

Superfreezer
CRR DF MPC2000
CRR DF MPC2000ID
CRR DF MP 3000

TK 50134-4-MM (Rev. 7, 03/2021)

The maintenance information in this manual covers unit models:

Superfreezer CRR-40 DF with MPC2000

Superfreezer CRR-40 DF with MPC2000ID

Superfreezer CRR-40 DF with MP3000

For further information, refer to:

Superfreezer CRR DF Parts Manual

TK50262

Diagnosing Thermo King Container Refrigeration Systems

TK41166

Evacuation Station Operation and Field Application

TK40612

Tool Catalog

TK5955

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

This manual is published for informational purposes only and the information so provided should not be considered as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation should be consulted.

Sale of product shown in this manual is subject to Thermo King's terms and conditions including, but not limited to, the Thermo King Limited Express Warranty. Such terms and conditions are available upon request. Thermo King's warranty will not apply to any equipment which has been "so repaired or altered outside the manufacturer's plants as, in the manufacturer's judgment, to effect its stability."

No warranties, express or implied, including warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations, and descriptions contained herein. Manufacturer is not responsible and will not be held liable in contract or in tort (including negligence) for any special, indirect or consequential damages, including injury or damage caused to vehicles, contents or persons, by reason of the installation of any Thermo King product or its mechanical failure.

Recover Refrigerant

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

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

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

Table of Contents

List of Figures	9
Introduction	11
CRR DF Model Features	11
Safety Precautions	13
General Practices	13
Refrigerant	13
First Aid	13
Refrigerant Oil	14
First Aid	14
Electrical	14
High Voltage	14
General Safety Precautions for Servicing Units (or Containers) Equipped with a Microprocessor Controller	15
Controller Repair	15
Welding of Units or Containers	16
Unit Decals	16
Serial Number Locations	16
Service Guide	19
Specifications	21
Full Cool Operation Net Cooling Capacity*	21
System Net Defrost Heating Capacity	21
Evaporator Airflow**	21
R-134a Refrigeration System	21
R-23 Refrigeration System	22
Electrical System	23
Microprocessor Controller	24
Physical Specifications	25
Compressor Torque — 3D Copeland Compressor Bolt Torque	25
Metric Hardware Torque Chart	26
Unit Description	27
General Description	27
Cascade Refrigeration System	27
Microprocessor Controller	28
Datalogger	28
Three Evaporator Fans	28
USDA Cold Treatment Temperature Recording	28
REFCON Remote Monitoring Modem (RMM)	29
Operating Modes	29
Frozen Loads	29
Operating Instructions	47
Basic Unit Controls, Instruments and Protection Devices	47
Unit Control Box	47
MPC2000, MPC2000ID or MP3000 Controller	47
Other	48
R-134a Refrigeration System Controls, Instruments and Protection Devices	48
R-23 Refrigeration System Controls, Instruments and Protection Devices	49
Pretrip Inspection	50
Power Selection	51
Pre-load Operation	51
Pre-Trip Conditions	51
Pre-Trip Checks	51
Loading Procedure	52
Post Load Procedure	53
Starting the Unit on Ship	53
Post Trip Procedure	54
Microprocessor Controller	55

Table of Contents

General Description	55
General Theory of Operation	61
Frozen Loads (Setpoint at -10 C [14 F] and Below)	61
Sequence Of Operation	62
Unit Start-up	62
Continuous Temperature Control Operation	63
Changing the Setpoint	64
Initiating a Manual Defrost	65
Displaying Alternate Controlling (Supply or Return) Air Sensor Temperature	65
Displaying Alternate Fahrenheit (F) or Celsius (C) Temperature	65
Menu Operating Instructions	65
Controller Menu	66
Data Menu	66
Alarm List Menu	67
Commands Menu	68
Manual function Test, DF units	70
Misc. Functions Menu	70
Configuration Menu	74
MP-3000 Configuration List, DF Units	74
Datalogger Menu	75
RMM State Menu	76
PTI (Pretrip) Test	77
Temperature Sensors	79
Manual Emergency Mode Operation	82
Replacing the EPROM Chip (MPC2000 and MP3000 Only)	83
Replacing the Microprocessor Controller	84
Flash Loading Controller Software	85
MPC 2000 ID / MP 3000, Super Freezer "Error message list"	86
Alarm Codes, Descriptions and Corrective Actions	87
Electrical Maintenance	97
Unit Wiring	97
High Pressure Cutout Switch	97
R-23 High Pressure Cutout Switch	97
R-134a High Pressure Cutout Switch	97
Condenser Fan and Evaporator Fan Rotation	97
Condenser Fan	98
Evaporator Fans	98
Electric Heaters	98
Low Pressure Cutout Switch (R-23 System on CRR DF MPC2000ID Units Only)	98
Low Pressure Cutout Switch:	99
Refrigeration Maintenance and Service Operations	101
Service Tools	101
R-134a Service Fittings and Gauge Manifold Set	101
Leak Detection	102
Vacuum Pump	102
System Cleanup	102
Refrigerant Recovery	102
Compressor Oil Acid Test	102
Compressor Discharge and Suction Service Valves	102
Gauge Manifold Valve Positions	104
R-134a Gauge Manifold Set (With Low Loss Fittings) Attachment And Purging	106
R-134a Gauge Manifold Set Installation	106
Gauge Manifold Set Removal	108
Service Procedure Guide	108
Typical R-23 and R-134a System Suction and Discharge Pressure Readings	108
Test Procedure	108
Discharge Pressure Regulator Test and Adjustment	109
Checking Compressor Oil	110
Checking the Compressor Oil Level	110

Adding Compressor Oil	110
Removing Excess Compressor Oil	111
Refrigerant Leak Test Procedure	112
Low Side Pump Down (R-134a Compressor Only)	113
Refrigerant Charge Inspection	114
Checking the R-134a Refrigerant Charge	114
Checking the R-23 Refrigerant Charge	115
Refrigerant Recovery	116
R-23 Recovery for System Repair	116
R-134a Vapor Recovery	117
R-134a Liquid Recovery	117
Evacuation and Cleanup of the Refrigeration System	117
Contamination	117
Compressor Oil Color Code	118
Refrigeration System Preparation and Hookup	118
Unit Evacuation	119
Pressure Rise Test	120
Factors Affecting the Speed of System Evacuation	120
Heat Saves Time	121
R-134a Refrigeration System Charging	121
Charging R-134a System with Liquid Refrigerant by Weight (from an Evacuated Condition)	121
R-134a Evacuation Station Removal	122
R-134a Final Charging Procedure for Partially Charged Units	122
R-23 Refrigeration System Charging	123
R-23 Evacuation Station Removal	124
Charging R-23 System with Gas Refrigerant Recovered in 40 Liter (42 qt.) Refrigerant Bottle(from an Evacuated Condition)	124
R-23 Final Charging Procedure for Partially Charged Units on Empty Containers	125
R-23 Charging Procedure for Partially Charged Units on Loaded Containers	125
Using Pressurized Nitrogen	126
Safety Precautions	126
Dehydration, Pressure Testing, Purging and Soldering Procedure	127
Compressor Replacement (R-134a or R-23 Systems)	128
Removal	128
Installation	128
Condenser Coil Replacement (R-134a or R-23 Systems)	129
Removal	129
Installation	129
Dehydrator (Filter Drier) Replacement (R-134a or R-23 Systems)	130
Removal	130
Installation	131
Expansion Valve Replacement (R-134a or R-23 Systems)	131
Removal	131
Installation	132
R-23 System Heat Exchanger Replacement	132
Removal	132
Installation	133
R-23 System to R-134a System Plate Heat Exchanger Replacement	133
Removal	133
Installation	133
Receiver Tank Replacement (R-134a or R-23 System)	134
Removal	134
Installation	134
High Pressure Cutout Switch Replacement (R-134a or R-23 System)	134
Removal	134
Installation	135
Liquid Line Solenoid Valve Replacement (R-134a System Only)	135
Removal	135
Installation	135

Table of Contents

Low Pressure Cutout Switch Replacement (CRR DF MPC2000ID and MP3000 Units Only)	136
Removal	136
Installation	136
Structural/Accessory Maintenance	137
Mounting Bolts	137
Unit Inspection	137
Condenser Coil	137
Evaporator Coil	138
Defrost Drains	138
Evaporator Fan Location	138
Condenser Fan Location	138
Vacuum Valve	139
Mechanical Diagnosis	141
Refrigeration System Diagnosis	143
Electrical, Refrigeration and Controller Menu Flow Diagrams	147

List of Figures

Figure 1: Unit Nameplate and Decal Locations	17
Figure 2: Unit Front View	30
Figure 3: Evaporator Section — Front View	31
Figure 4: Vacuum Valve	32
Figure 5: Power Cord Storage Compartment	33
Figure 6: Control Box and Microprocessor Controller	34
Figure 7: MPC2000 or MP3000 Controller and Remote Monitoring Modem	35
Figure 8: MPC2000ID and MP3000 Controller, and Remote Monitoring Modem	36
Figure 9: Unit Control Box with Door Open	37
Figure 10: Low Pressure Cutout Switch in R-23 Refrigeration System (CRR DF MPC2000ID Units Only)	38
Figure 11: R-23 Compressor Compartment	39
Figure 12: Additional R-23 Refrigeration System Components	40
Figure 13: R-134a Compressor Compartment	41
Figure 14: Additional R-134a Refrigeration System Components and Plate Heat Exchanger	42
Figure 15: Unit Back View	43
Figure 16: Unit Back View — Pressure Regulators and Buffer Tanks	44
Figure 17: Unit Back View — Electric Heaters and Evaporator Coil	45
Figure 18: MPC2000, MPC2000ID and MP3000 Controller	56
Figure 19: Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)	62
Figure 20: 3 Fan Evaporator: Evaporator (Defrost) Sensor Location	80
Figure 21: Manual Emergency Control Connections	83
Figure 22: R-134a Service Fittings Specifications	101
Figure 23: Service Valve Back Seated	103
Figure 24: Service Valve Open to Port	103
Figure 25: Service Valve Front Seated	103
Figure 26: Balancing R-134a System Pressure	104
Figure 27: Charging the R-134a System	104
Figure 28: Gauge Manifold Closed to Center Port	105
Figure 29: Gauge Manifold Open to Center Port	105
Figure 30: Removing R-134a Refrigerant	105
Figure 31: Removing Refrigerant	107
Figure 32: Purging Gauge Manifold	107
Figure 33: Discharge Pressure Regulator	110
Figure 34: Checking Compressor Oil Level	111
Figure 35: Adjusting Compressor Oil Level	112
Figure 36: Testing for Refrigerant Leaks	113
Figure 37: R-134a Refrigeration System Receiver Tank	114
Figure 38: R-23 Refrigeration System Receiver Tank	115
Figure 39: Constant Pressure Rise After Evacuation Indicates System Leak	120
Figure 40: Pressure Rise Levels Off After Evacuation Indicates Moisture in System	121
Figure 41: Typical Pressurized Gas Bottle with Pressure Regulator and Gauges	127
Figure 42: Mounting Bolts	137
Figure 43: Evaporator Fan Blade Placement	138
Figure 44: Vacuum Valve	139
Figure 45: Condenser Fan Blade Placement	139

Introduction

Superfreezer CRR DF Model Features

[illegible]

Safety Precautions

General Practices

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

Refrigerant

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

First Aid

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

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

Refrigerant Oil

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

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

First Aid

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

Electrical

High Voltage

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

Precautions

1. Be certain the unit On/Off switch is turned OFF before connecting or disconnecting the unit power plug. Never attempt to stop the unit by disconnecting the power plug.
2. Be certain the unit power plug is clean and dry before connecting it to a power source.
3. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
4. Do not make any rapid moves when working on high voltage circuits. If a tool or other object falls, do not attempt to grab it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
5. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
6. Never work alone on high voltage circuits on the refrigeration unit. Another person should always be standing by in the event of an accident to shut off the refrigeration unit and to aid a victim.
7. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

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

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

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

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

Low Voltage

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

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

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

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

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

Controller Repair

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

1. Disconnect all power to the unit.
2. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
3. Do wear a static discharge wrist strap (TK P/N 204-622) with the lead end connected to the controller's ground terminal. These straps are available at most electronic equipment distributors. DO NOT wear these straps with power applied to the unit.
4. Avoid contacting the electronic components on the circuit boards of the unit being serviced.
5. Leave the circuit boards in their static proof packing materials until ready for installation.

6. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
7. After servicing the circuit board and any other circuits, the wiring should be checked for possible errors before restoring power.

Welding of Units or Containers

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

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

Unit Decals

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

Serial Number Locations

Electric Motors: Nameplate attached to the motor housing.

Compressor: Nameplate on front of the compressor.

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

MPC2000 Controller: Nameplate on back of controller.

MPC2000ID Controller: Nameplate on back of controller.

MP3000 Controller: Nameplate on back of controller.

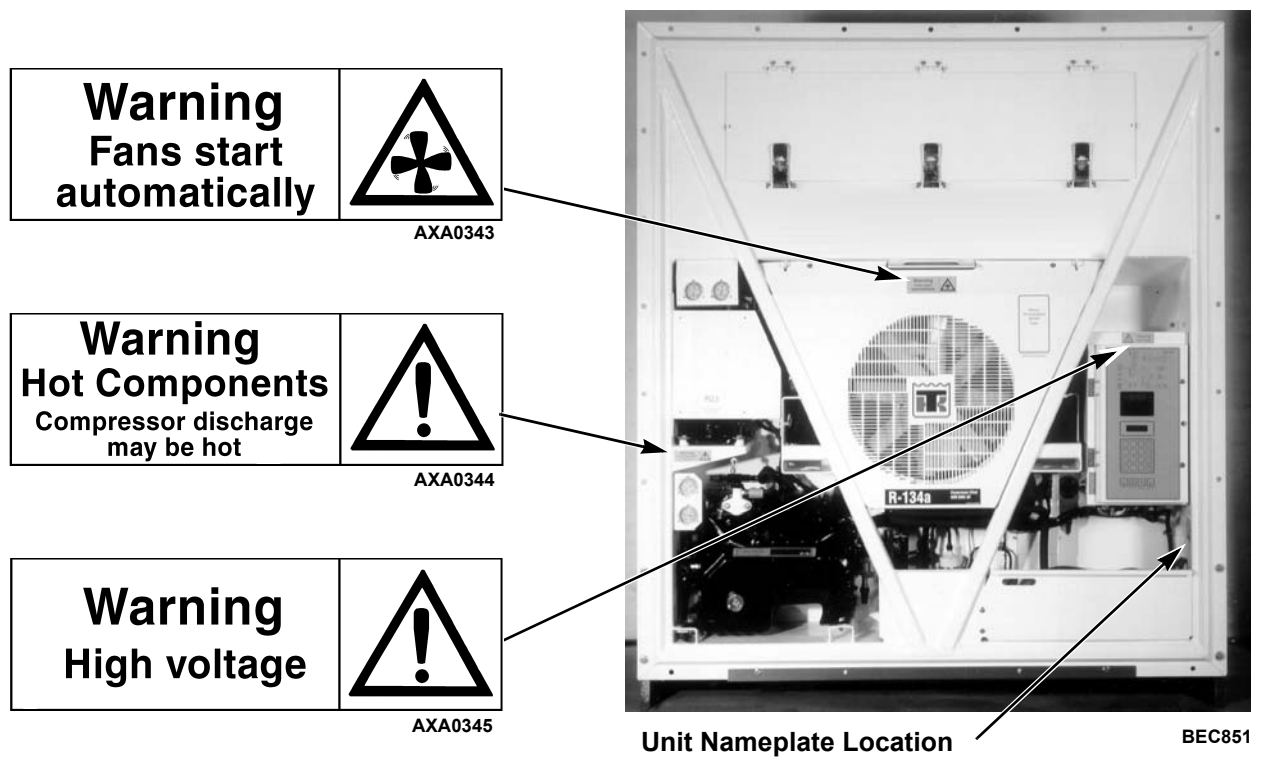


Figure 1: Unit Nameplate and Decal Locations

Service Guide

Pre-Trip	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 rotation.
•	•	•	Visually inspect electrical contacts for damage or loose connections.
•	•	•	Visually inspect wire harnesses for damaged wires or connections.
	•	•	Download the datalogger and check data for correct logging.
		•	Check operation of protection shutdown circuits.
			Refrigeration
•	•	•	Check refrigerant charge on both the R-134a and R-23 refrigeration circuits.
•	•	•	Check for proper suction pressure on both the R-134a and R-23 refrigeration circuits.
•	•	•	Check compressor oil level in both the reciprocating and scroll compressors.
		•	Check compressor efficiency and pump down R-134a refrigeration system (only).
		•	Check discharge and suction pressures of both the R-134a and R-23 refrigeration circuits.
		•	Check dehydrator for a restriction or corrosion on both the R-134a and R-23 refrigeration circuits.
			Structural
•	•	•	Visually inspect unit for damaged, loose or broken parts.
•	•	•	Tighten unit, compressor and fan motor mounting bolts.
•	•	•	Check operation of vacuum valve.
	•	•	Clean entire unit including condenser and evaporator coils and defrost drains.

Specifications

Full Cool Operation Net Cooling Capacity*

Return air to evaporator coil inlet	460V, 3 Phase, 60 Hz Power				380V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW @460V	Watts	Kcal/hr	BTU/hr	kW @380V
-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

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**

External Static Pressure (water column)	460V, 3 Phase, 60 Hz Power		380V, 3 Phase, 50 Hz Power	
	Low Speed		Low Speed	
	m ³ /hr	ft ³ /min	m ³ /hr	ft ³ /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

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)*	
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

Compressor Model No.	ZM18K4E-TFD-N275, Hermetic Scroll
Refrigerant Charge	3.2 Kg (7.05 lb) R-23
Evacuated System	Charge to 1700 kPa, 17.00 bar, 247 psig
Add Partial Charge by Pressure	
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
-30 C (-22 F) Box, Unit Cooling:	High Side
	Low Side
-60 C (-76 F) Box, Unit Cooling:	High Side
	Low Side
High Pressure Cutout Switch	
Cutout	3250 ± 50 kPa, 32.5 ± 0.50 bar, 470 ± 7 psig
Cutin	2590 ± 250 kPa, 25.90 ± 2.5 bar, 375 ± 38 psig
High Pressure Relief Valve	
Relief Pressure	3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig
Reset	2758 kPa, 27.58 bar, 400 psig
Low Pressure Cutout Switch (MPC2000ID Units Only)	
Cutout	0 ± 20 kPa, 0.0 ± 0.2 bar, 6 in. vacuum to 3 psig
Cutin	70 ± 20 kPa, 0.7 ± 0.2 bar, 10 ± 3 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

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 Speed 1725 rpm, Low Speed*
Full Load Amps (60 Hz) (Each)	1.4 amps — 460V, High Speed 0.5 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
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

Temperature Controller:	
CRR-40 DF MPC2000	MPC2000 microprocessor
CRR-40 DF MPC2000ID	MPC2000ID microprocessor
CRR-40 DF MP3000	MP3000 microprocessor
Description	MPC2000, MPC2000ID and MP3000 microprocessors include thermostat, digital thermometer, programming keypad, mode indicators, LED display and LCD display for displaying unit operating and cargo information. MPC2000ID microprocessor includes an integral datalogger. Data logger is furnished separately on units equipped with MPC2000 and 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

Base Unit Weight (net):	
CRR-40 DF MPC2000	610 Kg (1344 lb)
CRR-40 DF MPC2000ID	610 Kg (1344 lb)
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

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 Chart

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

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

*HH = Hex Head, CL = Class.

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 460-380V power cable into the proper power supply.

Each unit is equipped with 460-380V/3 Ph/60-50 Hz electric motors. An automatic phase correction system provides the proper electrical phase sequence for condenser fan and evaporator fan motor operation. Unit power cable is stored below the control box in the condenser section.

CRR DF MPC2000 units feature MPC2000 microprocessor controller and a MPC2000 Datalogger. CRR DF MP3000 units feature MP3000 microprocessor controller and a MP3000 Datalogger. CRR DF MPC2000ID units feature a MPC2000ID microprocessor controller with integral 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

MPC2000, MPC2000ID and MP3000 controllers incorporate refrigeration system component control, thermostat, digital thermometer and fault indication capabilities into one self-contained package. Units with a MPC2000 or MP3000 controller are also equipped with a separate datalogger while the MPC2000ID controller includes an integral 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 MPC2000, MPC2000ID or 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 MPC2000 or MP3000 controller are also equipped with a separate datalogger. The MPC2000ID controller includes an integral 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. MPC2000 or MP3000 data recordings are stored in a RAM memory that is backed by battery. MPC2000ID data recording are stored in a permanent Flash RAM memory.

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.

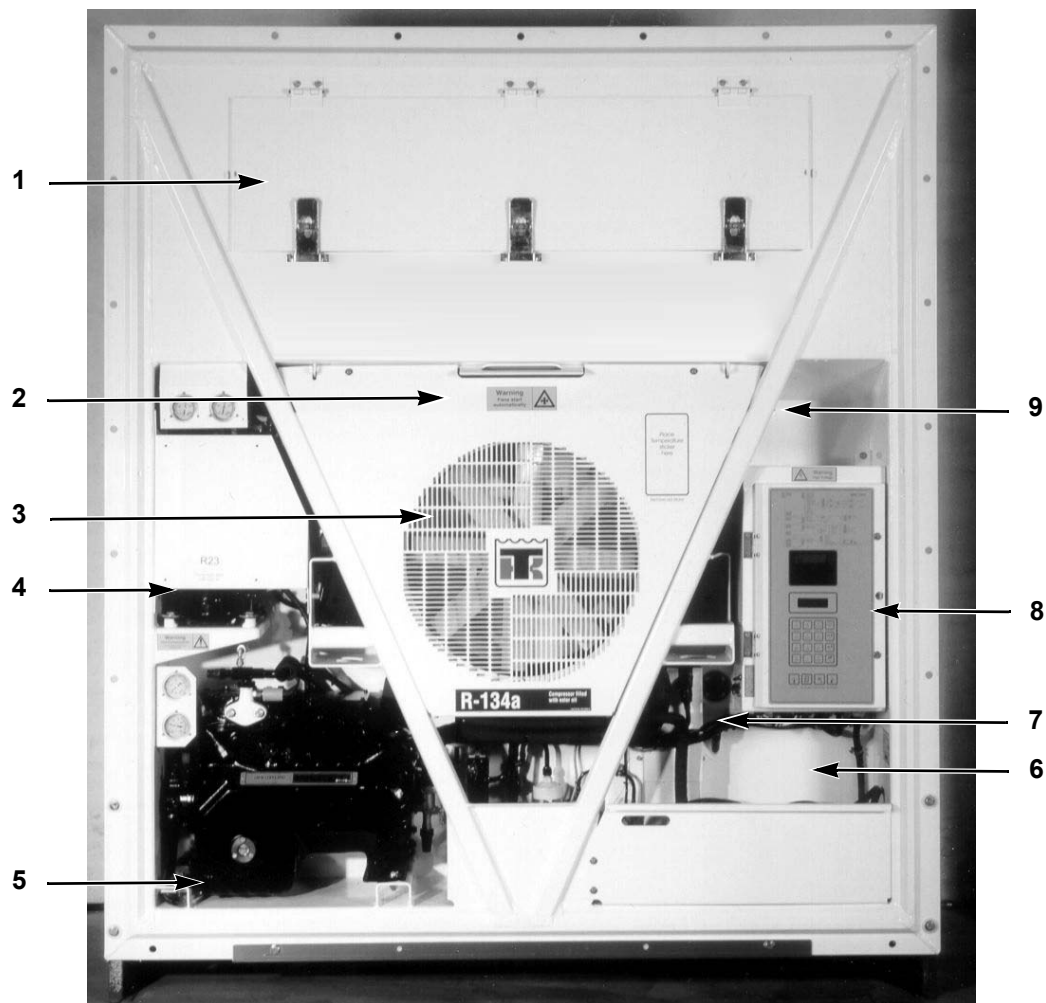
Frozen Loads

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).



BEC851

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		

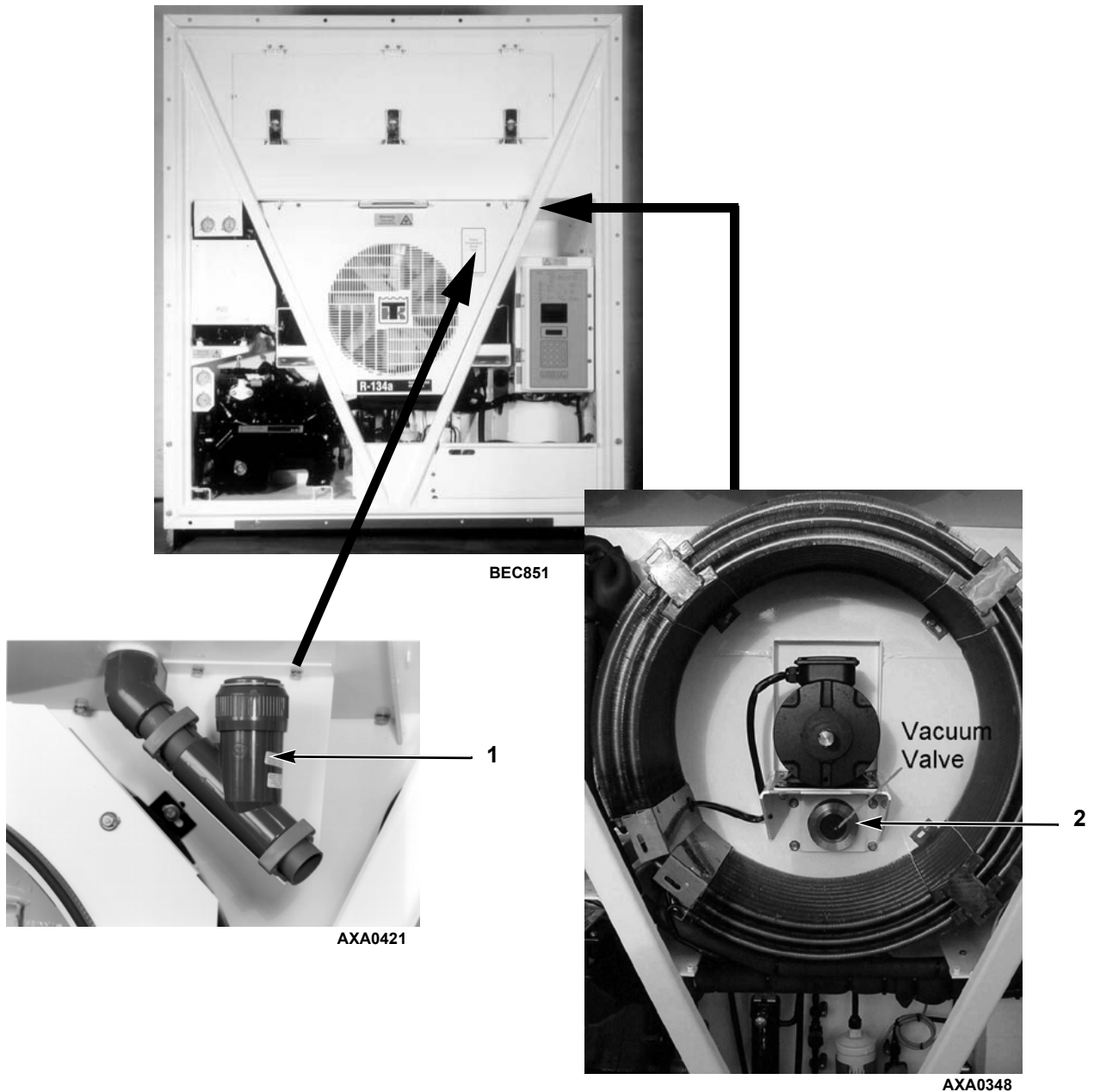
Figure 2: Unit Front View



AXA0347

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: Evaporator Section — Front View



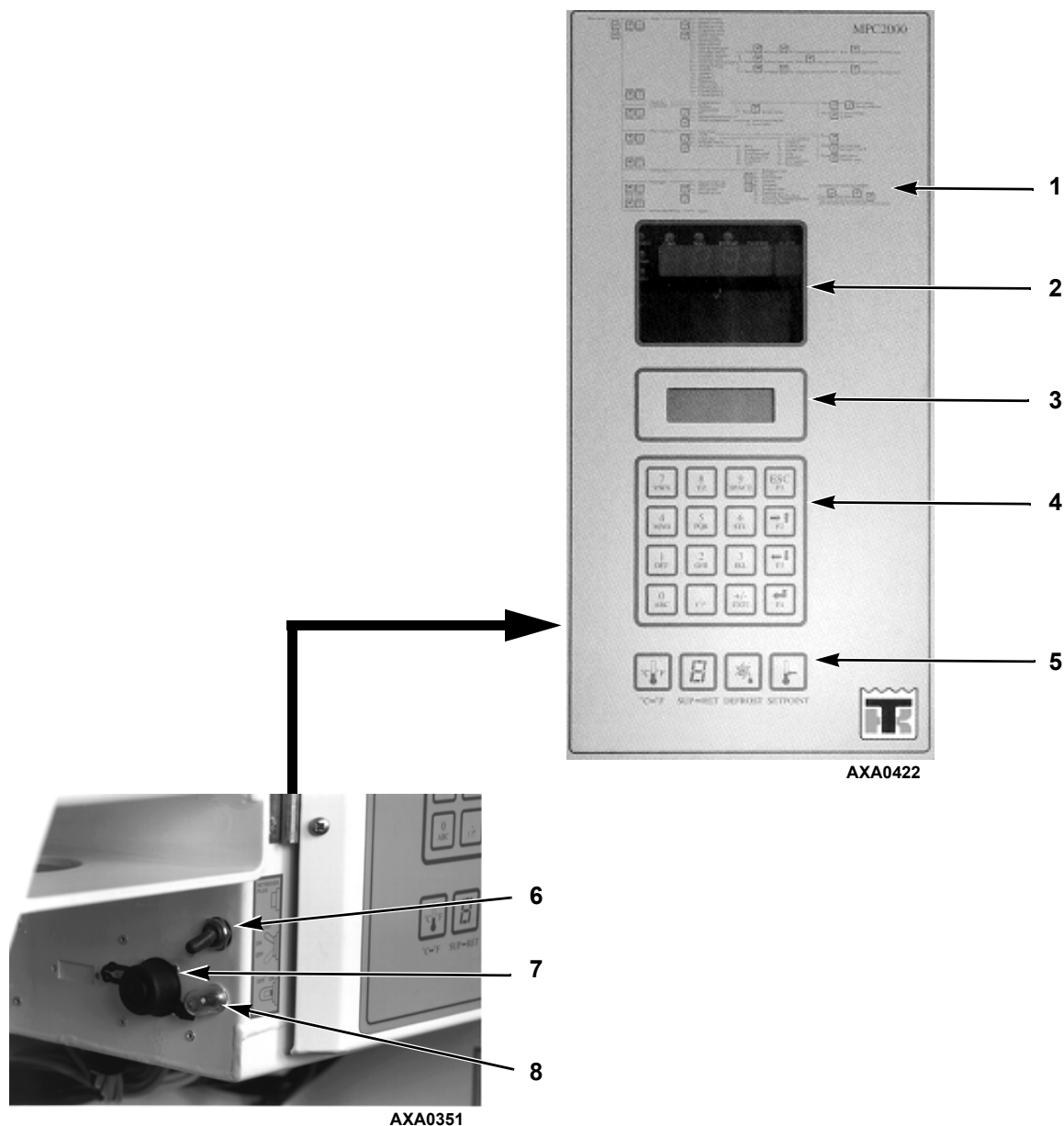
1.	Vacuum Valve (located behind condenser grille cover), earlier
2.	Vacuum Valve (located behind condenser grille cover), current

Figure 4: Vacuum Valve



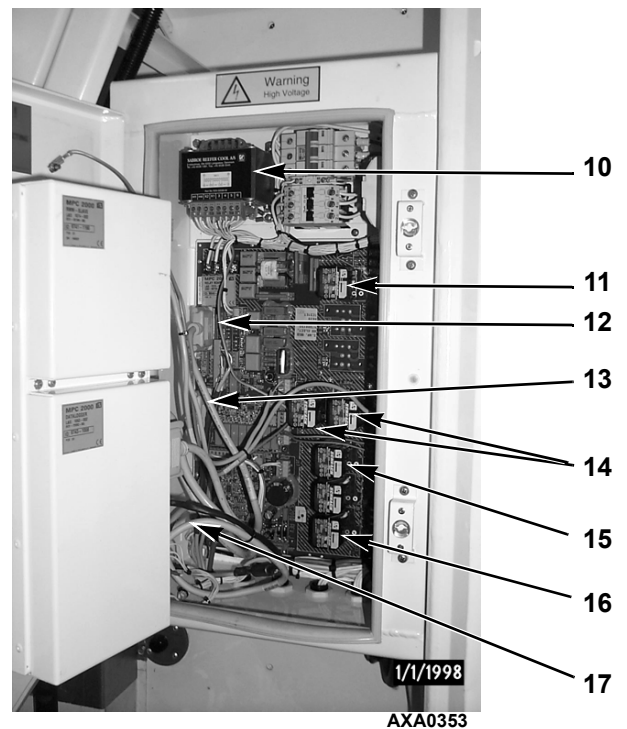
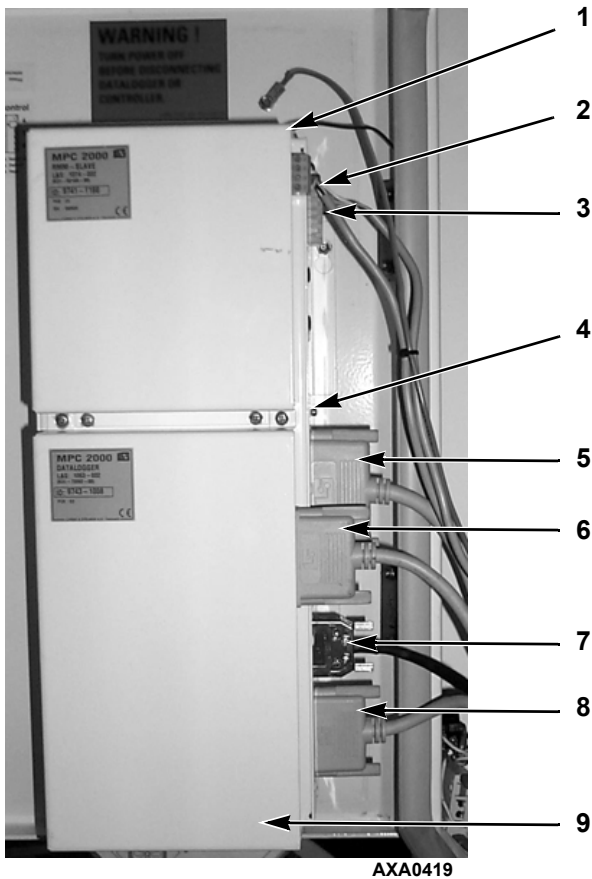
1.	Control Box	4.	Ambient Sensor Location
2.	Thermometer Sampling Port	5.	Power Plug and Cord
3.	Supply Air Sensor Probe Holder		

Figure 5: Power Cord Storage Compartment



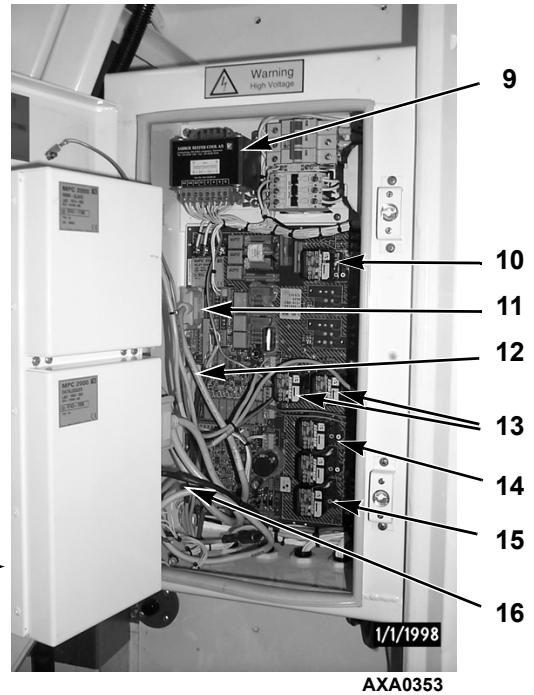
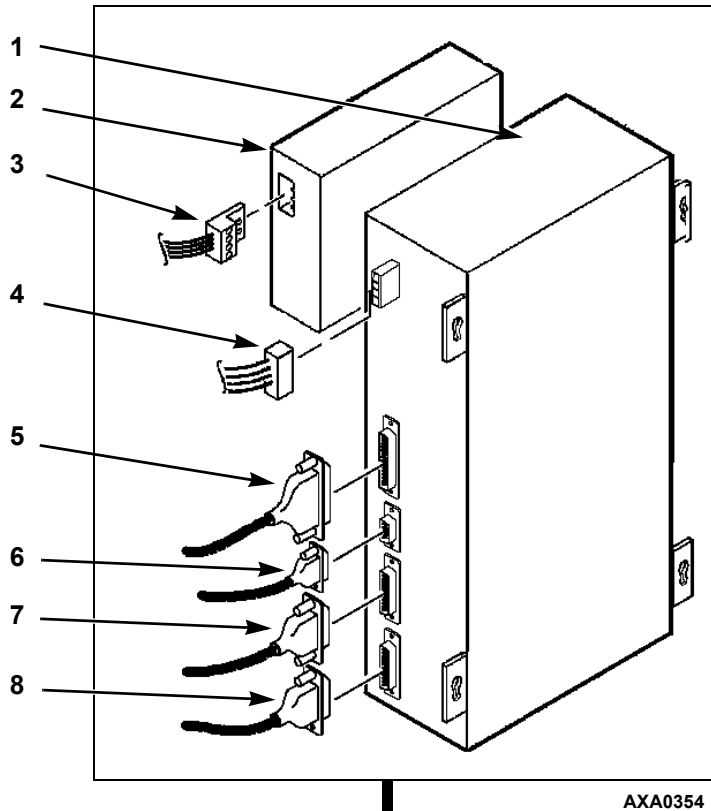
1.	MPC2000, MPC2000ID or MP3000 Controller	5.	Special Function Keypad
2.	LED Display (Return or Supply Air Temperature Display and Status Indicator LEDs)	6.	Unit On/Off Switch
3.	LCD Display (Setpoint Temperature, Message and Controller Main Menu Tree Display)	7.	Communications Connector for Data Retrieval
4.	General Purpose Keypad	8.	Circuit Breaker

Figure 6: Control Box and Microprocessor Controller



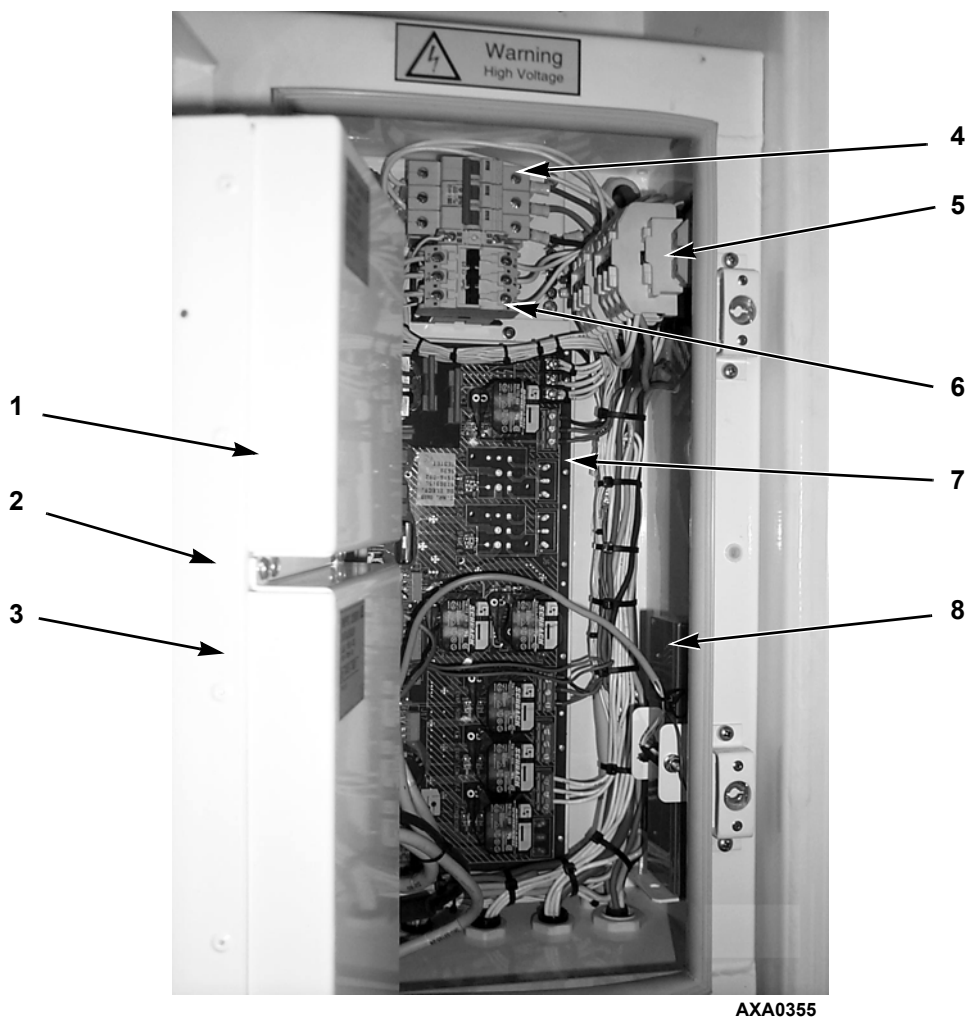
1.	Remote Monitoring Modem	10.	Control Power Transformer (28 Vac, 29 Vac, 40 Vac)
2.	RMM Connection Cable	11.	Heat Relay
3.	Battery Cable Connection to Controller	12.	Datalogger Cable Connection to Main Relay Board
4.	MPC2000 or MP3000 Controller	13.	Cable No. 2 Connection to Main Relay Board
5.	Cable No. 2 Connection to Controller	14.	Phase Sensor Relays
6.	Datalogger Cable Connection to Datalogger	15.	Evaporator Fan Relay – Low Speed
7.	Download Cable Connection to Controller	16.	Condenser Fan Relay
8.	Cable No. 1 Connection to Controller	17.	Cable No. 1 Connection to Main Relay Board
9.	MPC2000 Datalogger		

Figure 7: MPC2000 or MP3000 Controller and Remote Monitoring Modem



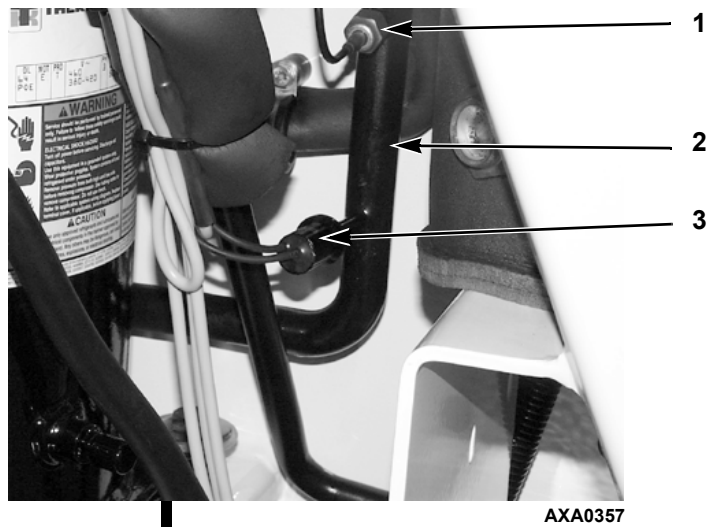
1.	MPC2000ID or MP3000 Controller with Integral Datalogger	9.	Control Power Transformer (28 Vac, 29 Vac, 40 Vac)
2.	Remote Monitoring Modem	10.	Heat Relay
3.	RMM Connection Cable	11.	Cable No. 3 Connection to Main Relay Board
4.	Battery Cable Connection to Controller	12.	Cable No. 2 Connection to Main 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: MPC2000ID and MP3000 Controller, and Remote Monitoring Modem



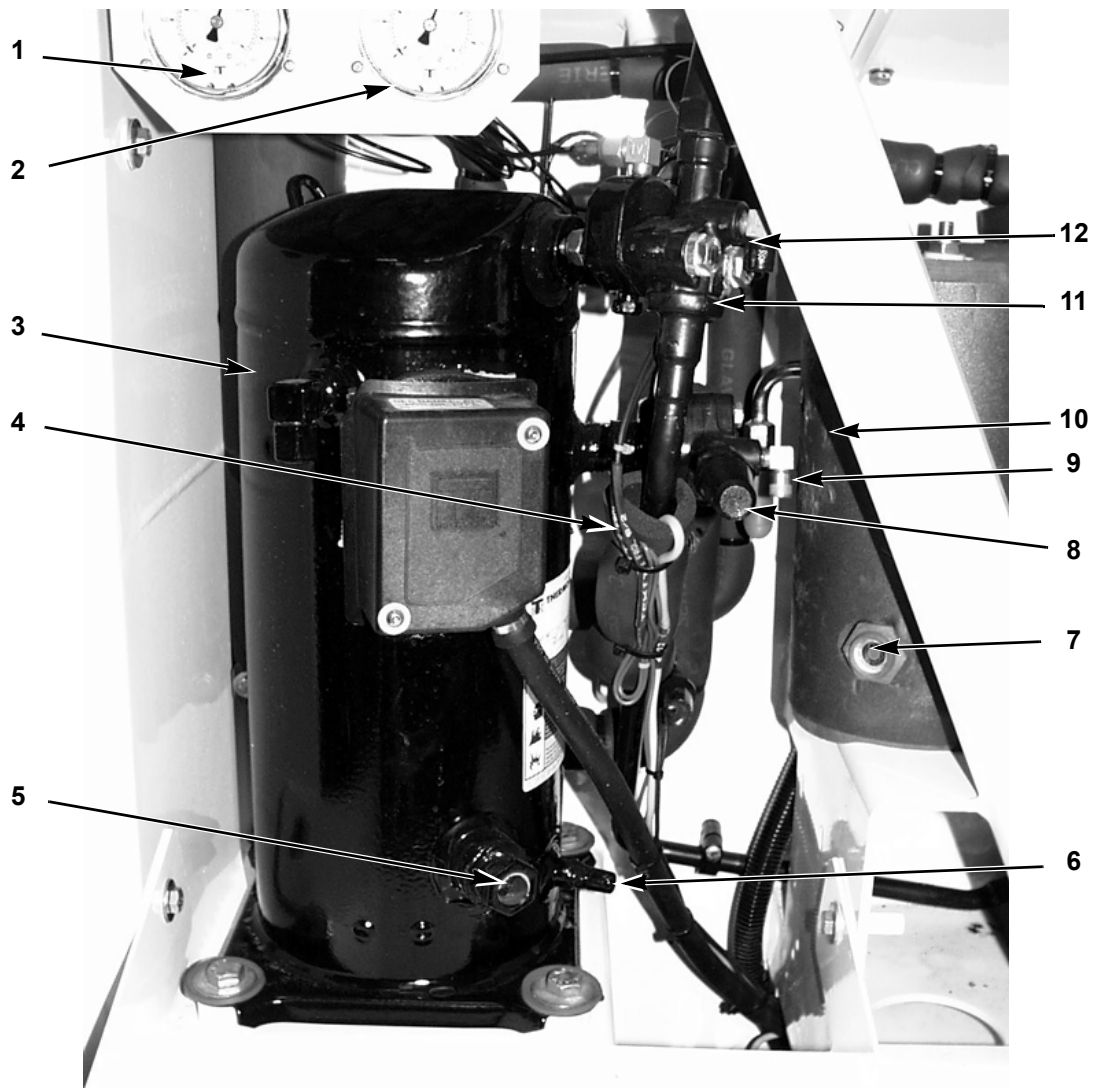
1.	Remote Monitoring Modem	5.	R-23 Scroll Compressor Contactors (2)
2.	MPC2000, MPC2000ID or MP3000 Controller	6.	R-134a Compressor Contactor
3.	Datalogger (CRR DF MPC2000 only)	7.	Main Relay Board
4.	32 Ampere Main Power Circuit Breaker	8.	12 Vdc Battery

Figure 9: Unit Control Box with Door Open



1.	R-23 Suction Pressure Gauge Line Connection	3.	Low Pressure Cutout Switch (CRR DF MPC2000ID Units Only)
2.	R-23 Suction Line		

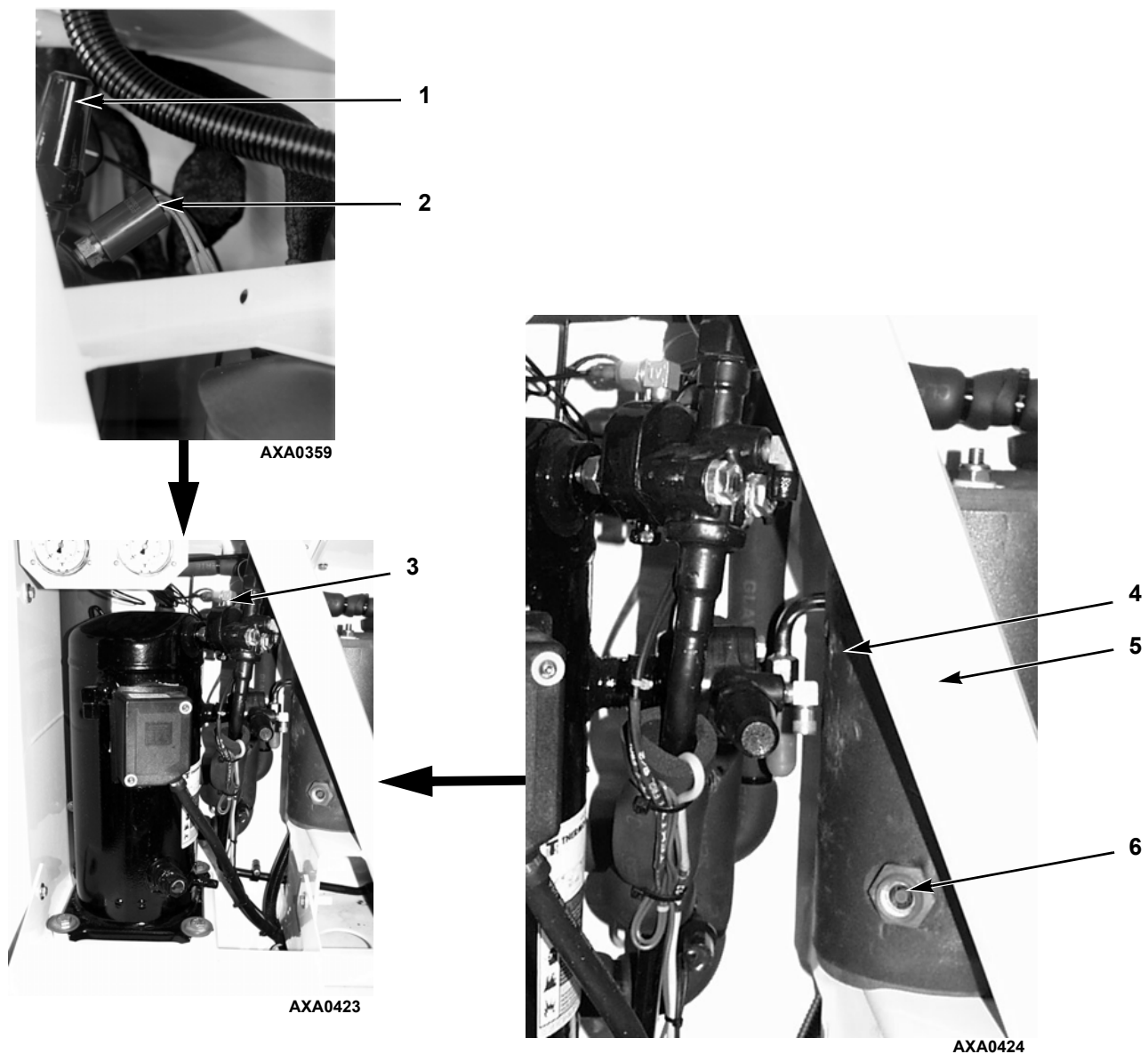
Figure 10: Low Pressure Cutout Switch in R-23 Refrigeration System (CRR DF MPC2000ID Units Only)



AXA0423

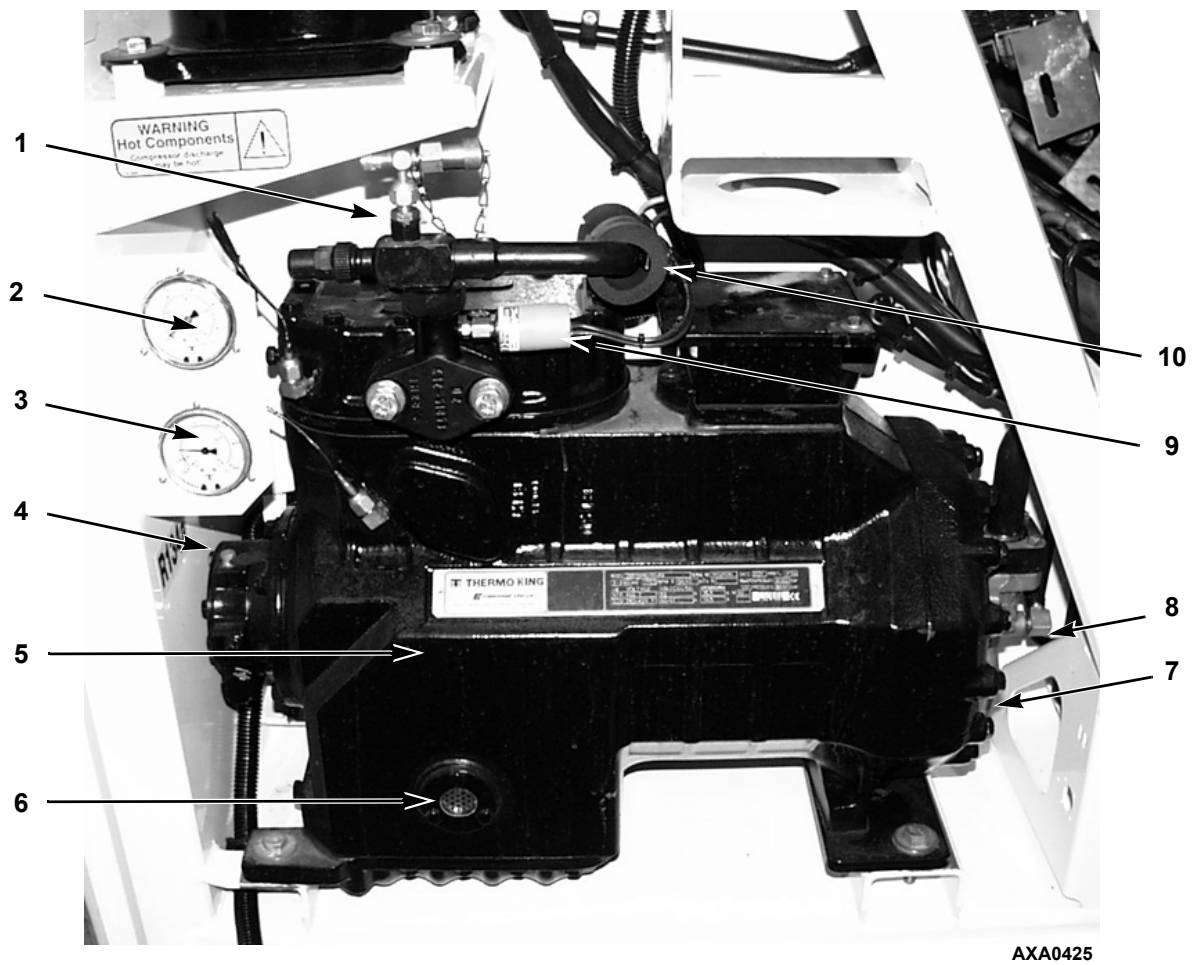
1.	R-23 Discharge Pressure Gauge	7.	R-23 Lower Receiver Tank Sight Glass
2.	R-23 Suction Pressure Gauge	8.	Suction Service Valve
3.	R-23 Scroll Compressor	9.	Suction Service Fitting
4.	Compressor Discharge Temperature Sensor	10.	R-23 Receiver Tank
5.	Compressor Oil Sight Glass	11.	Discharge Service Valve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

Figure 11: R-23 Compressor Compartment



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: Additional R-23 Refrigeration System Components



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: R-134a Compressor Compartment



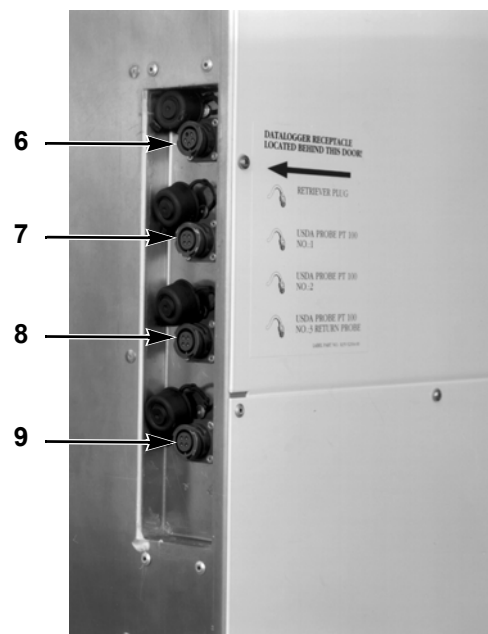
AXA0363

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: Additional R-134a Refrigeration System Components and Plate Heat Exchanger



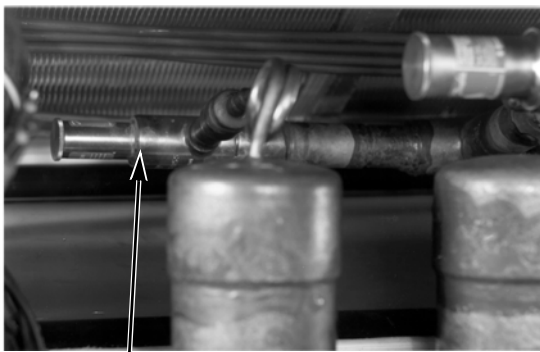
AXA0364



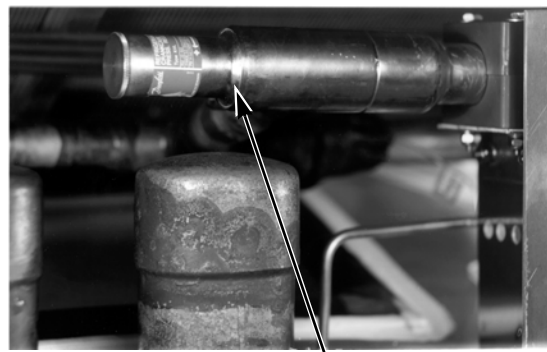
AXA0365

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		

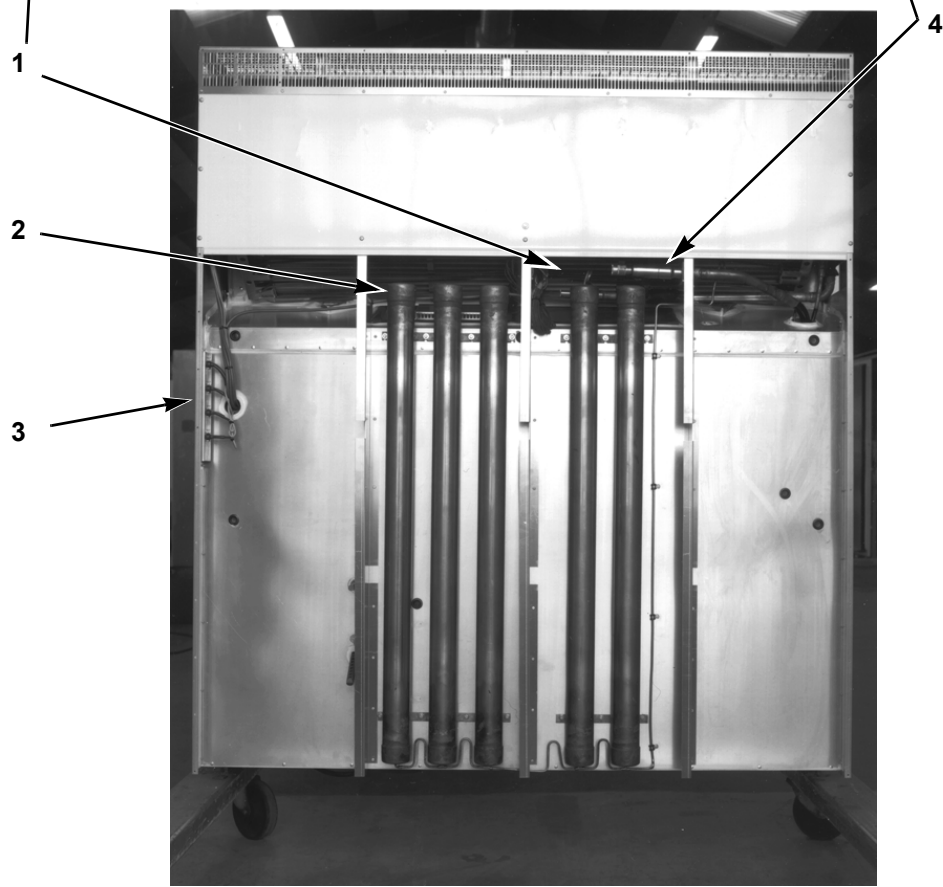
Figure 15: Unit Back View



AXA0366



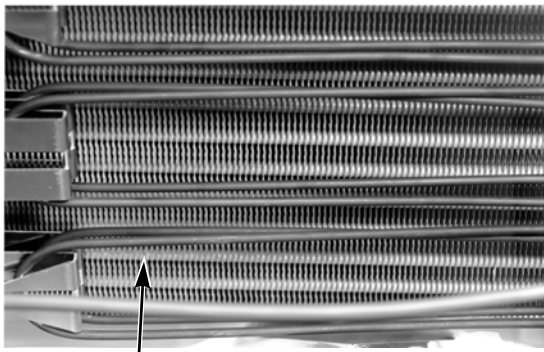
AXA0367



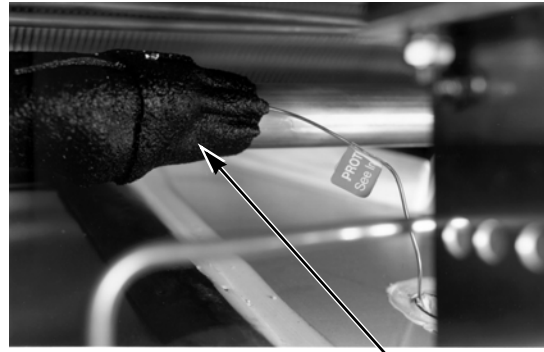
AXA0368

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)

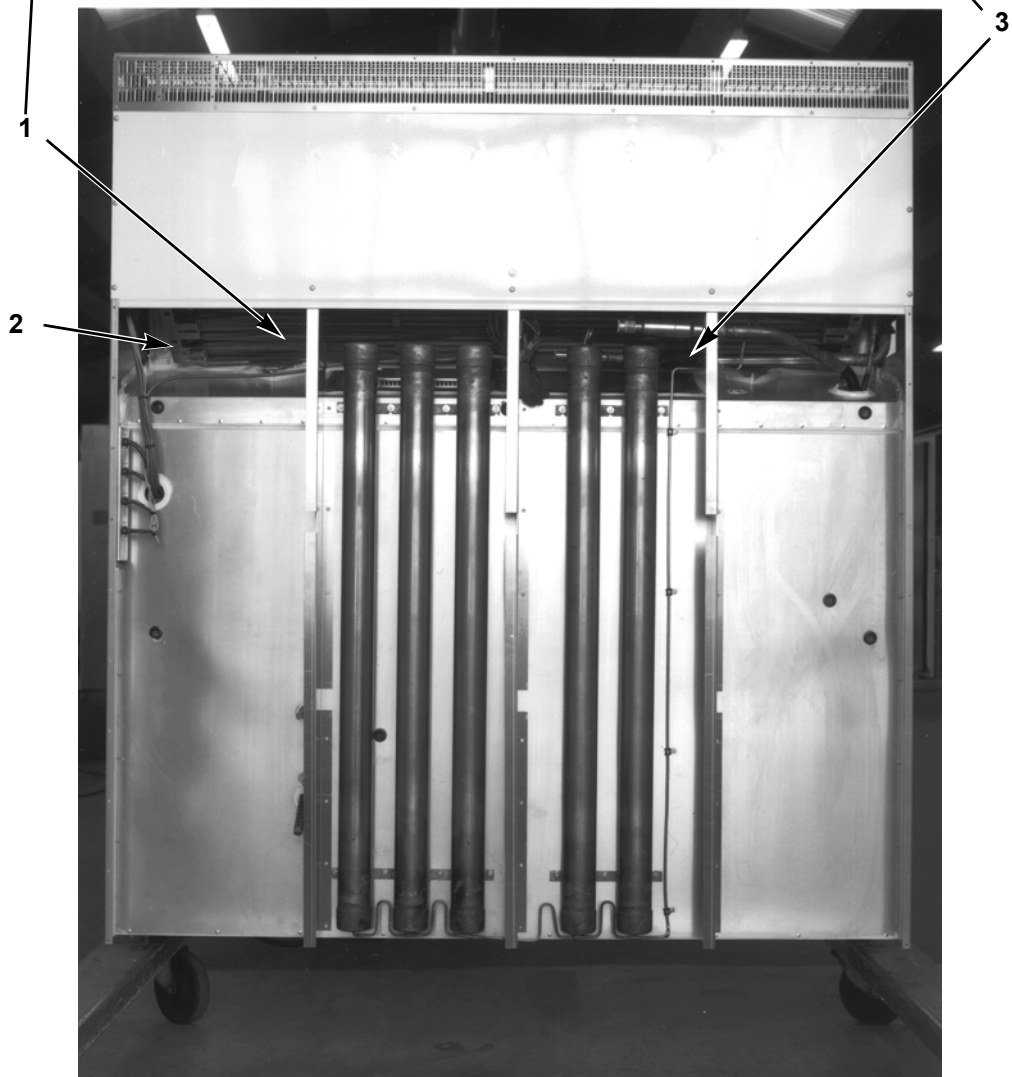
Figure 16: Unit Back View — Pressure Regulators and Buffer Tanks



AXA0369



AXA0370



AXA0368

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

Figure 17: Unit Back View — Electric Heaters and Evaporator Coil

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.

MPC2000, MPC2000ID or MP3000 Controller

A MPC2000, MPC2000ID or 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.

Other

Evaporator Overheat Switch: A temperature switch near the evaporator coil opens to de-energize the heater contactor if the evaporator temperature reaches 54 C (130 F) during Defrost. The switch closes (resets) when the evaporator temperature decreases to 32 C (90 F).

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.

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.

Low Pressure Cutout (LPCO) Switch (CRR DF MPC2000ID Units Only): If the compressor suction pressure decreases to 0 ± 20 kPa, 0 ± 0.2 bar, 6 in. vacuum to 3 psig; the low pressure cutout opens:

- Both the R-23 compressor and R-134a compressor STOP immediately.
- Evaporator and condenser fans continue normal operation.
- R-23 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 70 ± 20 kPa, 0.7 ± 0.2 bar, 10 ± 3 psig.
- When R-23 low pressure switch resets, R-23 compressor restarts 30 seconds after R-134a compressor restarts.

NOTE: *If the low pressure cutout switch remains open, check R-23 system suction and discharge pressures. Then check for an obstruction or refrigerant leak in the low or high pressure side of the R-23 refrigeration system.*

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

Pretrip Inspection

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

1. Visually check the unit for physical damage.
2. Check the electrical connections in the unit control box, making sure they are fastened securely.
3. Check the conditions of wires and terminals. Repair or replace if necessary.
4. 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. 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: *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: 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 on units equipped with the MPC2000 or MPC2000ID controller, 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 occurs during 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: 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. Stop the unit by moving the On/Off switch to the OFF position.

Loading Procedure

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

Post Load Procedure

1. Make sure all doors are closed and locked.
2. Switch the Unit On/Off switch 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 to 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: *Supply power connections from the refrigeration unit to the power source must always be made with the refrigeration Unit On/Off switch and power supply On/Off switch in the OFF positions. Never attempt to start or stop the refrigeration unit with the unit power cable.*

1. Connect the unit power cord to proper power source:
 - 460/380V power cord to 460/380V, 60-50 Hz power source.
 - Turn the power supply On/Off switch ON.
2. Turn the 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 MPC2000, MPC2000ID or 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.

Microprocessor Controller

General Description

The MPC2000, MPC2000ID and MP3000 are advanced microprocessor controllers that have been specially developed for control and monitoring of refrigeration units. Each controller 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

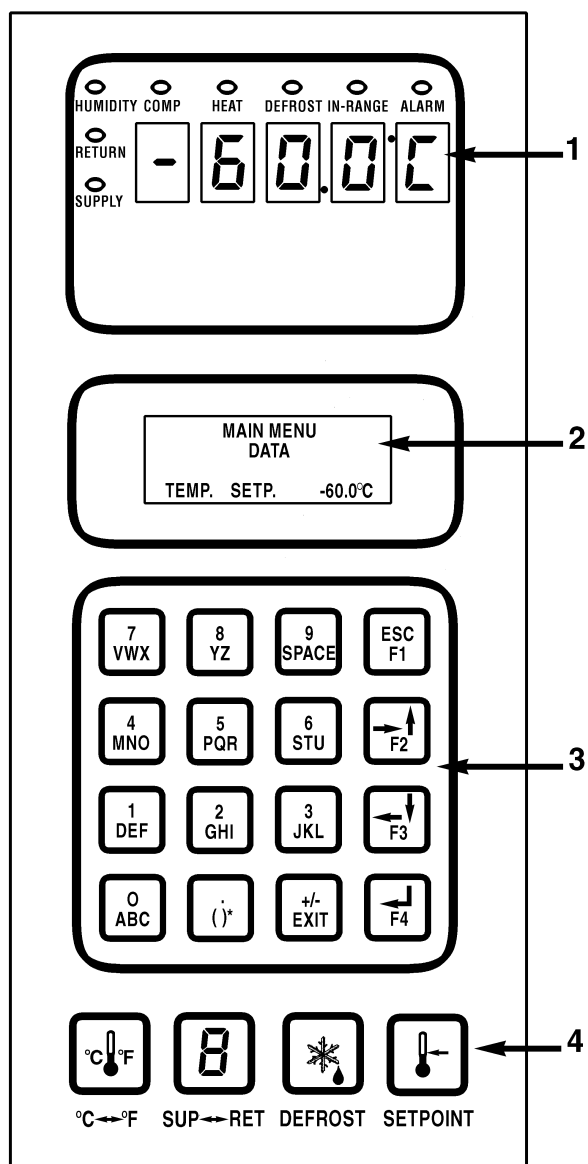
The indicator LEDs stay ON continuously to indicate sensor temperature display, unit operating mode or condition.

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

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).



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

Figure 18: MPC2000, MPC2000ID and MP3000 Controller

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

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 \pm 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 MPC2000 Datalogger and MPC2000ID Integral 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 MPC2000 or MPC2000ID 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 MPC2000 and MPC2000ID controllers use 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

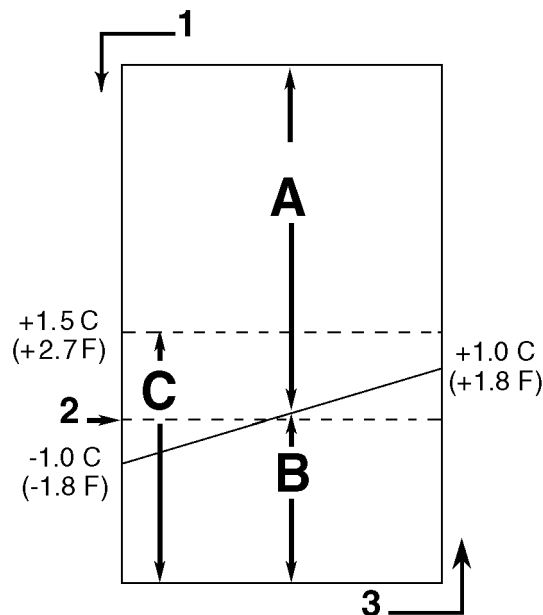
Unit Start-up

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.



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.	In-Range	3.	Increasing Temperature

Figure 19: Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)

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 (\pm) 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. Press F4 key for directly enter the Data menu. Menu items appear in LCD display.
2. Press F3 to scroll the cursor down through the menu list. The Data menu displays the following functions:
 - 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.
 - If the alarm condition is corrected, the Alarm LED will turn OFF and the alarm code disappears from the alarm list.

Viewing the Alarm List menu:

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

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

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

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

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

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

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: *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 MPC2000 Datalogger or MPC2000ID Integral Datalogger. 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

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

- 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.

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: 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.

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: <ul style="list-style-type: none"> • 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 High Activated 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: <ul style="list-style-type: none"> • 1.2 Amps approx. at 50 Hz, 1.6 Amps approx. at 60 Hz Amperes are recorded in PTI log. 	12, 13	10 Seconds

CRR Pretrip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.05	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

CRR Pretrip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
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 until 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:

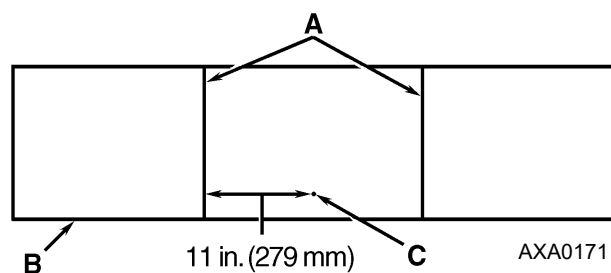
- Supply Air
- Return Air
- Evaporator Coil
- R-134a Compressor Discharge Line
- R-23 Compressor Discharge Line
- Ambient Air



CAUTION: *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.*



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

Figure 20: 3 Fan Evaporator: Evaporator (Defrost) Sensor Location

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

Resistance Values for R-134a or R-23 Compressor Discharge Line Sensor

Temp. °F	Temp. °C	OHMS	Temp. °F	Temp. °C	OHMS
118.4	48	36465	244.4	118	3229
122	50	33598	248	120	3047
125.6	52	30983	251.6	122	2877
129.2	54	28595	255.5	124	2718
132.8	56	26413	258.8	126	2569
136.4	58	24419	262.4	128	2430
140	60	22593	266	130	2299
143.6	62	20921	269.6	132	2176
147.2	64	19388	273.2	134	2118
150.8	66	17961	276.8	136	1953
154.4	68	16689	280.4	138	1852

1K Sensor Resistance Values for Supply, Return, Evaporator Coil and Air Sensors for MPC2000ID and 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

2K Sensor Resistance Values for Ambient Air Sensors for MPC2000ID and 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
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: *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: 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.

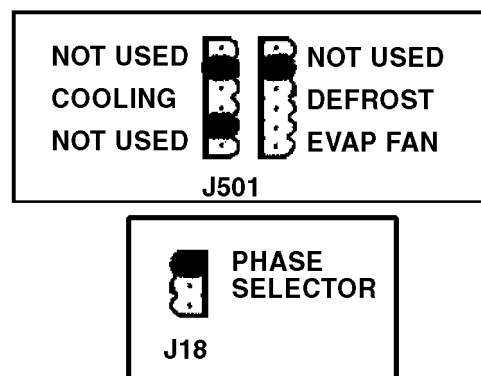


Figure 21: Manual Emergency Control Connections

Replacing the EPROM Chip (MPC2000 and MP3000 Only)

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: 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:
 - MPC2000 and MP3000 Controller: Remove the datalogger from the back of the controller by loosening the 4 screws.
 - MPC2000ID Controller: Remove 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: *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 (MPC2000 and MP3000 controller only) 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 (MPC2000 and MP3000 controller only) 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: *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: *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.

MPC 2000 ID / MP 3000, Super Freezer "Error message list"

#	Error Message	Controller Action
1	Power Error, Check 20A Fuses Indicates: <ul style="list-style-type: none"> One or more phases are missing Compressor is able to draw amps on all phases while heater lacks amps on one or more phases 	<ul style="list-style-type: none"> Controller activates alarm 18 Controller will try to restart unit after 60 minutes.
10	Cond probe found, please change type Indicates: <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> None. On CRR40 DF units, condenser sensor input must be left open.
11	Scroll Compressor, High Temperature Indicates: <ul style="list-style-type: none"> Compressor stops because discharge temperature is above 140 c (284 F). Message remains in display until discharge temperature decreases to normal. 	<ul style="list-style-type: none"> Controller clears message after compressor start up.
12	Scroll Compressor, Low Pressure Indicates: <ul style="list-style-type: none"> Low pressure cutout switch is open. Possible causes include stepper motor valve will not open, warm gas bypass valve wil not open, low refrigeratn charge, defective low pressure cutout switch, open circuit, etc. 	<ul style="list-style-type: none"> Controller activates Alarm 31 after 5 minutes. Controller clears message after compressor start up.
13	R134a Compressor, High Temperature Indicates: <ul style="list-style-type: none"> Compressor stops because discharge temperature is above 130 C (266 F). Compressor remains Off until discharge temperature decreases to 90 C (194 F) 	<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Controller clears message when high temperature switch closes. NO alarm is set until Controller determines that heater current draw is too high (alarm 10), unit current draw is too high (alarm 36), or defrost time is too long (alarm 20).
15	R134a Compressor Fault <ul style="list-style-type: none"> Feedback from 134a Compressor is Missing 	<ul style="list-style-type: none"> Check to be certain 134a compressor is running Check continuity through 134a auxiliary contactor on Main Relay Board plug J12.

Alarm Codes, Descriptions and Corrective Actions

NOTE: NOTE: Sensors used with the MPC2000, MPC2000ID and 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).

Code	Description	Corrective Action
00	Supply Air Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -80 C (-112 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 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) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 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) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -80 C (-112 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective controller 	<ul style="list-style-type: none"> • 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.

Code	Description	Corrective Action
03	Return Air Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 1000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
04	Evaporator Coil Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance higher than 100,000 ohms. • Temperature below -80 C (-112 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller • Low evaporator coil temperature 	<ul style="list-style-type: none"> • Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 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) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 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.
06*	R-134 Compressor Current Too High (Check Alarm) <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) only. • Compressor power consumption is higher than approximately 13 amps. • Indicates: <ul style="list-style-type: none"> • Defective compressor or valve plate • Defective volt or amp meter on relay board • Inaccurate ambient temperature measurement • Out of range power supply 	<ul style="list-style-type: none"> • 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.

Code	Description	Corrective Action
07*	R-134 Compressor Current Too Low (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Compressor power consumption is higher than approximately 7 amps. Indicates: <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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.
<p>*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.</p>		
10*	Heater Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Heater power consumption is higher than approximately 9 amps and lower than 13 amps. Indicates: <ul style="list-style-type: none"> Incorrect heaters or heater connections Defective volt or amp meter on relay board Defective heater element 	<ul style="list-style-type: none"> 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).
11*	Heater Current Too Low (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Heater power consumption is lower than approximately 6 to 9 amps, depending on voltage. Indicates: <ul style="list-style-type: none"> Incorrect heaters or heater connections Defective heater elements or heat relay Defective wire connections Defective high evaporator temperature switch 	<ul style="list-style-type: none"> 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).
<p>*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.</p>		

Code	Description	Corrective Action
14*	Evaporator Fan Low Speed Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Evaporator fan power consumption is higher than approximately 2.6 to 2.9 amps, depending on voltage. Indicates: <ul style="list-style-type: none"> Defective or stuck evaporator fan motor Incorrect motor or motor connections Motor high and low speed connection are interchanged Defective volt or amp meter on relay board 	<ul style="list-style-type: none"> Open evaporator door and make sure all fans rotate freely. 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) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Evaporator fan power consumption is lower than approximately 1.0 to 1.2 amps, depending on voltage. Indicates: <ul style="list-style-type: none"> Defective evaporator fan motor relay Defective or open fan motor internal over temperature protection switch Defective volt or amp meter on relay board Incorrect motor or motor connections 	<ul style="list-style-type: none"> Open evaporator door and make sure all fans rotate freely. 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.
<p>*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).</p>		

Code	Description	Corrective Action
16*	Condenser Fan Current Too High (Check Alarm) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Condenser fan power consumption is higher than approximately 1.25 amps, depending on voltage Indicates: <ul style="list-style-type: none"> Defective or stuck condenser fan motor Defective volt or amp meter on relay board Incorrect motor or motor connections 	<ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> Occurs during Pretrip (PTI) only. Condenser fan power consumption is lower than approximately 0.7 amps, depending on voltage). Indicates: <ul style="list-style-type: none"> Defective condenser fan motor relay Defective or open fan motor internal over temperature protection switch Defective volt or amp meter on relay board 	<ul style="list-style-type: none"> 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.
18	Power Supply Phase Error (Log Alarm) <ul style="list-style-type: none"> One or more frequency inputs are missing for more than 20 seconds. Indicates: <ul style="list-style-type: none"> One phase on power line is missing Defective fuse on relay board Defective digital inputs on relay board 	<ul style="list-style-type: none"> Enter "Data" menu and view voltage reading on each phase. Check all fuses. Check cable No. 1 on relay board. 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).		

Code	Description	Corrective Action
19	Temperature Too Far from Setpoint (Check Alarm) <ul style="list-style-type: none"> After 80 minutes of operation, return air temperature is not in-range and does not approach setpoint by 0.1 C/hr. Indicates: <ul style="list-style-type: none"> Ice or frost on evaporator coil Low refrigerant charge Container air leakage (doors open) 	<ul style="list-style-type: none"> Press SUP/RET key to check supply and return air sensor temperatures. Compare temperatures to evaluate unit cooling capacity and performance. Temperature difference should be 4 C to 6 C. Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check refrigerant charge of R-23 and R-134a systems. <p>NOTE: This alarm can be activated if the supply or temperature does approach setpoint.</p>
20	Defrost Time Too Long (Check Alarm) <ul style="list-style-type: none"> Heat signal has been on for more than 90 minutes (120 minutes if power supply below 55 Hz) during Defrost. Indicates: <ul style="list-style-type: none"> Defective heater elements Defective heat relay Evaporator sensor placed wrong 	<ul style="list-style-type: none"> Initiate a manual defrost and check amperage draw and evaporator coil temperature. Evaluate defrost performance. Open evaporator door and check location of evaporator coil sensor. <p>NOTE: This alarm can be activated at low voltage and very low box temperature conditions, even under normal operating conditions.</p>
22	Capacity Test 1 Error (Check Alarm) <ul style="list-style-type: none"> Occurs during pre-trip (PTI) test only. Return air temperature does not reach -30 C (22 F) within 4 hours. Indicates: <ul style="list-style-type: none"> Incorrect refrigeration system operation Container door is open Container is not empty Incorrect connection of return air sensor 	<ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> Occurs during pre-trip (PTI) test only. Return air temperature does not reach -55 C (-67 F) within 6 hours. Indicates: <ul style="list-style-type: none"> Incorrect refrigeration system operation Container door is open Container is not empty Incorrect connection of return air sensor 	<ul style="list-style-type: none"> 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.

Code	Description	Corrective Action
34	Ambient Air Sensor Open Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance is higher than 100,000 ohms. • Temperature is below -70 C (-94 F). • Indicates: <ul style="list-style-type: none"> • Open circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 1,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
35	Ambient Air Sensor Short Circuit (Check Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance is lower than 200 ohms. • Temperature is above 80 C (176 F). • Indicates: <ul style="list-style-type: none"> • Short circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 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) <ul style="list-style-type: none"> • Return air temperature increases above 35 C (95 F) during defrost. • Indicates: <ul style="list-style-type: none"> • Defective return air or evaporator coil sensor • Return air and evaporator coil sensor connections are reversed 	<ul style="list-style-type: none"> • Check for sensor alarm codes. • Check supply and return sensor connections and locations.
52	Probe Error (Check Alarm) <ul style="list-style-type: none"> • Occurs during Pretrip (PTI) test only. • Temperature difference between supply air, • return air or evaporator coil sensor is too high (3 C maximum) • Indicates: <ul style="list-style-type: none"> • Indication error on one of the sensors • Supply air sensor not placed in airflow stream 	<ul style="list-style-type: none"> • Check sensor connections. Check sensor resistance of each sensor. Resistance must be 1,000 ohms at 25 C (77 F). • Check supply air sensor locations.

Code	Description	Corrective Action
56	Compressor Temperature Too High (Shutdown Alarm) <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Air in refrigeration system Low refrigerant charge in R-134a system R-134a Only: Defective compressor or valve plate Wrong or defective sensor 	<ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Defective relay board Defective relay board cable No. 2 Defective phase relay 	<ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> Power consumption is More than 50% above or below (Min 0,8 Amp). Indicates: <ul style="list-style-type: none"> Open connection on one phase of power supply to a 3-phase unit component including R-134a compressor or R-23 compressor. 	<ul style="list-style-type: none"> 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.
97	Compressor Sensor Open Circuit (Log Alarm) <ul style="list-style-type: none"> Sensor circuit resistance is higher than 10,000,000 ohms on R-134a or R-23 compressor. Temperature below -30 C (-22 F). Indicates: <ul style="list-style-type: none"> Open circuit to sensor Defective or wrong sensor Defective relay board Defective cable No. 1 Defective controller 	<ul style="list-style-type: none"> Check sensor resistance between pins 9 and 10 on plug J15 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. <p>NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.</p>

Code	Description	Corrective Action
98	Compressor Sensor Short Circuit (Log Alarm) <ul style="list-style-type: none"> • Sensor circuit resistance lower than 200 ohms. • Temperature above 180 C (356 F). • Indicates: <ul style="list-style-type: none"> • Short circuit to sensor • Defective or wrong sensor • Defective relay board • Defective cable No. 1 • Defective controller 	<ul style="list-style-type: none"> • Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F). • Check cable No. 1 between controller and relay board.
112	Zero Current Too High (Check Alarm) <ul style="list-style-type: none"> • Ground (zero current) circuit 30 milliamps. • Indicates: <ul style="list-style-type: none"> • Defective motor or heater insulation to ground 	<ul style="list-style-type: none"> • Start "Manual Function Test" and operate each motor and heater separately. Note when alarm occurs.

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.

Condenser Fan and Evaporator Fan Rotation

NOTE: *If both the condenser fan and evaporator fans are rotating backwards, diagnose the automatic phase selection system for Alarm Code 18.*

Condenser Fan

Check for proper condenser fan rotation by placing a small cloth or sheet of paper against the condenser fan grille on the front of the unit. Proper rotation will blow the cloth or paper away from the grille. Improper rotation will hold the cloth or paper against the grille.

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

Evaporator Fans

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

If an evaporator fans rotate backwards, 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.)

Electric Heaters

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

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

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

Low Pressure Cutout Switch (R-23 System on CRR DF MPC2000ID Units Only)

A low pressure cutout switch is located on the R-23 compressor suction line. If the R-23 suction pressure becomes too low, the switch opens to stop both compressors:

- LCD Display Message: R-23 Low Pressure Cutout.
- Evaporator and condenser fans continue normal operation.
- R-134a 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 70 ± 20 kPa, 0.7 ± 0.2 bar, 10 ± 3 psig.
- When R-23 low pressure switch resets, R-23 compressor restarts 30 seconds after R-134a compressor restarts.

Low Pressure Cutout Switch:

Opens: 0 ± 20 kPa, 0 ± 0.2 bar, 6 in. vacuum to 3 Psig

Closes: 70 ± 20 kPa, 0.7 ± 0.2 bar, 10 ± 3 Psig

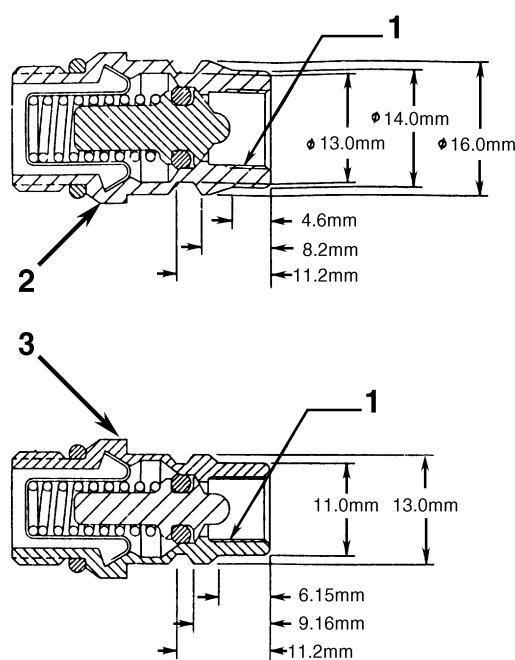
If the low pressure cutout switch is suspected of being defective, replace it with a known good switch.

Refrigeration Maintenance and Service Operations

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

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

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



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

Figure 22: R-134a Service Fittings Specifications

Service Tools

CAUTION: R-134a and R-23 are HFC (Hydrofluoro-carbon) refrigerants. When servicing the CRR DF refrigeration systems, use only those service tools (i.e., vacuum pump, refrigerant recovery equipment, gauge hoses, and gauge manifold set) certified for and dedicated to HFC refrigerants and Polyol Ester based compressor oils. Residual non-HFC refrigerants or non-Ester based oils will contaminate HFC systems. Separate service tools should be dedicated to R-134a and R-23 refrigerant systems.

R-134a Service Fittings and Gauge Manifold Set

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

- Low side near the compressor suction service valve,

- High side near the compressor discharge service valve,
- High side on the receiver tank.

An R-134a gauge manifold set (P/N 204-758) should be dedicated for use with R-134a (HFC) refrigerant only.

Leak Detection

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

Vacuum Pump

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

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

System Cleanup

Cleanup devices such as suction line filters and compressor oil filters may be used if they are properly cleaned and new filters and cartridges are used. All standard petroleum and synthetic compressor oils must be removed to prevent the contamination of R-134a or R-23 refrigeration systems.

Refrigerant Recovery

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

Compressor Oil Acid Test

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

Compressor Discharge and Suction Service Valves

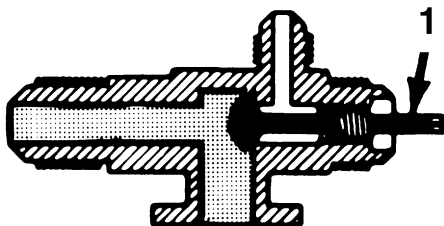
The discharge and suction valves isolate the compressor from the high and low sides of the refrigeration system for system diagnosis, service and repair.

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

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

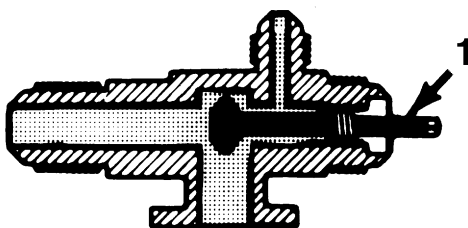


WARNING: Do not start unit with discharge valve in FRONT SEATED position.



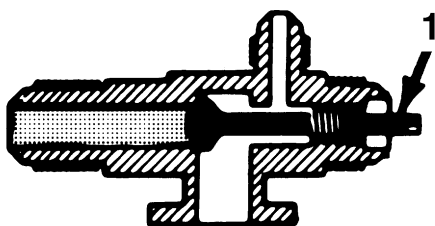
1.	Full Counterclockwise
----	-----------------------

Figure 23: Service Valve Back Seated



1.	1/2 Turn In
----	-------------

Figure 24: Service Valve Open to Port



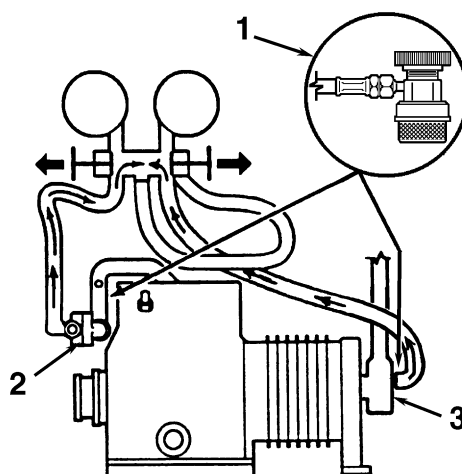
1.	Full Clockwise
----	----------------

Figure 25: Service Valve Front Seated

Gauge Manifold Valve Positions

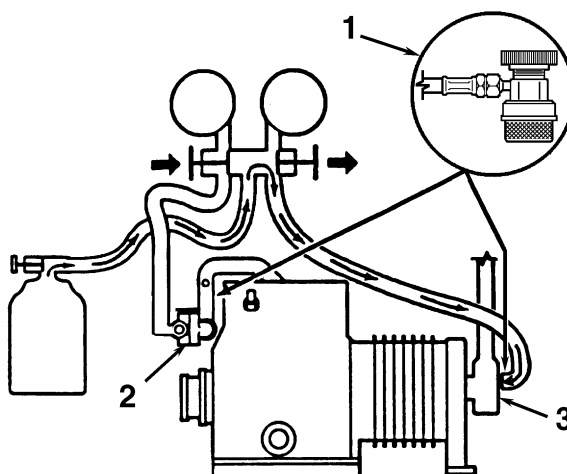
The gauges indicate low and high side pressures.

Operate one or both hand valves to perform the different service operations.



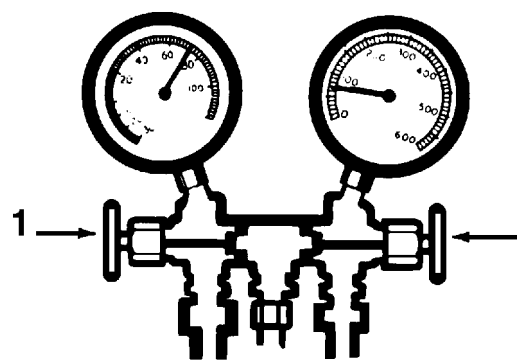
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

Figure 26: Balancing R-134a System Pressure



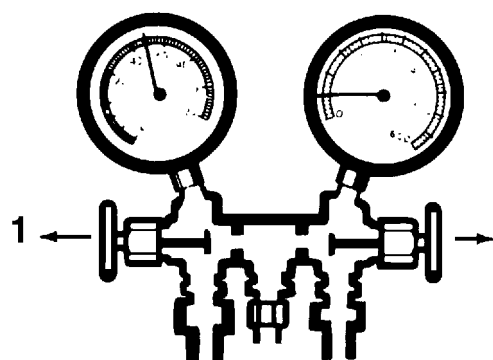
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

Figure 27: Charging the R-134a System



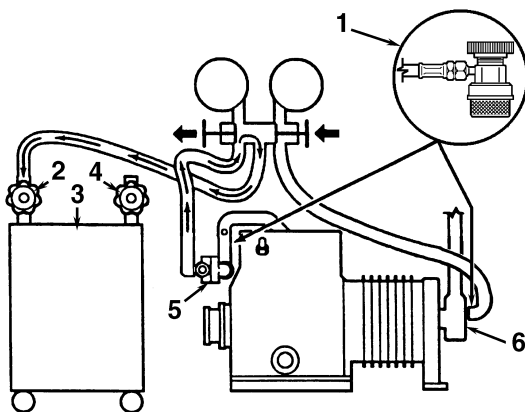
1.	Close Hand Valves
----	-------------------

Figure 28: Gauge Manifold Closed to Center Port



1.	Open Hand Valves
----	------------------

Figure 29: Gauge Manifold Open to Center Port



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

Figure 30: Removing R-134a Refrigerant

R-134a Gauge Manifold Set (With Low Loss Fittings) Attachment And Purging

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

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

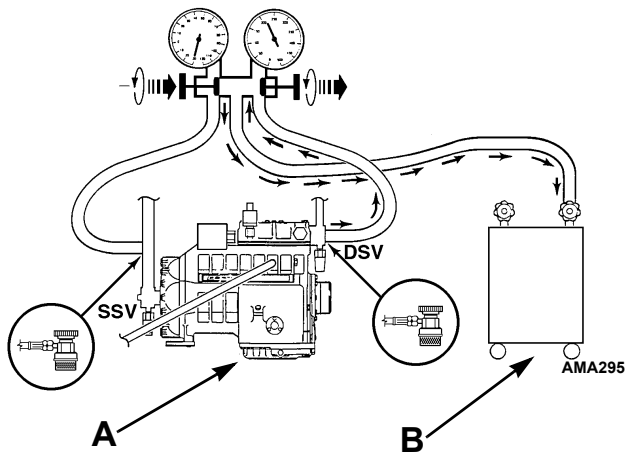
R-134a Gauge Manifold Set Installation

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



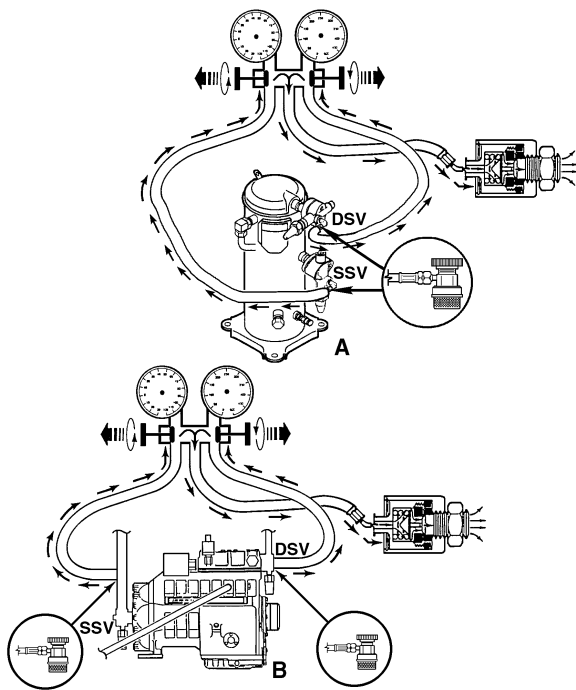
CAUTION: *Due to extremely high pressure in normal ambient, R23 cannot be reclaimed by use of reclaim station.*

1. Inspect gauge manifold for proper hose and fitting connections.
2. Clean dirt and moisture from around service ports.
3. Remove small service port caps from suction and discharge service fittings. Save and re-use the caps and sealing washers or gaskets.
4. Rotate both hose coupler hand wheels counterclockwise to back the stem out of the high and low hose fittings. Then attach low hose (compound gauge) to the suction line valve port.
5. With 69 kPa, 0.69 bar, 10 psig or greater pressure in the low side (unit operating on Cool), open the suction service manifold hand valve fully. Then rotate the suction hose fitting hand wheel clockwise to open (depress) the suction line port valve to the low hose.
6. Slowly screw a 1/2 inch ACME fitting into the low loss fitting on the manifold's service (center) line to purge the suction and service hoses. Remove ACME fitting after purging.
7. Close the suction service manifold hand valve fully to center port.
8. Attach high side hose (pressure gauge) to the discharge service line port.
9. Open discharge service manifold hand valve fully. Then rotate discharge fitting hand wheel clockwise to open (depress) discharge line port valve to the high hose.
10. Slowly screw a 1/2 inch ACME fitting into the manifold's service (center) line to purge the high and service hoses. Remove ACME fitting after purging.
11. Close discharge service manifold hand valve fully to center port. You are now ready to use the gauge manifold to check system pressures or perform MOST service procedures.



A.	R-134a Reciprocating Compressor
B.	Reclaimer
DSV = Discharge Service Valve	
SSV = Suction Service Valve	
NOTE: Use quick disconnect access valves on refrigerant hoses.	

Figure 31: Removing Refrigerant



A.	R-23 Scroll Compressor
B.	R-134a Reciprocating Compressor
DSV = Discharge Service Valve	
SSV = Suction Service Valve	
NOTE: Use quick disconnect access valves on refrigerant hoses.	

Figure 32: Purging Gauge Manifold

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

Gauge Manifold Set Removal

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

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

Service Procedure Guide

Scroll Compressor (R-23 Refrigeration System)

Procedure	Repair/Service Action
Reclaim Refrigerant	Open the high side of the refrigeration system.
Reclaim Refrigerant	Open the low side of the refrigeration system.

Reciprocating Compressor (R-134a Refrigeration System)

Procedure	Repair/Service Action
Reclaim Refrigerant	Open the high side of the refrigeration system.
Low Side Pump Down	Open the low side of the refrigeration system.

Typical R-23 and R-134a System Suction and Discharge Pressure Readings

Test Procedure

1. Operate unit in COOL for 10 minutes or more.
2. Maintain discharge pressure (shown in table below) for a 80-100 F (27-38 C) ambient temperature by covering the condenser coil.
3. Compare unit suction pressure with approximate expected reading (shown in table below).
4. A cool, moist line is normal. A frosted or abnormally dry line and out-of-range pressures indicate a problem in the refrigeration system.

NOTE: *Control condenser air flow to maintain condenser temperature (R-134a System) near a 27-38°C (80-100°F) ambient while reading discharge and suction pressures.*

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

R-23 Refrigeration System — Standby (Unit OFF) and Cool Operation

Container Temp.	Ambient Temp.	Suction Pressure	Discharge Pressure
Standby (Unit OFF, Empty box)	0 C (32 F)	1600 kPa 16.0 bar 232 psig	1600 kPa 16.0 bar 232 psig
	20 C (68 F)	1700 kPa 17.0 bar 247 psig	1700 kPa 17.0 bar 247 psig
	38 C (100 F)	1800 kPa 18.0 bar 261 psig	1800 kPa 18.0 bar 261 psig
Cooling: -30 C (-22 F)		250 - 280 kPa 2.5-2.8 bar 36 - 41 psig	2100 - 2300 kPa 21 - 23 bar 305 - 334 psig
Cooling: -60 C (-76 F)		900 - 1100 kPa .9 - 1.1 bar 13 - 16 psig	1400 - 1600 kPa 14 - 16 bar 203 - 232 psig

R-134a Refrigeration System — Cool Operation

Container Temp.	Ambient Temp.	Suction Pressure	Discharge Pressure
Standby (Unit OFF, Empty box)	0 to 38 C (32 to 100 F)	—	—
Cooling: -30 C (-22 F)	27 to 38 C (80 to 100 F)	60-90 kPa 0.6-0.9 bar 9-13 psig	1500-1800 kPa 15.0-18.0 bar 218-261 psig
Cooling: -60 C (-76 F)	27 to 38 C (80 to 100 F)	20-50 kPa 0.2-0.5 bar 3-7 psig	1380-1500 kPa 13.80-15.0 bar 200-218 psig

"= Inches of Hg Vacuum

Discharge Pressure Regulator Test and Adjustment

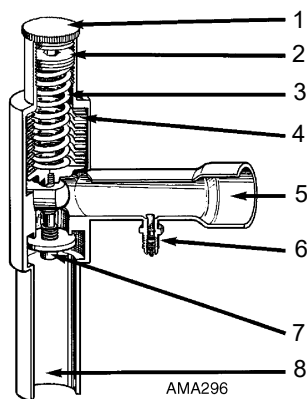
Regulators are preset at the factory and adjustment should not be required. If adjustment is necessary, use the following procedure:

Install a calibrated gauge manifold on the discharge service fitting downstream of the pressure regulator.

Operate in Cool for 10 minutes.

Read the valve setting on the gauge manifold. The correct setting is 280 kPa (2.8 bar; 41 psi).

Remove the protective cap. Use a hex key to turn adjustment screw in to increase or reduce the setting as necessary to achieve the correct setting.



1.	Protective cap	5.	Inlet
2.	Adjustment	6.	Fitting for checking upstream pressure (some models)
3.	Spring	7.	Seat
4.	Bellows	8.	Outlet

Figure 33: Discharge Pressure Regulator

Checking Compressor Oil



CAUTION:

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

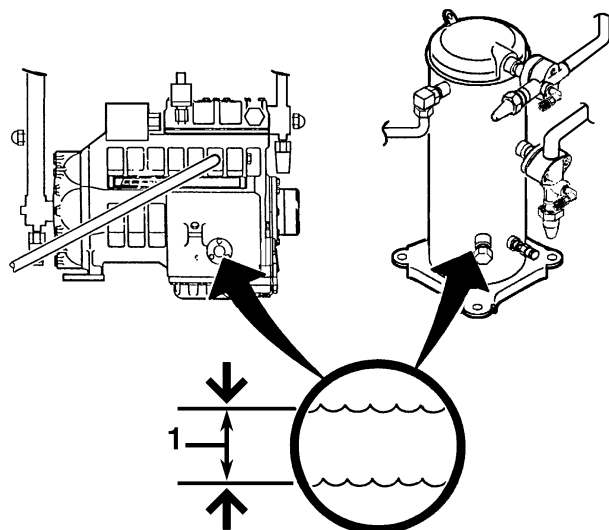
The compressor oil should be checked during pretrip inspections and when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

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.



- | | |
|----|------------------------------------------------------------------------------|
| 1. | Normal R-134a and R-23 compressor oil level: Sight glass is 1/4 to 3/4 full. |
|----|------------------------------------------------------------------------------|

Figure 34: Checking Compressor Oil Level

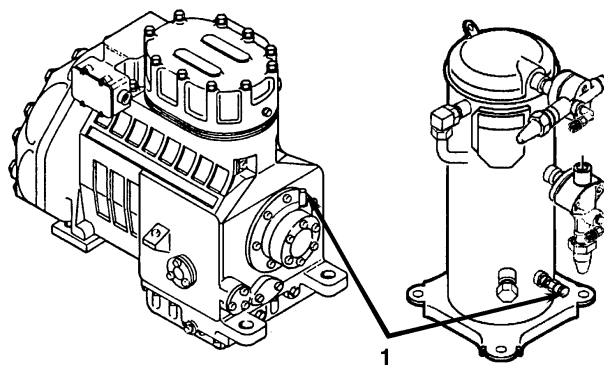
3. After stopping the compressor, adjust the low side pressure to 21 kPa, 0.21 bar, 3 psig using the service gauge set. (Pressure measured at the suction line service port.)
4. Remove the cap from oil pressure fitting on compressor.
5. Using a commercial hand pump, force oil in through the oil pressure 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, P/N 203-433 ONLY!
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.



- | | |
|----|-------------------------------------------------------------|
| 1. | Add and Remove Compressor Oil at the Compressor Oil Fitting |
|----|-------------------------------------------------------------|

Figure 35: Adjusting Compressor Oil Level

Refrigerant Leak Test Procedure

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

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

If refrigerant has leaked or been removed from the R-134a or R-23 refrigeration system:

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

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

6. Close both hand valves on gauge manifold (front seated).
7. Disconnect the refrigerant charging hose.

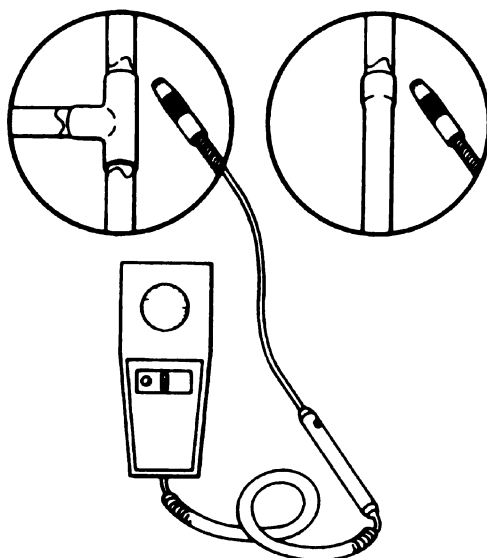


Figure 36: Testing for Refrigerant Leaks

8. Connect the charging hose to a source of nitrogen. Adjust the pressure regulator to 1380 kPa, 13.80 bar, 200 psig. See “Using Pressurized Nitrogen” in this manual chapter.



CAUTION: Nitrogen (N₂) is under 15,170 kPa, 151.70 bar, 2200 psig pressure in a full cylinder at 21 C (70 F). DO NOT use oxygen, acetylene or any other type of pressurized gas in the system.

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

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

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

Low Side Pump Down (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.



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

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

Refrigerant Charge Inspection

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. If the unit is low on R-134a charge, inspect the unit for refrigerant leaks with a reliable leak detector.

- R-134a Refrigeration System Charge: 3.5 Kg (7.7 lb)
- R-23 Refrigeration System Charge: 3.2 Kg (7.05 lb)

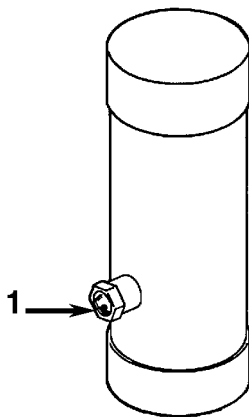
NOTE: See “Receiver Tank Sight Glass” under Unit Instruments in the Operating Instructions chapter for information about checking the moisture indicator in the sight glass.

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: 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.



- | | |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Refrigerant charge is OK if the ball floats at any time: <ul style="list-style-type: none"> • If the ball does NOT float, the R-134a refrigeration system is unit is low on refrigerant |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

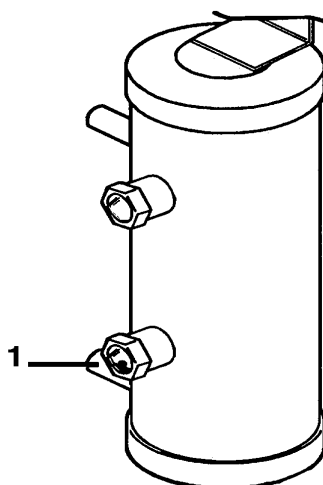
Figure 37: R-134a Refrigeration System Receiver Tank

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
0 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



1.	<p>The bottom sight glass ball will rarely float on a fully charged system during normal operation.</p> <ul style="list-style-type: none"> Check the refrigerant charge based on the R-23 system pressure with the container empty, the unit OFF and all refrigeration system components above
<p>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.</p>	

Figure 38: R-23 Refrigeration System Receiver Tank

- **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. See “R-23 Charging Procedure for Partially Charged Units on Loaded Containers” on page 125.

Refrigerant Recovery



CAUTION: Use only refrigerant recovery equipment approved for and dedicated to HFC refrigerants.

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

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

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

R-23 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 R23 cannot be reclaimed by use of reclaim station.

1. Prepare an empty refrigerant bottle at least 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: Do not allow the compressor suction pressure to decrease below 100 kPa, 1.00 bar, 15 psig.



WARNING: 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 the Refrigeration System

Contamination

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

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

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

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

- **AIR** — with oxygen as a contaminant. Oxygen in the air reacts with the oil. The oil begins to break down and can eventually lead to carbonization in the compressor and acid buildup. The longer this breakdown process goes on, the darker the compressor oil becomes until finally the color is **BLACK** indicating major system contamination.

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

Compressor Oil Color Code

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

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

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

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

Refrigeration System Preparation and Hookup



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

1. Recover all refrigerant from the system and reduce the unit pressure to the proper level (US Federal Law requires a -17 to -34 kPa, -0.17 to -0.34 bar, 5 to 10 in. vacuum that is dependent upon the recovery equipment used).
2. Break vacuum with refrigerant and equalize system pressure to 0 kPa, 0 bar, 0 psig. Replace the liquid line filter drier.
3. Confirm that the Evacuation Station functions properly and determine “Blank Off” Pressure. The Blank Off Pressure of the Vacuum Pump is the deepest vacuum that the vacuum pump can attain when isolated from the rest of the system.

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

4. Connect the Evacuation Station and refrigerant tank with gauge manifold (optional) to the unit. Connect evacuation hoses to the compressor suction and discharge service lines and the receiver tank outlet valve.
5. Mid-seat the receiver tank outlet valve.
6. Replace valve stem cap on the receiver tank outlet valve.

7. 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.
8. 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.
9. If connecting a refrigerant tank and gauge manifold to the evacuation station, close the gauge manifold and refrigerant tank valves to prevent refrigerant from being drawn from the tank.

Unit Evacuation

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

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.

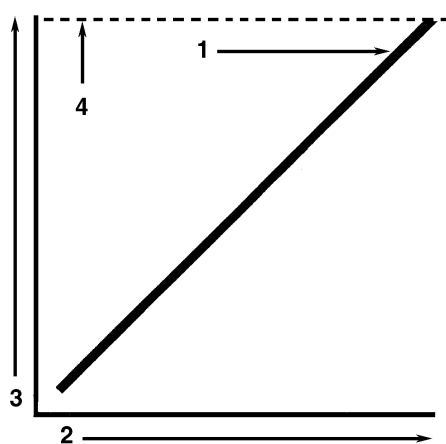
Moisture: When the needle indicates a rise and then stabilizes at a level below atmospheric pressure, it is an indication that the system is vacuum tight, but is still wet and requires additional dehydration and pumping time (see “Pressure Rise Test Evaluation” below).

Factors Affecting the Speed of System Evacuation

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

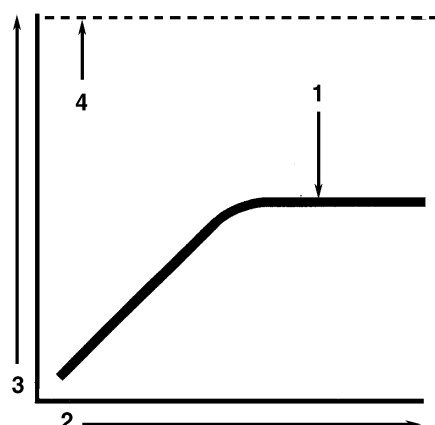
- System size
- Amount of moisture contained in the system
- Ambient temperature
- Internal restrictions within the system
- External restrictions between the system and the vacuum pump

Hose size, both diameter and length, affect evacuation times. Laboratory tests show that the evacuation time can be significantly reduced by larger diameter hoses and shorter hoses. To obtain optimum pumping speed, keep hoses as short as possible and as large in diameter as possible. For example, it takes eight times as long to pull a given vacuum through a 1/4 inch diameter hose as it does through a 1/2 inch diameter hose. It takes twice as long to pull a vacuum through a 6 foot long hose as it does through a 3 foot long hose.



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

Figure 39: Constant Pressure Rise After Evacuation Indicates System Leak



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

Figure 40: Pressure Rise Levels Off After Evacuation Indicates Moisture in System

Heat Saves Time

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



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

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

R-134a Refrigeration System Charging

Charging R-134a System with Liquid Refrigerant by Weight (from an Evacuated Condition)

NOTE: *When both the R-134a and R-23 systems require charging, charge the R-23 system first.*

1. Close valve V4.
2. Open the Gas Ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. The discharge valve remains mid-seated.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (see “Evacuation Station and Unit Hookup” in this chapter).



CAUTION: *Be sure to add the correct refrigerant to the system.*

6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge then subtract the amount of the charge to be input to your unit from the total weight of the tank of refrigerant. This provides final tank weight after the unit receives a full system refrigerant charge.
8. Set the refrigerant tank for liquid. Open the hand valve on the tank.
9. With the unit OFF, open the gauge manifold hand valve and charge liquid refrigerant into the system.
10. Close the refrigerant tank hand valve when the correct amount (by weight) of refrigerant has been added or if the system will take no more liquid.
11. Back seat the discharge service valve.

The unit is now ready to have the Evacuation Station removed. See R-134a final charging procedure for partially charged units to complete charging procedure.

R-134a Evacuation Station Removal

1. Make sure the discharge service valve is back seated.
2. Make sure the refrigerant tank hand valve is closed.
3. Operate the unit in cool mode.



CAUTION: *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.
4. Open the hand valve at the gauge manifold and read suction pressure.
 5. Front seat the suction service valve and pump down the system to 21 to 35 kPa, 0.21 to 0.35 bar, 3 to 5 psig.
 6. Back seat the suction service valve.
 7. Remove the hoses from the receiver tank service fitting and discharge service valve.
 8. Cap the both service ports and the discharge service valve stem.

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: *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: *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: *Be sure to return the controller to the setpoint indicated on the shipping manifest.*

R-23 Refrigeration System Charging

Charging R-23 System with Liquid Refrigerant by Weight (from an Evacuated Condition)

NOTE: *When both the R-134a and R-23 systems require charging, charge the R-23 system first.*

1. Close valve V4.
2. Open the Gas Ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. The discharge valve remains mid-seated.
5. Connect a refrigerant hose from the refrigerant tank to the service fitting on the receiver tank (see “Evacuation Station and Unit Hookup” in this chapter).



CAUTION: *Be sure to add the correct refrigerant to the system.*

6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge then subtract the amount of the charge to be input to your unit from the total weight of the tank of refrigerant. This provides final tank weight after the unit receives a full system refrigerant charge.

NOTE: *If a scale is not available, the R-23 system can be accurately charged by pressure. Add refrigerant to the receiver tank until the unit suction and discharge pressure gauges indicate 1700 kPa, 17 bar, 247 psig.*

8. Set the refrigerant tank for liquid. Open the hand valve on the tank.
9. With the unit OFF, open the refrigerant tank hand valve and charge liquid refrigerant into the system.
10. Close the refrigerant tank hand valve when the correct amount (by weight) of refrigerant has been added or if the system will take no more liquid.

The unit is now ready to have the Evacuation Station removed. See R-23 final charging procedure for partially charged units to complete charging procedure.

R-23 Evacuation Station Removal

1. Make sure the discharge service valve is back seated.
2. Make sure the refrigerant tank hand valve is closed.
3. Operate the unit in cool mode.



CAUTION: *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.*
4. Front seat the suction service valve and pump down the system below 100 kPa, 1.00 bar, 15 psig.
 5. Back seat the suction service valve.
 6. Remove the hoses from the receiver tank and discharge valve service fittings.
 7. Cap all service ports and valve stems.

Charging R-23 System with Gas Refrigerant Recovered in 40 Liter (42 qt.) Refrigerant Bottle(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. Back seat the discharge service valve.
5. Connect a refrigerant hose to the refrigerant tank and the service fitting on the suction service valve.
6. Midseat the suction service valve.
7. Open the hand valve on the 40 liter (42 qt.) recovery bottle containing R-23 gas.
8. Wait 2 minutes while the gas pressure equalizes between the unit and the recovery bottle of R23 gas.
9. Use the Manual Function Test menu of the controller to start the R-23 compressor ONLY. Operate the R-23 compressor until either:
 - a. The discharge pressure gauge indicates approximately 2800 kPa, 28 bar, 400 psig. This method completes the charging procedure faster by lowering the refrigerant pressure in the buffer tanks; or
 - b. The recovery bottle pressure (suction pressure) decreases to 300 kPa, 3 bar, 44 psig.

10. Close the refrigerant tank hand valve.
11. Back seat the suction service valve. Then stop the compressor.
12. Remove the hoses from the receiver outlet and discharge service valves. Cap the receiver outlet service port.
13. Wait for the plate-type R-134a / R-23 system heat exchanger to warm above 0 C (32 F). This can take up to 30 minutes.

See R-23 final charging procedure for partially charged units for empty or loaded containers to complete charging procedure.

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

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
0 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.

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

NOTE: *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.



CAUTION: *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.

Using Pressurized Nitrogen

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

Safety Precautions

Observe the proper handling of cylinders:

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



CAUTION: *Nitrogen (N₂) 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 (O₂), acetylene or any other types of pressurized gas on refrigeration systems or any component of a system.*

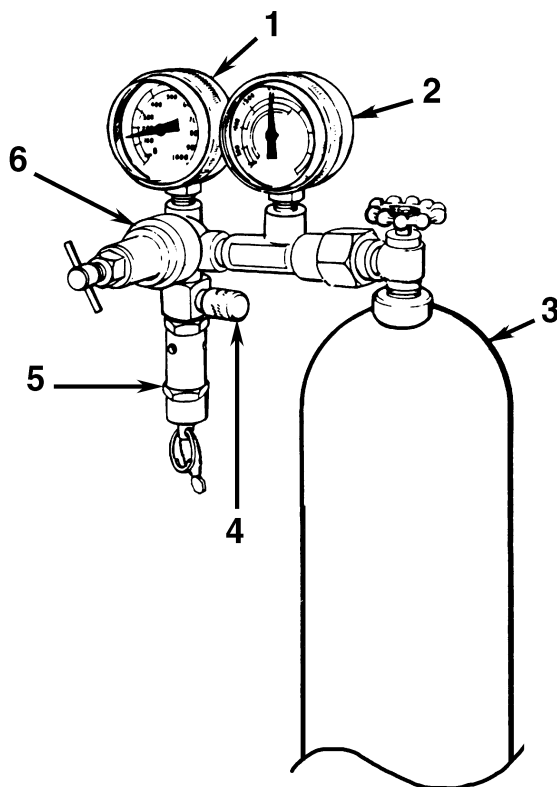
Dehydration, Pressure Testing, Purging and Soldering Procedure

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.

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

The following procedures should utilize the following MAXIMUM gas pressure:

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



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

Figure 41: Typical Pressurized Gas Bottle with Pressure Regulator and Gauges

Compressor Replacement (R-134a or R-23 Systems)

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: 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: 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: 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: *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 (R-134a or R-23 Systems)

Removal

1. Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).
2. Remove the condenser fan grille, condenser fan blade and condenser fan shroud.
3. Remove the condenser coil support brackets from the coil.
4. Unsolder the coil inlet and liquid line connections.
5. Support the coil and unbolt the condenser coil mounting brackets. Slide the coil from the unit.

Installation

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

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

4. Pressurize the system and test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
5. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
6. Then evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
7. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
8. Recharge the unit with R-134a or R23 refrigerant and check the compressor oil level. Add oil if necessary.

Dehydrator (Filter Drier) Replacement (R-134a or R-23 Systems)

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 the dehydrator for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
 - d. If no leaks are found, place the unit in operation.
- R-23 System:
 - a. Pressurize the system 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. Then evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
 - d. Recharge the unit with R-23 refrigerant and check the compressor oil level. Add oil if necessary.

Expansion Valve Replacement (R-134a or R-23 Systems)

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.

R-23 System Heat Exchanger Replacement

Removal

1. Recover the refrigerant charge from the system (see “Refrigerant Recovery” in this chapter).
2. Remove the “U” mounting clamps that hold the heat exchanger assembly to the wall of the condenser section.

3. Heat and unsolder liquid inlet and outlet line connections.
4. Heat and unsolder the suction line connections.
5. Lift the heat exchanger assembly from the unit.

Installation

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

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

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



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

4. Solder the liquid line connections.
5. Pressurize the low side and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
6. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
7. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
8. Recharge the unit (see “Refrigerant Charge” in this chapter).

R-23 System to R-134a System Plate 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: 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 (R-134a or R-23 System)

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: 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 (R-134a or R-23 System)

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

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.



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

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.



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

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

Low Pressure Cutout Switch Replacement (CRR DF MPC2000ID and MP3000 Units Only)

Removal

1. Recover the R-23 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.



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

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.

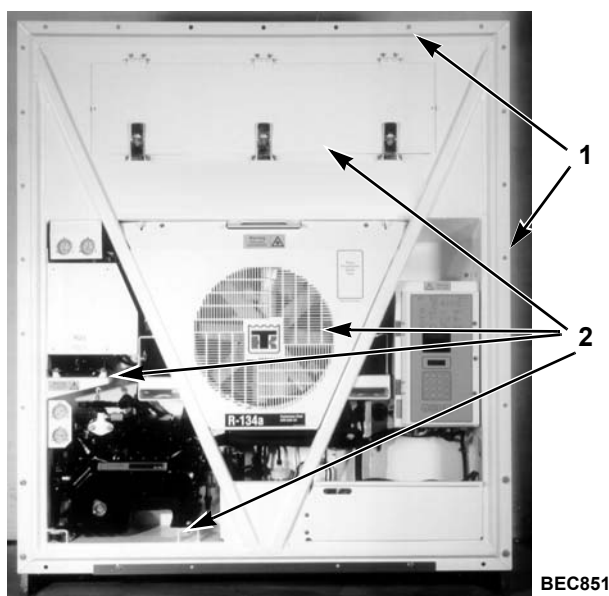
Structural/Accessory Maintenance

Mounting Bolts

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

Unit Inspection

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



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

Figure 42: Mounting Bolts

Condenser Coil

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



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

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

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

Evaporator Coil

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



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

Defrost Drains

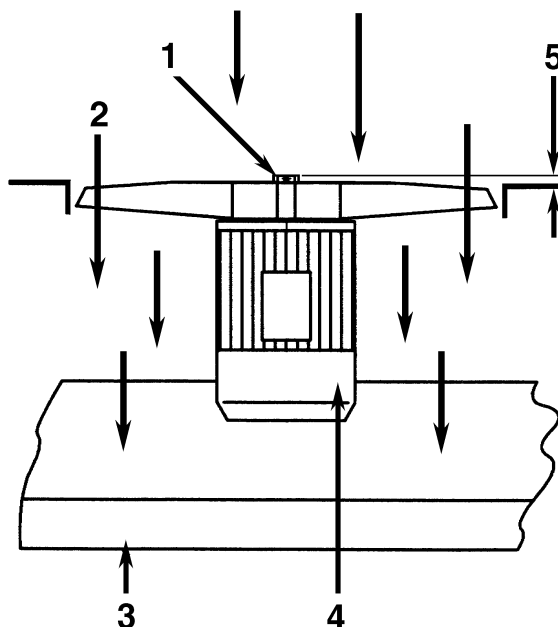
Clean the defrost drains every 1,000 operating hours to be sure the lines remain open.

Evaporator Fan Location

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

Condenser Fan Location

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



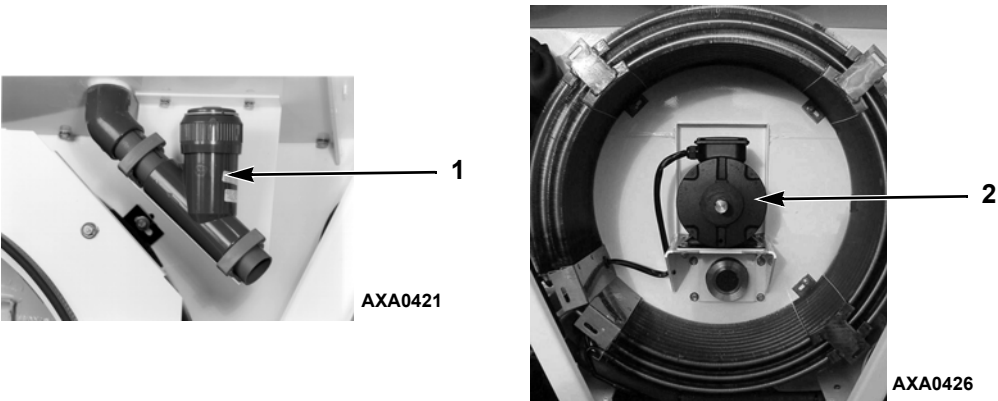
AXA0404

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

Figure 43: Evaporator Fan Blade Placement

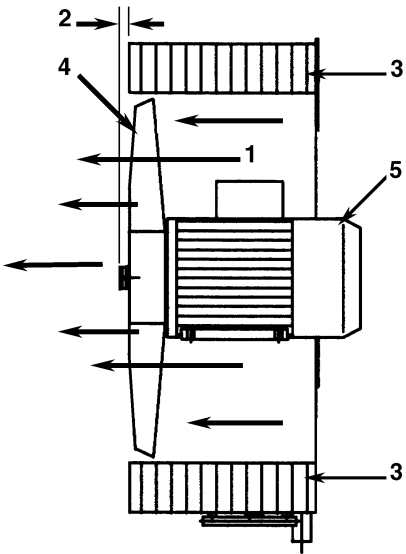
Vacuum Valve

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.



1.	Vacuum valve (Located behind the condenser grille cover), earlier
2.	Vacuum valve (Located behind the condenser grille cover), current

Figure 44: Vacuum Valve



AXA0196

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

Figure 45: Condenser Fan Blade Placement

Mechanical Diagnosis

Condition	Possible Cause	Remedy
One or Both Compressors do not operate — no amperage draw	Controller on; unit start sequence still timing	Wait at least 1 minute for both compressors to start
	No power to unit (condenser and evaporator fans do not operate)	Locate fault and repair: power source, power plug, main circuit breaker, motor contactor, motor terminals, motor
	Open in 24 Vac control circuit	Check fuses and On/Off switch. Replace or repair as required
	Container temperature does not demand compressor operation	Adjust controller setpoint
	Compressor contactor inoperative	Replace compressor contactor
	No output signal from controller	Diagnose and replace main relay board or controller
	Unit on defrost	Turn Unit On/Off switch Off and then On again
	Detective high pressure cutout switch in R-134a or R-23 system	Replace defective switch
	High condenser head pressure causing high pressure cutout on R-134a or R-23 system	Check refrigeration system and correct fault
	Defective R-134a or R-23 compressor	Replace compressor
	Controller shut unit down on Compressor Over Temperature (fault code 56)	Let compressor cool and controller will reset automatically. Check compressor temperature sensor, R-134a refrigerant charge, R-23 refrigerant charge
	Compressor motor internal thermal overload protection open	If compressor contactor is energized, wait 60 minutes for protector to cool and reset.
	Low suction pressure or defective low pressure cutout on R-23 system (CRR DF MPC2000ID Units Only)	Check R-23 refrigeration system for leaks or and obstruction in the low or high side. Replace a defective low pressure cutout switch
Compressor does not operate; excessive amperage draw or intermittent cycling on overload	Piston stuck (R-134 System) Rotating Scroll Stuck (R-23 System)	R-134a System: Remove compressor head and look for broken valve and jammed parts R-23 System: 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
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% of compressor motor rating
	Excessive line voltage	Reduce line voltage to at least 110% of compressor motor rating
	Short cycling	Eliminate cause of short cycling
Unit short cycles	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 (R-134a or R-23) with cycling compressor
	Inefficient condenser operation causing cycling on high pressure cutout	Check condenser airflow, condenser fan motor, condenser fan grille. If R-23 compressor is cycling off, check R-134a system operation and refrigerant charge
Noisy unit	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	Add oil or refrigerant charge. Check expansion valve adjustment.
	Worn fan motor bearings	Replace bearings or motor
	Faulty compressor	Repair or replace compressor
Condenser fan motor does not operate	Unit in Null, Heat or Defrost	Check indicator lights. If unit is in Null, 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
	Defective condenser fan contactor	Replace defective contactor
	No condenser fan output signal from controller	Diagnose and replace condenser fan relay, main relay board or controller
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 speed evaporator fan output signal from controller	Diagnose and replace evaporator fan relay, main relay board or controller

Refrigeration System Diagnosis

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 (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

Condition	Possible Cause	Remedy
Load temperature too high (unit not cooling)	One or both compressors do not operate	See "Mechanical Diagnosis" and unit wiring schematic
	Shortage of refrigerant (R-134a or R-23 system)	Repair leak and recharge
	Overcharge of refrigerant (R-134a or R-23 system)	Purge system
	Air in system (R-134a or R-23 system)	Evacuate and recharge
	Controller setpoint too high	Adjust controller setpoint
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Too much compressor oil in R-134a or R-23 system	Remove excessive compressor oil from compressor
	Iced or dirty evaporator coil	Defrost or clean evaporator coil
	Restricted lines on high side (R-134a or R-23 system)	Clear restriction
	Plugged dehydrator (R-134a or R-23 system)	Change dehydrator
	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 open too much (R-134a or R-23 system)	Adjust or replace valve
	Expansion valve power element lost its charge (R-134a or R-23 system)	Replace power element
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact (R-134a or R-23 system)	Correct feeler bulb installation
R-134a or R-23 System: Head pressure too low	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.
R-134a or R-23 System: 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	See "Condenser Fan Motor Does Not Operate" under Mechanical Diagnosis
	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 dehydrator or clear restriction
	Defective high pressure gauge	Replace service gauge
R-134a or R-23 System: Compressor loses oil	Refrigerant leak	Repair leak and recharge
Compressor oil migrates to system	Short cycling	See "Unit Short Cycles" under Mechanical Diagnosis

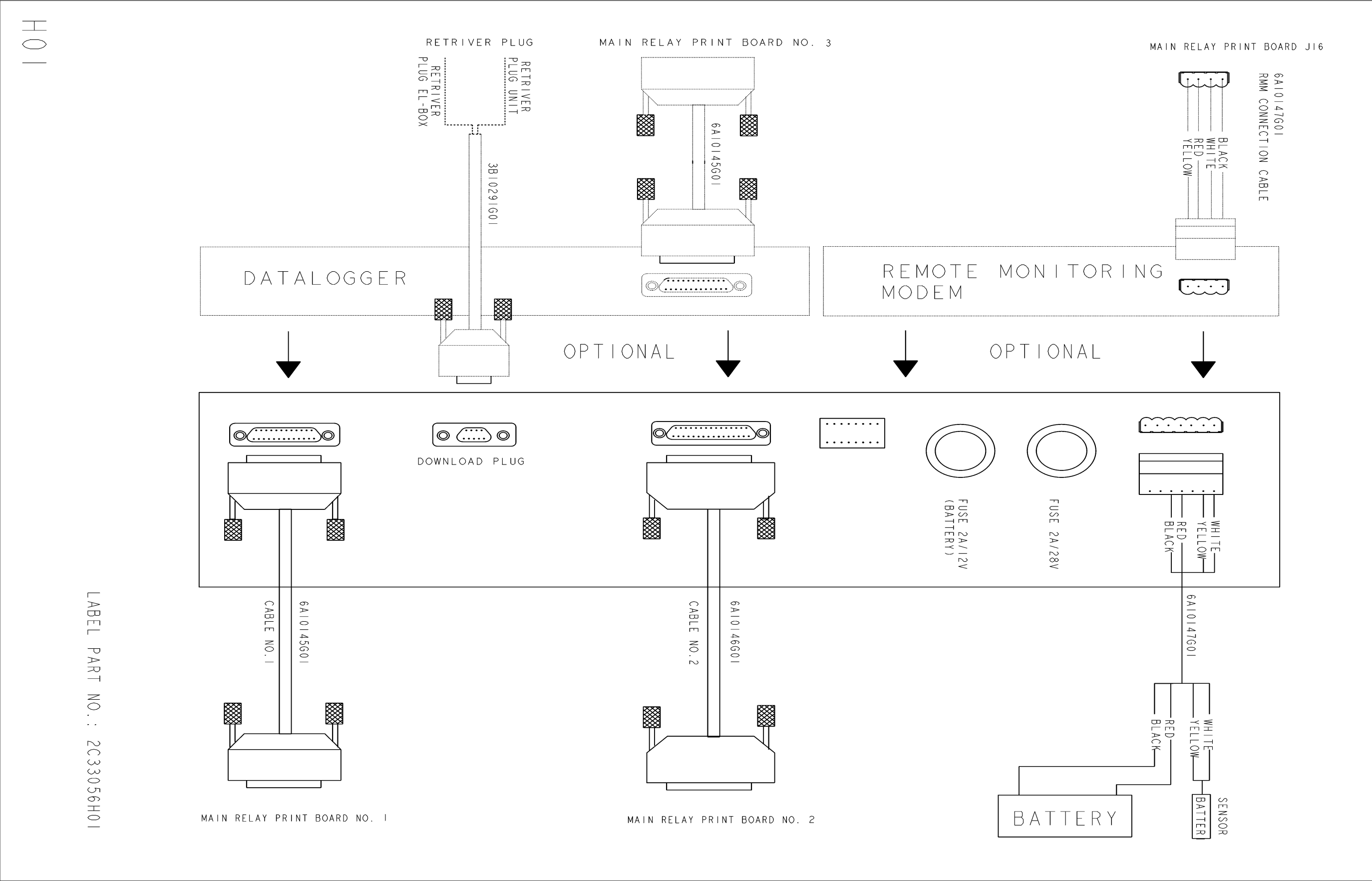
Condition	Possible Cause	Remedy
Rapid cycling between Cool and Null modes	Air short cycling through evaporator	Check and correct cargo load
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Short cycling	See "Unit Short Cycles" under Mechanical Diagnosis
R-134a or R-23 System: Hot liquid line	Shortage of refrigerant	Repair or recharge
	Expansion valve open too wide	Adjust or replace expansion valve
R-134a or R-23 System: Frosted liquid line	Liquid line service valve partially closed or restricted	Open valve or remove restriction
	Restricted dehydrator	Replace dehydrator
R-134a or R-23 System: Frosted or sweating suction line	Expansion valve admitting excess refrigerant	Check feeler bulb and adjust expansion valve or replace
	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)	See "Evaporator Fan Motor Does Not Operate" under Mechanical Diagnosis and unit wiring schematic
R-134a or R-23 System: 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 dehydrator
R-134a or R-23 System: High suction pressure	Overcharge of refrigerant	Purge system
	Expansion valve open too much	Adjust or replace valve
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Suction pressure gauge out of calibration	Adjust or replace service gauge
R-134a or R-23 System: Low suction pressure	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 dehydrator	Replace dehydrator
	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 (R-23 system only)	Check evaporator fan motors and control circuit and correct fault
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component.
	Suction pressure gauge out of calibration	Adjust or replace gauge

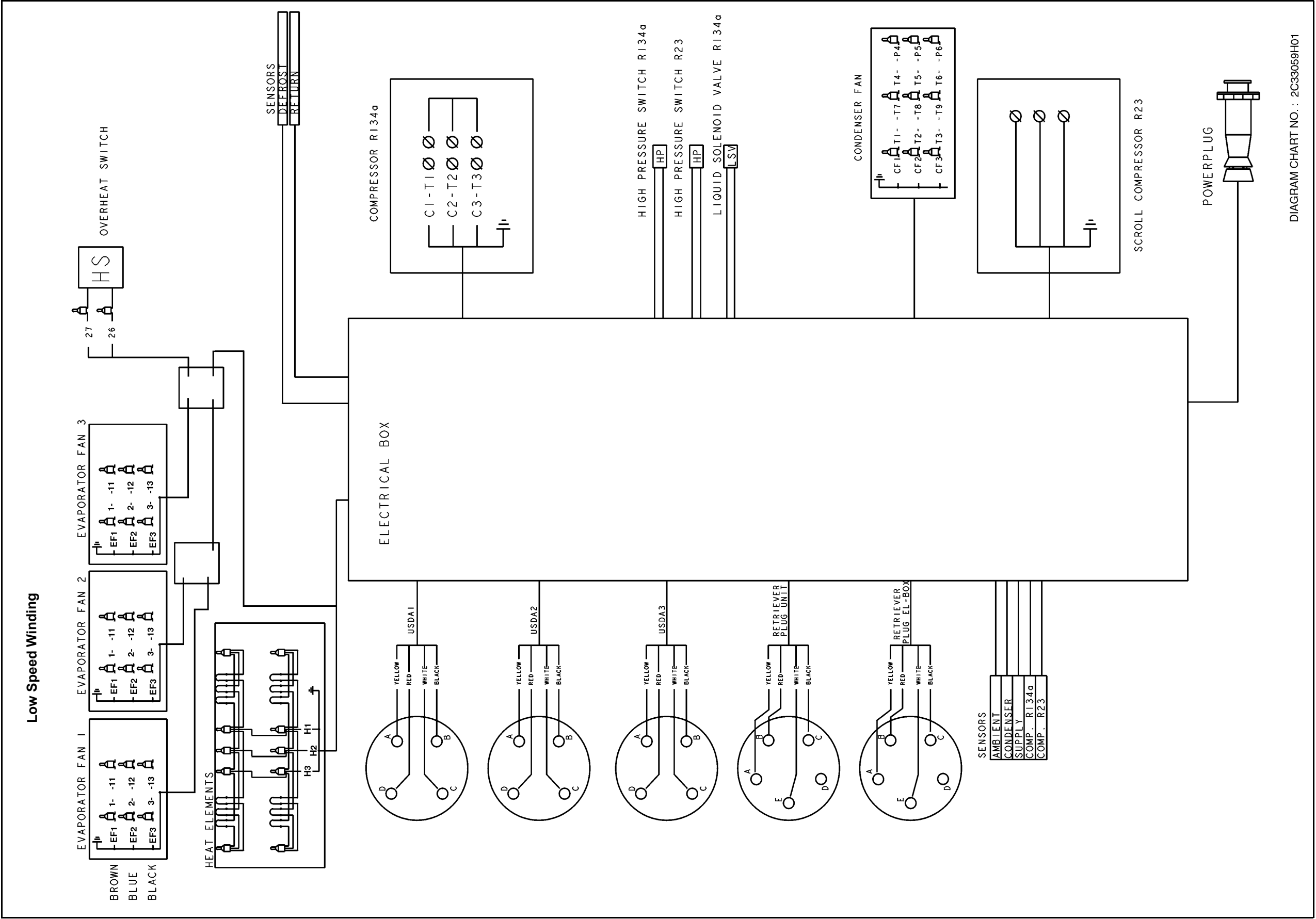
Electrical, Refrigeration and Controller Menu Flow Diagrams

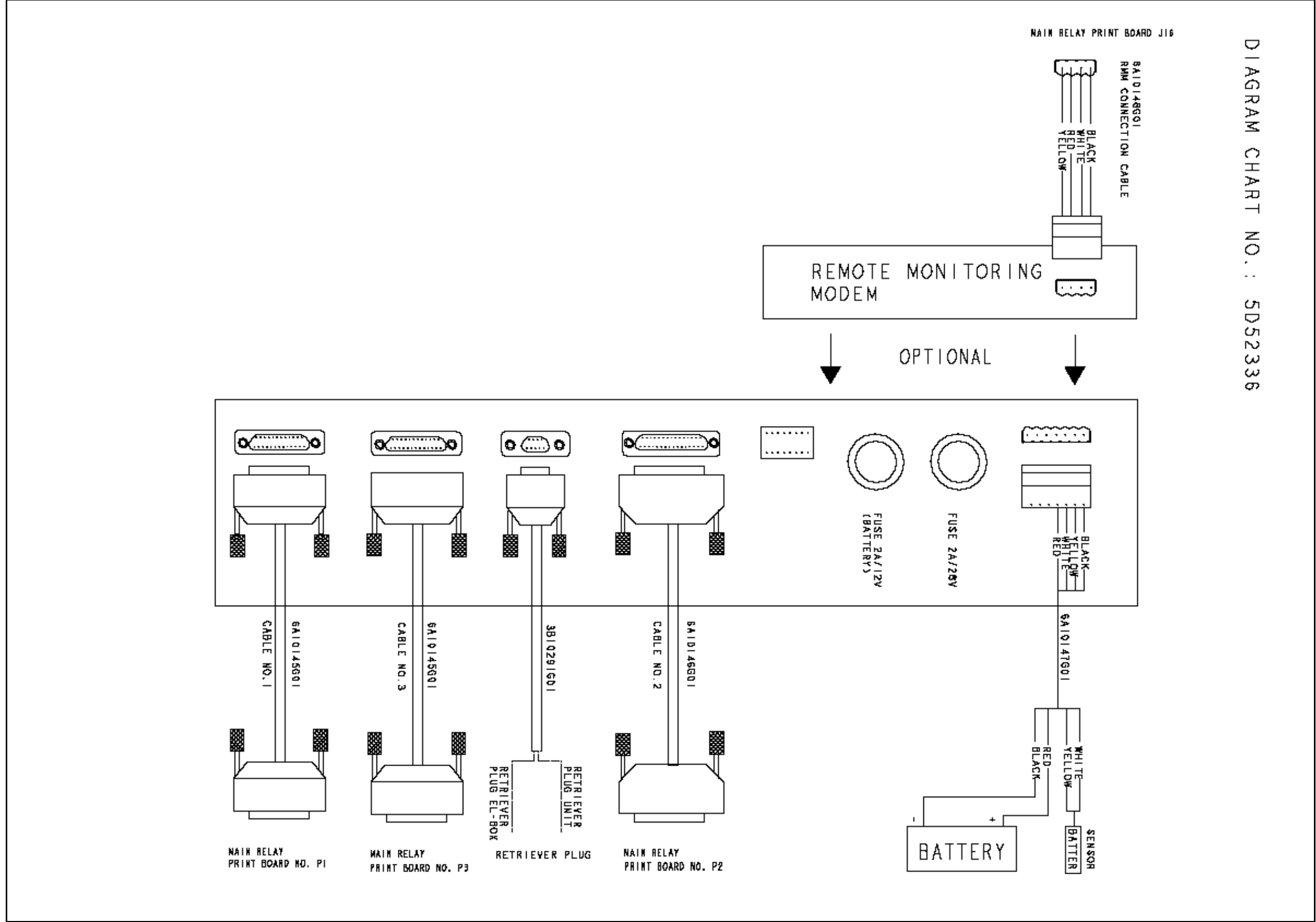
Dwg No.	Drawing Title	Rev.	Page
2C33056H01	CRR DF MPC2000 Controller Diagram	A	149
2C33057H01	CRR DF MPC2000 Main Relay Board Electrical Diagram	A	150
2C33059H01	CRR DF MPC2000 Unit Wiring Schematic	A	151
5D52336	CRR DF MP3000A Controller Diagram	B	152
5D52338	CRR DF MP3000A Main Relay Board Electrical Diagram	G	153
5D52335	CRR DF MP3000A Unit Wiring Schematic	D	154
—	Legend of CRR DF Refrigeration System Components	—	155
—	CRR DF Refrigeration System Components	—	156
—	Legend of CRR DF Off Cycle Standby Flow and Pressure Diagram	—	157
—	CRR DF Off Cycle Standby Flow and Pressure Diagram	—	158
—	Legend for CRR DF Full Cool Flow and Pressure Diagram	—	159
—	CRR DF Full Cool Flow and Pressure Diagram	—	160
—	Legend for CRR DF Evacuation Station and Unit Connections	—	161
—	CRR DF Evacuation Station and Unit Connections	—	162
—	MPC2000 Menu Flow Diagram	—	163
—	MPC3000A Menu Flow Diagram	—	163

This page intentionally left blank.

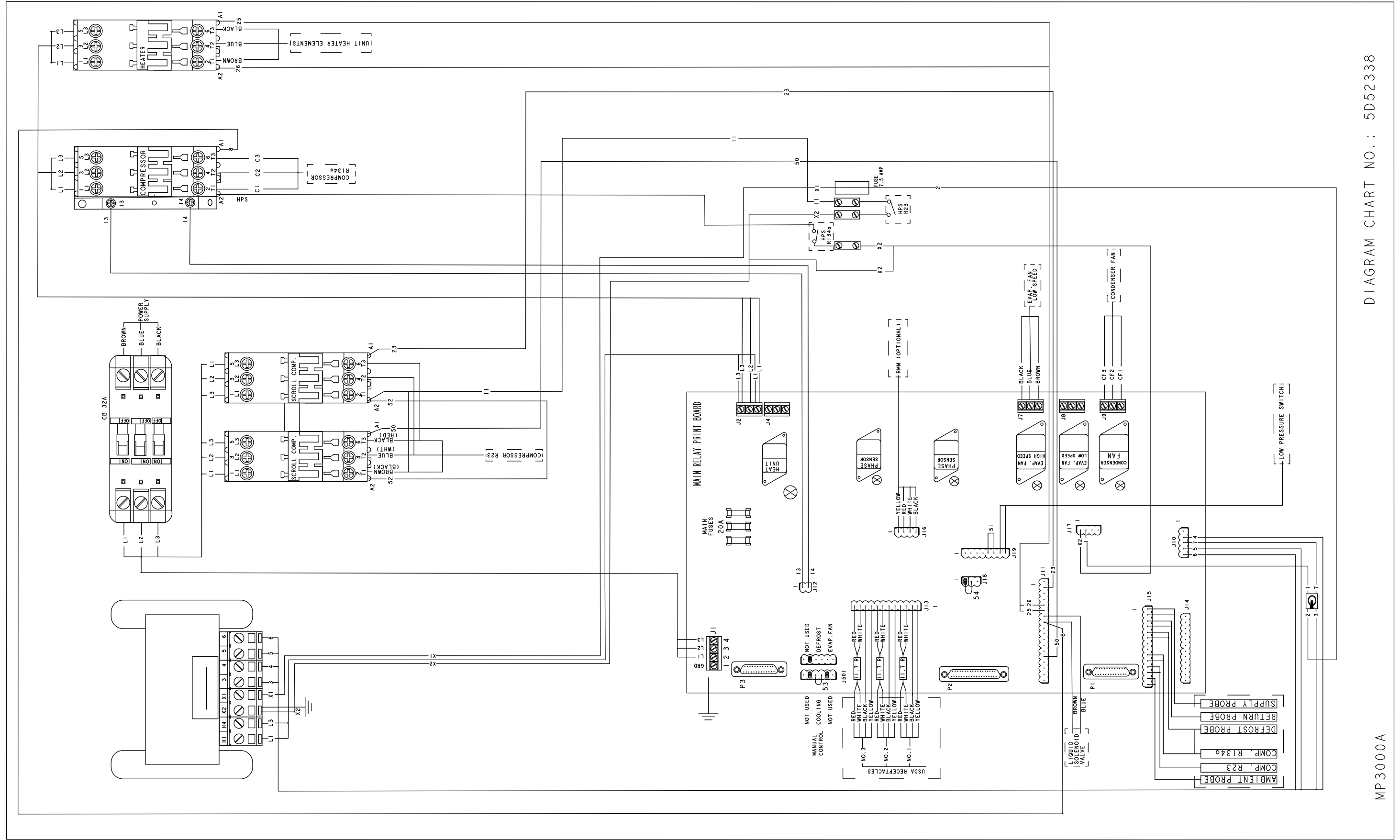
CRR DF MPC2000 Controller Diagram

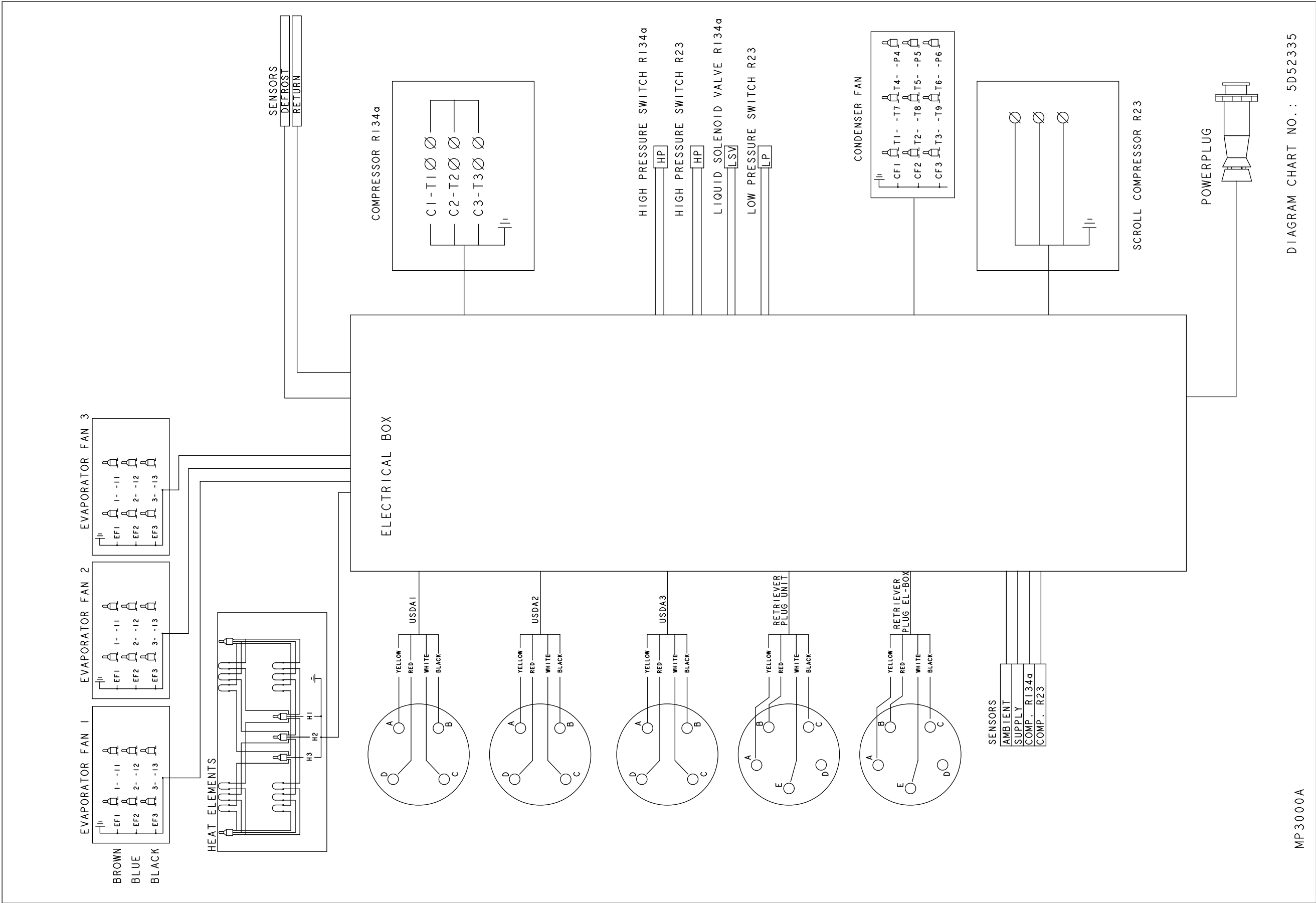






CRR DF MP3000A Main Relay Board Electrical Diagram





Unit Compartments

- A. Evaporator Section
- B. Condenser Section

Controller and Temperature Sensors

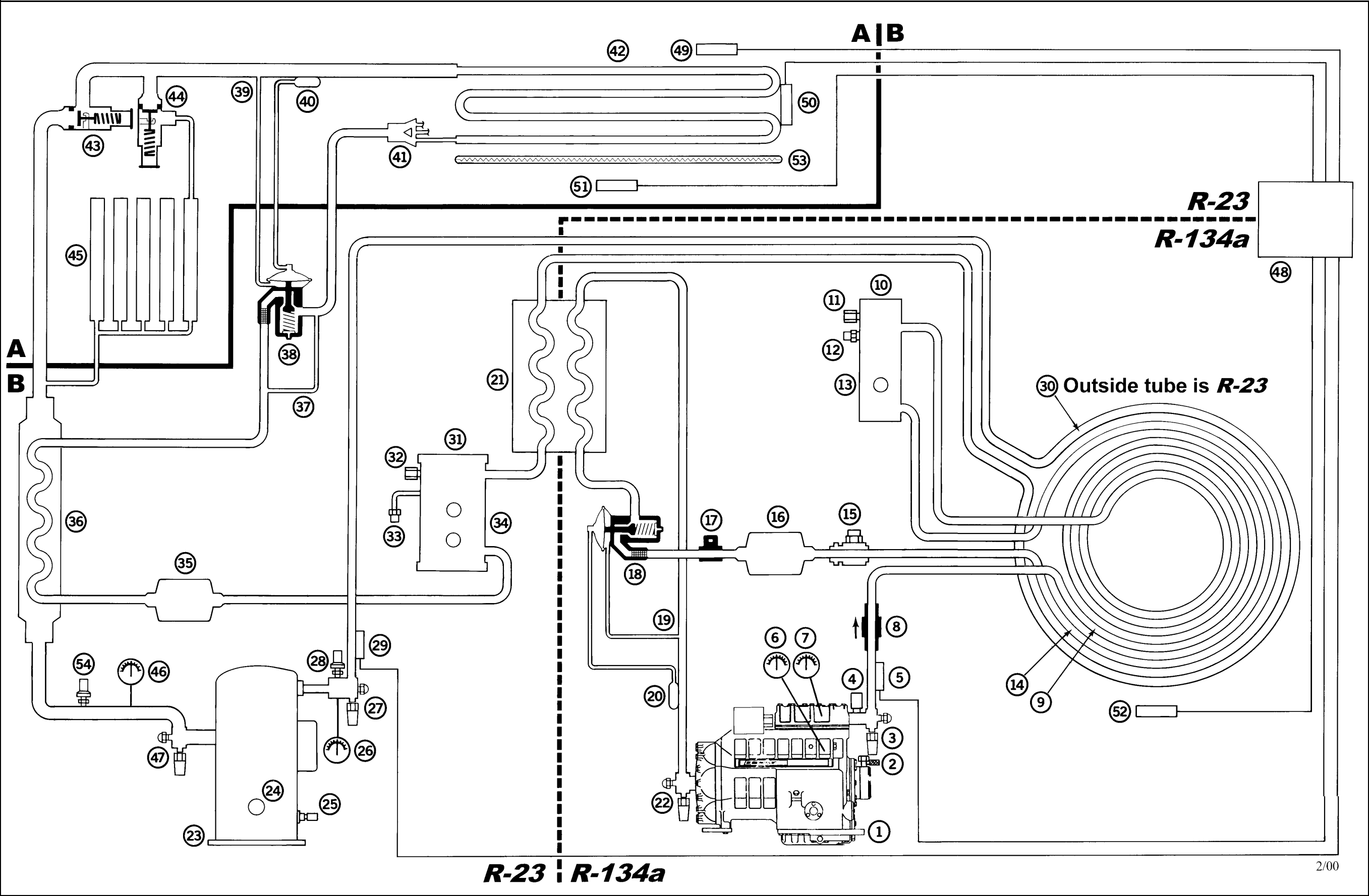
- 5. R-134a Compressor Discharge Line Temperature Sensor
- 29. R-23 Compressor Discharge Line Temperature Sensor
- 48. MPC2000 or MPC2000ID Controller
- 49. Return Air Sensor
- 50. Evaporator Coil Sensor
- 51. Supply Air Sensor
- 52. Ambient Sensor

R-134a Refrigeration Circuit Components

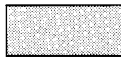
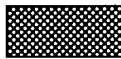

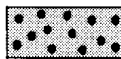
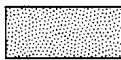
- 1. R-134a Reciprocating Compressor
- 2. Oil Fill / Drain Fitting
- 3. Discharge Service Valve
- 4. High Pressure Cutout Switch
- 5. R-134a Compressor Discharge Line Temperature Sensor
- 6. Low (Suction) Pressure Gauge
- 7. High (Discharge) Pressure Gauge
- 8. Condenser Check Valve
- 9. Condenser Coil 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
- 54. Low Pressure Cutout Switch (MPC2000ID Units Only)



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

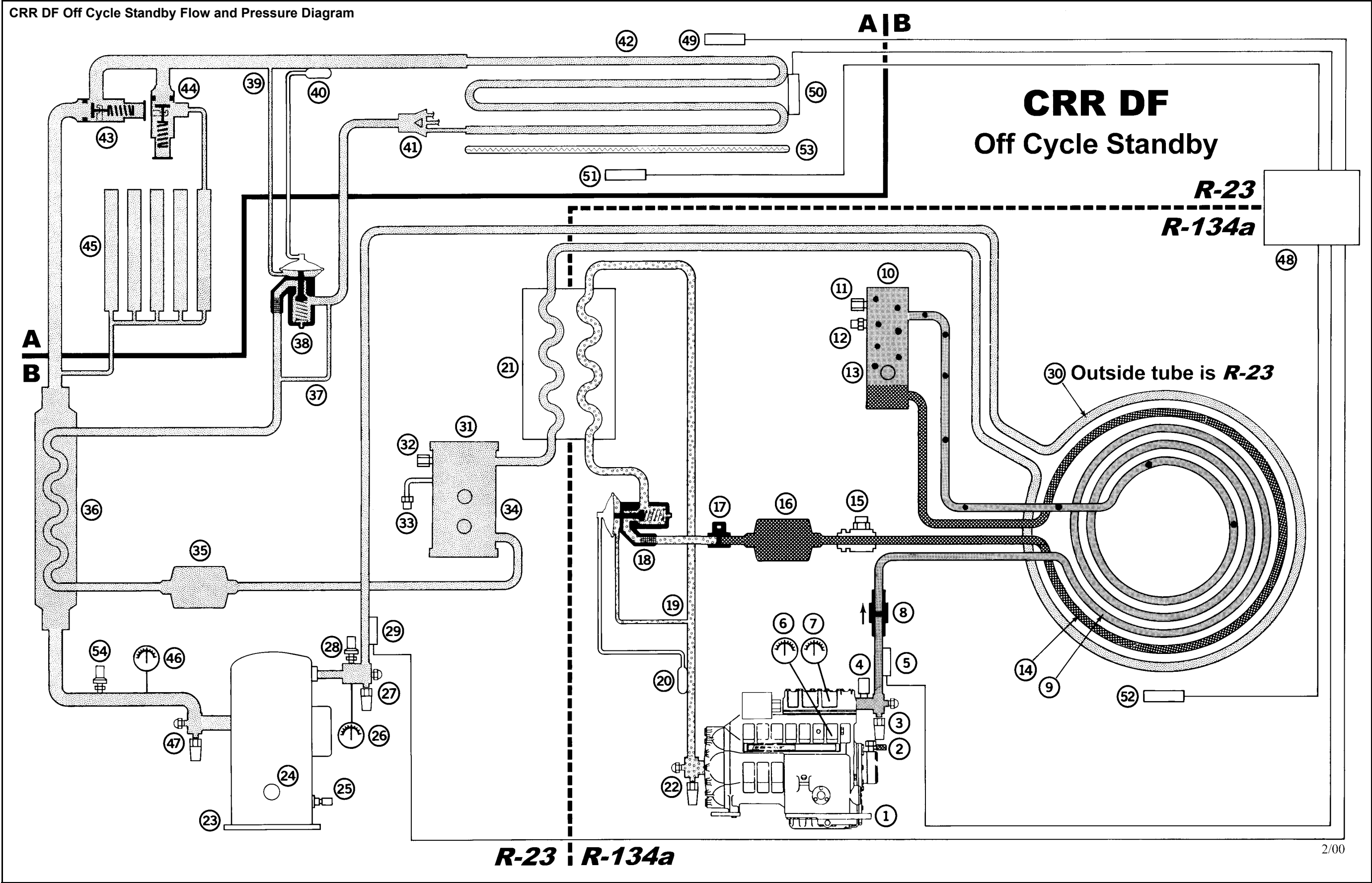
- 5. R-134a Compressor Discharge Line Temperature Sensor
- 29. R-23 Compressor Discharge Line Temperature Sensor
- 48. MPC2000 or MPC2000ID Controller
- 49. Return Air Sensor
- 50. Evaporator Coil Sensor
- 51. Supply Air Sensor
- 52. Ambient Sensor

R-134a Refrigeration Circuit Components

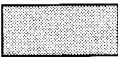
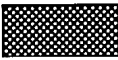
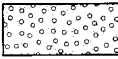
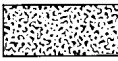
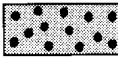
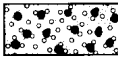
- 1. R-134a Reciprocating Compressor
- 2. Oil Fill / Drain Fitting
- 3. Discharge Service Valve
- 4. High Pressure Cutout Switch
- 5. R-134a Compressor Discharge Line Temperature Sensor
- 6. Low (Suction) Pressure Gauge
- 7. High (Discharge) Pressure Gauge
- 8. Condenser Check Valve
- 9. Condenser Coil 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
- 54. Low Pressure Cutout Switch (MPC2000ID Units Only)



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

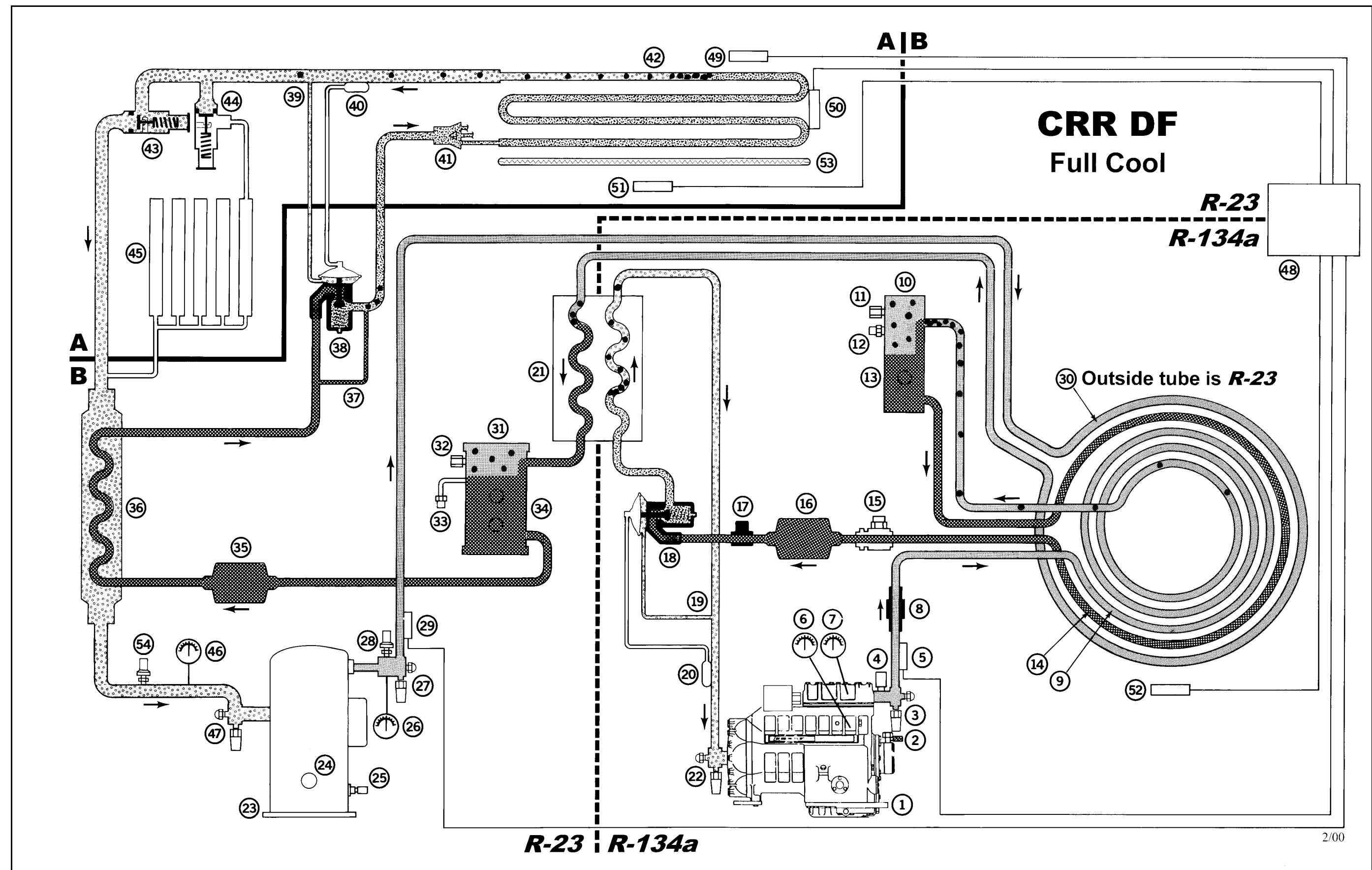
- 5. R-134a Compressor Discharge Line Temperature Sensor
- 29. R-23 Compressor Discharge Line Temperature Sensor
- 48. MPC2000 or MPC2000ID Controller
- 49. Return Air Sensor
- 50. Evaporator Coil Sensor
- 51. Supply Air Sensor
- 52. Ambient Sensor

R-134a Refrigeration Circuit Components

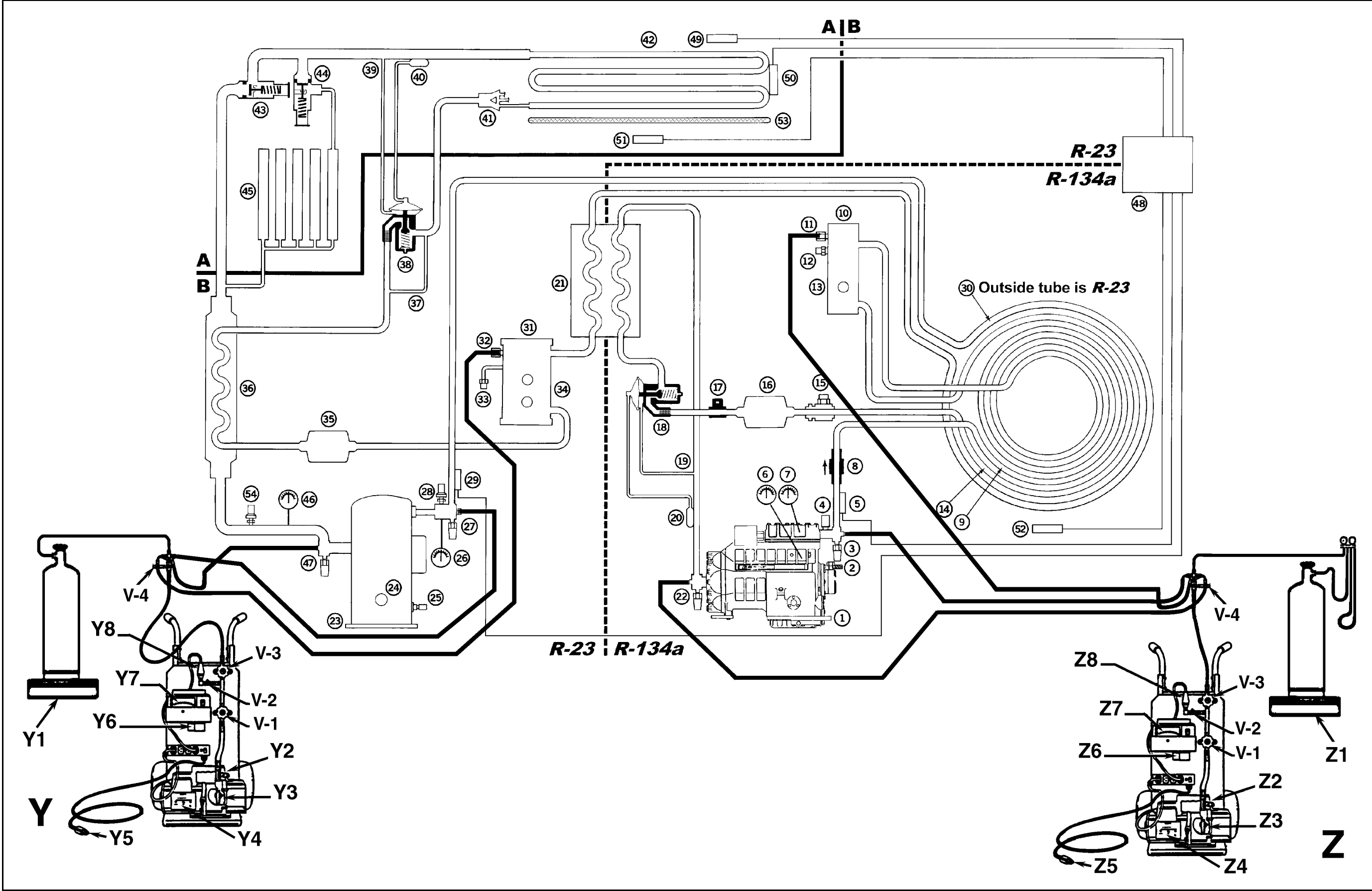
- 1. R-134a Reciprocating Compressor
- 2. Oil Fill / Drain Fitting
- 3. Discharge Service Valve
- 4. High Pressure Cutout Switch
- 5. R-134a Compressor Discharge Line Temperature Sensor
- 6. Low (Suction) Pressure Gauge
- 7. High (Discharge) Pressure Gauge
- 8. Condenser Check Valve
- 9. Condenser Coil 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
- 54. Low Pressure Cutout Switch (MPC2000ID Units Only)



<p>Evacuation Stations</p> <p><i>NOTE: Special, self-sealing quick disconnect couplers are required for R-134a systems and R-23 systems.</i></p> <p>Y. R-23 Evacuation Station and Unit Connections</p> <p>Y1. Scale, R-23 Refrigerant Tank and Refrigerant Hose Only</p> <p>Y2. Gas Ballast Valve</p> <p>Y3. Iso Valve</p> <p>Y4. Two-stage Vacuum Pump</p> <p>Y5. To 220/190 VAC Power</p> <p>Y6. Calibration Standard</p> <p>Y7. Micron Meter</p> <p>Y8. Sensor</p> <p>Z. R-134a Evacuation Station and Unit Connections</p> <p>Z1. Scale, R-134a Refrigerant Tank and Gauge Manifold</p> <p>Z2. Gas Ballast Valve</p> <p>Z3. Iso Valve</p> <p>Z4. Two-stage Vacuum Pump</p> <p>Z5. To 220/190 VAC Power</p> <p>Z6. Calibration Standard</p> <p>Z7. Micron Meter</p> <p>Z8. Sensor</p> <p>Unit Compartments</p> <p>A. Evaporator Section</p> <p>B. Condenser Section</p> <p>Controller and Temperature Sensors</p> <p>5. R-134a Compressor Discharge Line Temperature Sensor</p> <p>29. R-23 Compressor Discharge Line Temperature Sensor</p> <p>48. MPC2000 or MPC2000ID Controller</p> <p>49. Return Air Sensor</p> <p>50. Evaporator Coil Sensor</p> <p>51. Supply Air Sensor</p> <p>52. Ambient Sensor</p>	<p>R-134a Refrigeration Circuit Components</p> <p>1. R-134a Reciprocating Compressor</p> <p>2. Oil Fill / Drain Fitting</p> <p>3. Discharge Service Valve</p> <p>4. High Pressure Cutout Switch</p> <p>5. R-134a Compressor Discharge Line Temperature Sensor</p> <p>6. Low (Suction) Pressure Gauge</p> <p>7. High (Discharge) Pressure Gauge</p> <p>8. Condenser Check Valve</p> <p>9. Condenser Coil Outlet Tube</p> <p>10. Receiver Tank</p> <p>11. R-134a Receiver Tank Service Fitting</p> <p>12. R-134a High Pressure Relief (Fusible Plug)</p> <p>13. Sight Glass</p> <p>14. Condenser Coil Outlet Tube</p> <p>15. Liquid Line Ball (Service) Valve</p> <p>16. R-134a Threaded Filter Drier</p> <p>17. Liquid Line Solenoid</p> <p>18. R-134a Expansion Valve</p> <p>19. Equalizer Line</p> <p>20. Expansion Valve Feeler Bulb</p> <p>21. Plate Heat Exchanger, R-134a/R-23</p> <p>22. Suction Service Valve</p>	<p>R-23 Refrigeration Circuit Components</p> <p>21. Plate Heat Exchanger, R-134a/R-23</p> <p>23. R-23 Scroll Compressor</p> <p>24. Sight Glass</p> <p>25. Oil Fill / Drain Fitting</p> <p>26. High (Discharge) Pressure Gauge</p> <p>27. Discharge Service Valve</p> <p>28. High Pressure Cutout Switch</p> <p>29. R-23 Compressor Discharge Line Temperature Sensor</p> <p>30. R-23 Condenser Coil Tube (Circular)</p> <p>31. Receiver Tank</p> <p>32. R-23 Receiver Tank Service Fitting</p> <p>33. R-23 High Pressure Relief Valve</p> <p>34. Sight Glass</p> <p>35. R-23 Soldered Filter Drier</p> <p>36. Heat Exchanger</p> <p>37. R-23 Equalizer Line</p> <p>38. Expansion Valve</p> <p>39. Expansion Valve Equalizer Line</p> <p>40. Expansion Valve Feeler Bulb</p> <p>41. Distributor</p> <p>42. Evaporator Coil</p> <p>43. Crankcase Pressure Regulator</p> <p>44. Constant Pressure Regulator</p> <p>45. Buffer (Receiver Tanks)</p> <p>46. Low (Suction) Pressure Gauge</p> <p>47. Suction Service Valve</p> <p>53. Electric Heaters</p> <p>54. Low Pressure Cutout Switch (MPC2000ID Units Only)</p>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------



MPC2000 and 3000A Menu Flow Diagram

