Unit Wiring Schematic

Figure 37. CRR DF MP3000A Unit Wiring Schematic

Unit Compartments

A. Evaporator Section

B. Condenser Section

Controller and Temperature Sensors

5. R-134a Compressor Discharge Line Temperature Sensor
29. R-23 Compressor Discharge Line Temperature Sensor
49. Return Air Sensor
50. Evaporator Coil Sensor
51. Supply Air Sensor
52. Ambient Sensor

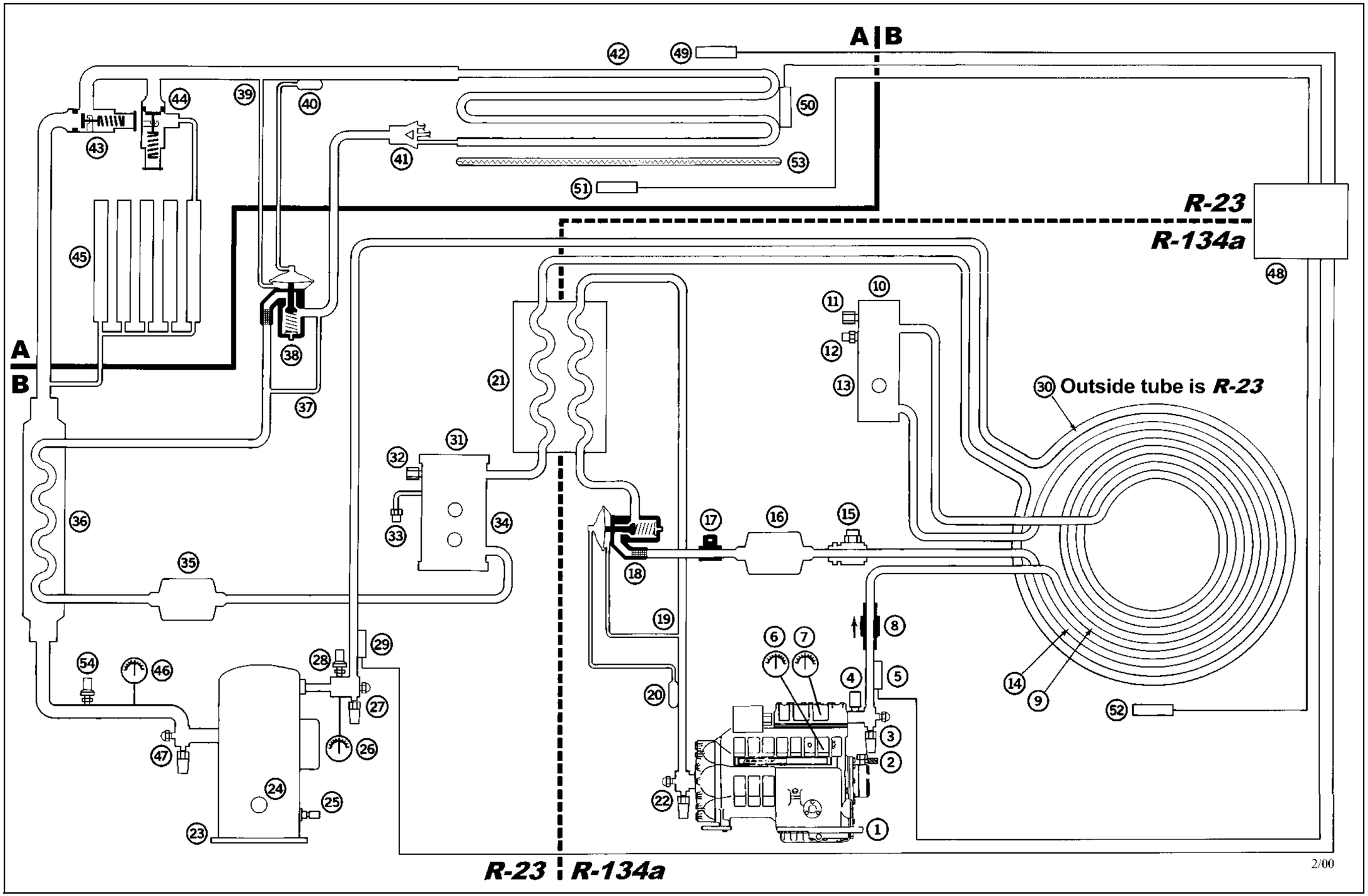
R-134a Refrigeration Circuit Components

1. R-134a Reciprocating Compressor
2. Oil Fill / Drain Fitting
3. Discharge Service Valve
4. High Pressure Cutout Switch
5. R-134a Compressor Discharge Line Temperature Sensor
6. Low (Suction) Pressure Gauge
7. High (Discharge) Pressure Gauge
8. Condenser Check Valve
9. Condenser Coil Outlet Tube
10. Receiver Tank
11. R-134a Receiver Tank Service Fitting
12. R-134a High Pressure Relief (Fusible Plug)
13. Sight Glass
14. Condenser Coil Outlet Tube
15. Liquid Line Ball (Service) Valve
16. R-134a Threaded Filter Drier
17. Liquid Line Solenoid
18. R-134a Expansion Valve
19. Equalizer Line
20. Expansion Valve Feeler Bulb
21. Plate Heat Exchanger, R-134a/R-23
22. Suction Service Valve

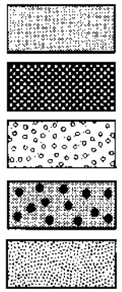
R-23 Refrigeration Circuit Components

21. Plate Heat Exchanger, R-134a/R-23
23. R-23 Scroll Compressor
24. Sight Glass
25. Oil Fill / Drain Fitting
26. High (Discharge) Pressure Gauge
27. Discharge Service Valve
28. High Pressure Cutout Switch
29. R-23 Compressor Discharge Line Temperature Sensor
30. R-23 Condenser Coil Tube (Circular)
31. Receiver Tank
32. R-23 Receiver Tank Service Fitting
33. R-23 High Pressure Relief Valve
34. Sight Glass
35. R-23 Soldered Filter Drier
36. Heat Exchanger
37. R-23 Equalizer Line
38. Expansion Valve
39. Expansion Valve Equalizer Line
40. Expansion Valve Feeler Bulb
41. Distributor
42. Evaporator Coil
43. Crankcase Pressure Regulator
44. Constant Pressure Regulator
45. Buffer (Receiver Tanks)
46. Low (Suction) Pressure Gauge
47. Suction Service Valve
53. Electric Heaters

Figure 38. CRR DF Refrigeration System Components — Page 2 of 2



Legend for CRR DF Off Cycle Standby Flow and Pressure Diagram



Medium Pressure Gas

Medium Pressure Liquid

Low Pressure Gas

Medium Pressure Mixture (Gas/Liquid)

High Pressure Gas (Entire R-23 System)

Unit Compartments

A. Evaporator Section

B. Condenser Section

Controller and Temperature Sensors

5. R-134a Compressor Discharge Line Temperature Sensor
29. R-23 Compressor Discharge Line Temperature Sensor
49. Return Air Sensor
50. Evaporator Coil Sensor
51. Supply Air Sensor
52. Ambient Sensor

R-134a Refrigeration Circuit Components

1. R-134a Reciprocating Compressor
2. Oil Fill / Drain Fitting
3. Discharge Service Valve
4. High Pressure Cutout Switch
5. R-134a Compressor Discharge Line Temperature Sensor
6. Low (Suction) Pressure Gauge
7. High (Discharge) Pressure Gauge
8. Condenser Check Valve
9. Condenser Coil Outlet Tube
10. Receiver Tank
11. R-134a Receiver Tank Service Fitting
12. R-134a High Pressure Relief (Fusible Plug)
13. Sight Glass
14. Condenser Coil Outlet Tube
15. Liquid Line Ball (Service) Valve
16. R-134a Threaded Filter Drier
17. Liquid Line Solenoid
18. R-134a Expansion Valve
19. Equalizer Line
20. Expansion Valve Feeler Bulb
21. Plate Heat Exchanger, R-134a/R-23
22. Suction Service Valve

R-23 Refrigeration Circuit Components

21. Plate Heat Exchanger, R-134a/R-23
23. R-23 Scroll Compressor
24. Sight Glass
25. Oil Fill / Drain Fitting
26. High (Discharge) Pressure Gauge
27. Discharge Service Valve
28. High Pressure Cutout Switch
29. R-23 Compressor Discharge Line Temperature Sensor
30. R-23 Condenser Coil Tube (Circular)
31. Receiver Tank
32. R-23 Receiver Tank Service Fitting
33. R-23 High Pressure Relief Valve
34. Sight Glass
35. R-23 Soldered Filter Drier
36. Heat Exchanger
37. R-23 Equalizer Line
38. Expansion Valve
39. Expansion Valve Equalizer Line
40. Expansion Valve Feeler Bulb
41. Distributor
42. Evaporator Coil
43. Crankcase Pressure Regulator
44. Constant Pressure Regulator
45. Buffer (Receiver Tanks)
46. Low (Suction) Pressure Gauge
47. Suction Service Valve
53. Electric Heaters

Figure 40. CRR DF Off Cycle Standby Flow and Pressure Diagram — Page 2 of 2

CRR DF Off Cycle Standby Flow and Pressure Diagram

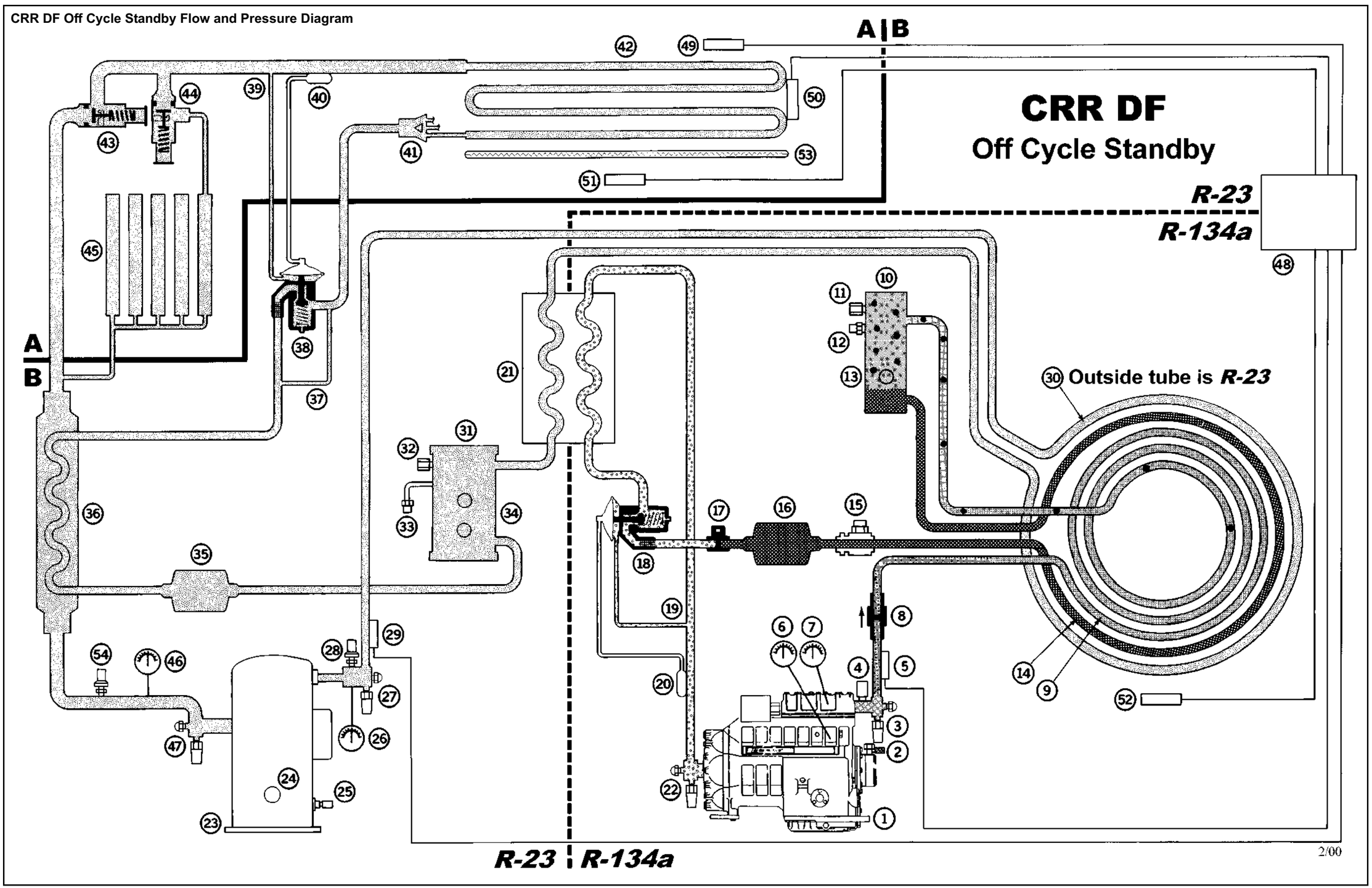
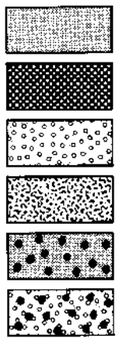


Figure 41. Legend for CRR DF Full Cool Flow and Pressure Diagram — Page 1 of 2

Legend for CRR DF Full Cool Flow and Pressure Diagram



High Pressure Gas

High Pressure Liquid

Low Pressure Gas

Low Pressure Liquid

Condensing High Pressure Gas

Low Pressure Vaporizing Liquid

Unit Compartments

A. Evaporator Section

B. Condenser Section

Controller and Temperature Sensors

5. R-134a Compressor Discharge Line Temperature Sensor
29. R-23 Compressor Discharge Line Temperature Sensor
49. Return Air Sensor
50. Evaporator Coil Sensor
51. Supply Air Sensor
52. Ambient Sensor

R-134a Refrigeration Circuit Components

1. R-134a Reciprocating Compressor
2. Oil Fill / Drain Fitting
3. Discharge Service Valve
4. High Pressure Cutout Switch
5. R-134a Compressor Discharge Line Temperature Sensor
6. Low (Suction) Pressure Gauge
7. High (Discharge) Pressure Gauge
8. Condenser Check Valve
9. Condenser Coil Outlet Tube
10. Receiver Tank
11. R-134a Receiver Tank Service Fitting
12. R-134a High Pressure Relief (Fusible Plug)
13. Sight Glass
14. Condenser Coil Outlet Tube
15. Liquid Line Ball (Service) Valve
16. R-134a Threaded Filter Drier
17. Liquid Line Solenoid
18. R-134a Expansion Valve
19. Equalizer Line
20. Expansion Valve Feeler Bulb
21. Plate Heat Exchanger, R-134a/R-23
22. Suction Service Valve

R-23 Refrigeration Circuit Components

21. Plate Heat Exchanger, R-134a/R-23
23. R-23 Scroll Compressor
24. Sight Glass
25. Oil Fill / Drain Fitting
26. High (Discharge) Pressure Gauge
27. Discharge Service Valve
28. High Pressure Cutout Switch
29. R-23 Compressor Discharge Line Temperature Sensor
30. R-23 Condenser Coil Tube (Circular)
31. Receiver Tank
32. R-23 Receiver Tank Service Fitting
33. R-23 High Pressure Relief Valve
34. Sight Glass
35. R-23 Soldered Filter Drier
36. Heat Exchanger
37. R-23 Equalizer Line
38. Expansion Valve
39. Expansion Valve Equalizer Line
40. Expansion Valve Feeler Bulb
41. Distributor
42. Evaporator Coil
43. Crankcase Pressure Regulator
44. Constant Pressure Regulator
45. Buffer (Receiver Tanks)
46. Low (Suction) Pressure Gauge
47. Suction Service Valve
53. Electric Heaters

Figure 42. CRR DF Full Cool Flow and Pressure Diagram — Page 2 of 2

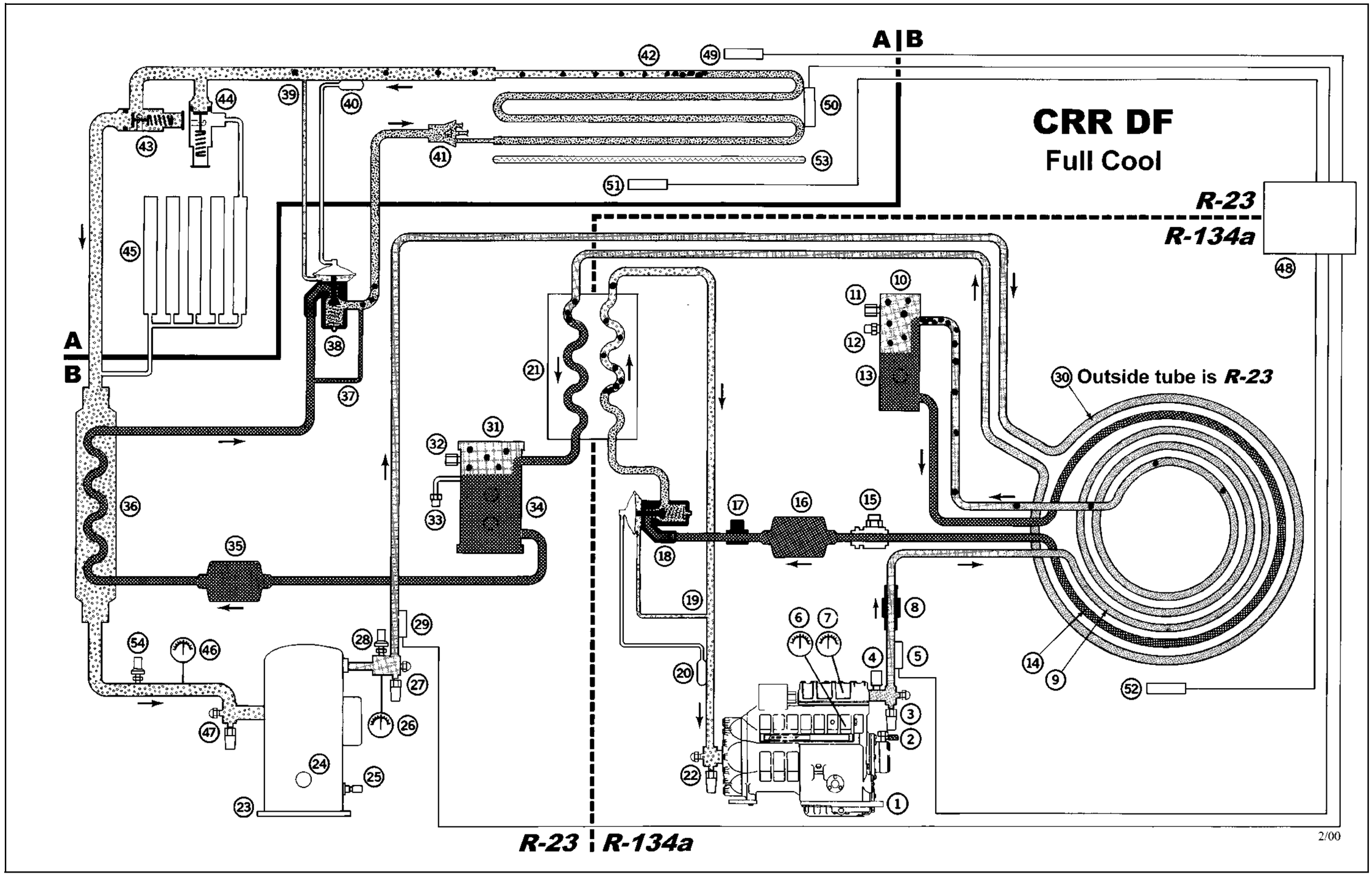


Figure 43. Legend for CRR DF Evacuation Station and Unit Connections — Page 1 of 2

Evacuation Stations

NOTE: Special, self-sealing quick disconnect couplers are required for R-134a systems and R-23 systems.

Y. R-23 Evacuation Station and Unit Connections
Y1. Scale, R-23 Refrigerant Tank and Refrigerant Hose Only
Y2. Gas Ballast Valve
Y3. Iso Valve
Y4. Two-stage Vacuum Pump
Y5. To 220/190 VAC Power
Y6. Calibration Standard
Y7. Micron Meter
Y8. Sensor

Z. R-134a Evacuation Station and Unit Connections
Z1. Scale, R-134a Refrigerant Tank and Gauge Manifold
Z2. Gas Ballast Valve
Z3. Iso Valve
Z4. Two-stage Vacuum Pump
Z5. To 220/190 VAC Power
Z6. Calibration Standard
Z7. Micron Meter
Z8. Sensor

Unit Compartments

A. Evaporator Section
B. Condenser Section

Controller and Temperature Sensors

5. R-134a Compressor Discharge Line Temperature Sensor
29. R-23 Compressor Discharge Line Temperature Sensor
49. Return Air Sensor
50. Evaporator Coil Sensor
51. Supply Air Sensor
52. Ambient Sensor

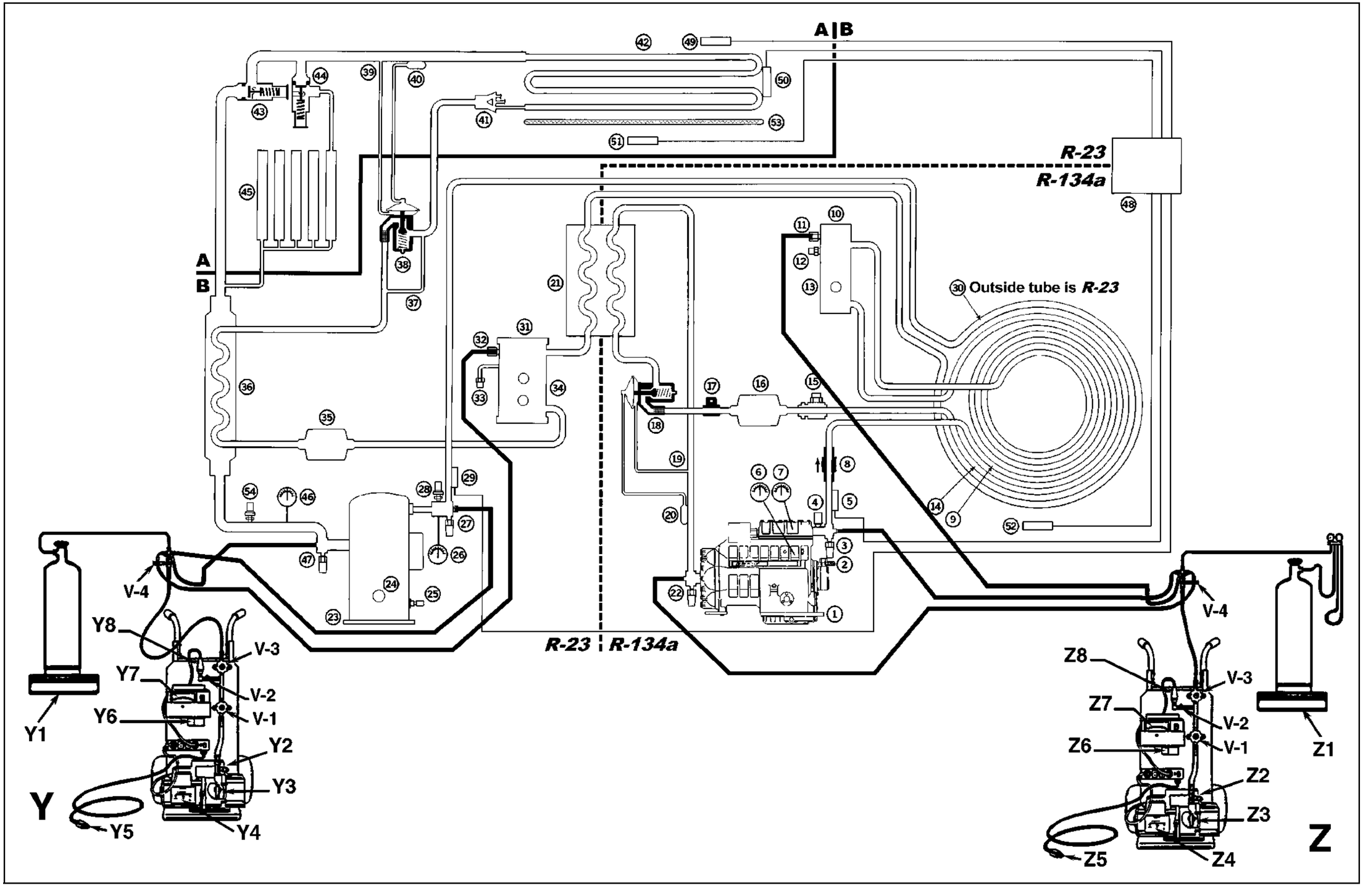
R-134a Refrigeration Circuit Components

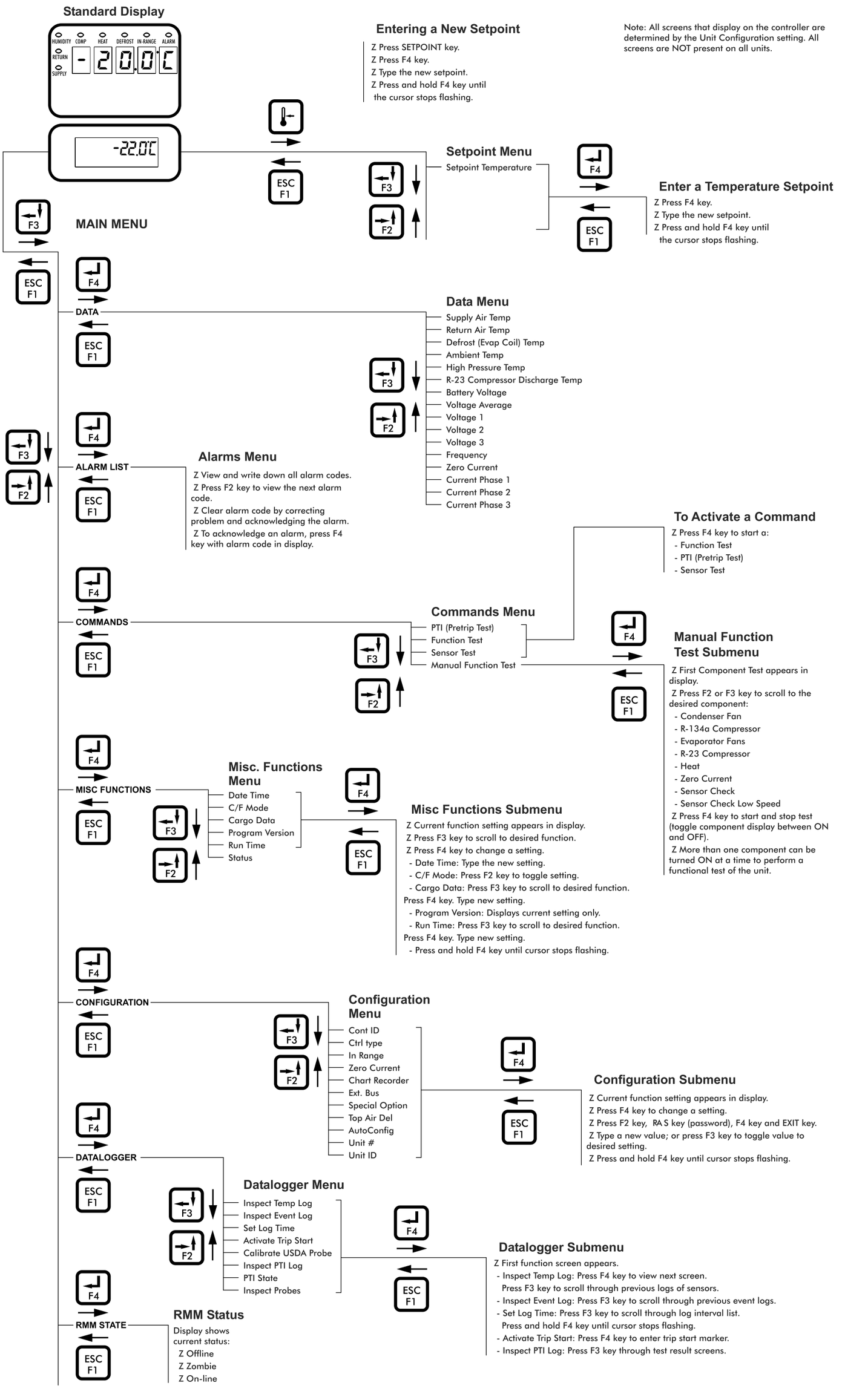
1. R-134a Reciprocating Compressor
2. Oil Fill / Drain Fitting
3. Discharge Service Valve
4. High Pressure Cutout Switch
5. R-134a Compressor Discharge Line Temperature Sensor
6. Low (Suction) Pressure Gauge
7. High (Discharge) Pressure Gauge
8. Condenser Check Valve
9. Condenser Coil Outlet Tube
10. Receiver Tank
11. R-134a Receiver Tank Service Fitting
12. R-134a High Pressure Relief (Fusible Plug)
13. Sight Glass
14. Condenser Coil Outlet Tube
15. Liquid Line Ball (Service) Valve
16. R-134a Threaded Filter Drier
17. Liquid Line Solenoid
18. R-134a Expansion Valve
19. Equalizer Line
20. Expansion Valve Feeler Bulb
21. Plate Heat Exchanger, R-134a/R-23
22. Suction Service Valve

R-23 Refrigeration Circuit Components

21. Plate Heat Exchanger, R-134a/R-23
23. R-23 Scroll Compressor
24. Sight Glass
25. Oil Fill / Drain Fitting
26. High (Discharge) Pressure Gauge
27. Discharge Service Valve
28. High Pressure Cutout Switch
29. R-23 Compressor Discharge Line Temperature Sensor
30. R-23 Condenser Coil Tube (Circular)
31. Receiver Tank
32. R-23 Receiver Tank Service Fitting
33. R-23 High Pressure Relief Valve
34. Sight Glass
35. R-23 Soldered Filter Drier
36. Heat Exchanger
37. R-23 Equalizer Line
38. Expansion Valve
39. Expansion Valve Equalizer Line
40. Expansion Valve Feeler Bulb
41. Distributor
42. Evaporator Coil
43. Crankcase Pressure Regulator
44. Constant Pressure Regulator
45. Buffer (Receiver Tanks)
46. Low (Suction) Pressure Gauge
47. Suction Service Valve
53. Electric Heaters

Figure 44. CRR DR Evacuation Station and Unit Connections — Page 2 of 2




Standard Display
HUMIDITY COMP HEAT DEFROST IN-RANGE ALARM
RETURN
SUPPLY
-20.0°C
-22.0°C
Entering a New Setpoint
Z Press SETPOINT key.
Z Press F4 key.
Z Type the new setpoint.
Z Press and hold F4 key until the cursor stops flashing.
Note: All screens that display on the controller are determined by the Unit Configuration setting. All screens are NOT present on all units.
ESC F1
F3
F2
F4
Setpoint Menu
Setpoint Temperature
Enter a Temperature Setpoint
Z Press F4 key.
Z Type the new setpoint.
Z Press and hold F4 key until the cursor stops flashing.
MAIN MENU
DATA
Data Menu
Supply Air Temp
Return Air Temp
Defrost (Evap Coil) Temp
Ambient Temp
High Pressure Temp
R-23 Compressor Discharge Temp
Battery Voltage
Voltage Average
Voltage 1
Voltage 2
Voltage 3
Frequency
Zero Current
Current Phase 1
Current Phase 2
Current Phase 3
ALARM LIST
Alarms Menu
Z View and write down all alarm codes.
Z Press F2 key to view the next alarm code.
Z Clear alarm code by correcting problem and acknowledging the alarm.
Z To acknowledge an alarm, press F4 key with alarm code in display.
To Activate a Command
Z Press F4 key to start a:
- Function Test
- PTI (Pretrip Test)
- Sensor Test
COMMANDS
Commands Menu
PTI (Pretrip Test)
Function Test
Sensor Test
Manual Function Test
Manual Function Test Submenu
Z First Component Test appears in display.
Z Press F2 or F3 key to scroll to the desired component:
- Condenser Fan
- R-134a Compressor
- Evaporator Fans
- R-23 Compressor
- Heat
- Zero Current
- Sensor Check
- Sensor Check Low Speed
Z Press F4 key to start and stop test (toggle component display between ON and OFF).
Z More than one component can be turned ON at a time to perform a functional test of the unit.
MISC FUNCTIONS
Misc. Functions Menu
Date Time
C/F Mode
Cargo Data
Program Version
Run Time
Status
Misc Functions Submenu
Z Current function setting appears in display.
Z Press F3 key to scroll to desired function.
Z Press F4 key to change a setting.
- Date Time: Type the new setting.
- C/F Mode: Press F2 key to toggle setting.
- Cargo Data: Press F3 key to scroll to desired function.
Press F4 key. Type new setting.
- Program Version: Displays current setting only.
- Run Time: Press F3 key to scroll to desired function.
Press F4 key. Type new setting.
- Press and hold F4 key until cursor stops flashing.
CONFIGURATION
Configuration Menu
Cont ID
Ctrl type
In Range
Zero Current
Chart Recorder
Ext. Bus
Special Option
Top Air Del
AutoConfig
Unit #
Unit ID
Configuration Submenu
Z Current function setting appears in display.
Z Press F4 key to change a setting.
Z Press F2 key, RAS key (password), F4 key and EXIT key.
Z Type a new value; or press F3 key to toggle value to desired setting.
Z Press and hold F4 key until cursor stops flashing.
DATALOGGER
Datalogger Menu
Inspect Temp Log
Inspect Event Log
Set Log Time
Activate Trip Start
Calibrate USDA Probe
Inspect PTI Log
PTI State
Inspect Probes
Datalogger Submenu
Z 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 Trip Start: 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:
Z Offline
Z Zombie
Z On-line

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