

VM-405 PBBD2

TK 52317-E-1-MM (Rev. 1, 2/09)

The contents of this manual covers information related to the VM-405 PBBD2 unit.

For further information, refer to...

VM-405 PBBD2 Operating Manual

TK 52318-E-1-OP

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.

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Recover Refrigerant

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

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

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

R-404A



WARNING: Use *ONLY* Polyol Ester based refrigeration compressor oil (TK P/N 203-513).

DO NOT use Polyol Ester based oil in standard Thermo King units.

DO NOT mix Polyol Ester and standard synthetic compressor oils.

Keep Polyol Ester compressor oil in tightly sealed containers. If Polyol Ester oil becomes contaminated with moisture or standard oils, dispose of properly—**DO NOT USE!**



WARNING: When servicing Thermo King R-404A units, use only those service tools certified for and dedicated to R-404A refrigerant and Polyol Ester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-404A systems.

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Safety Precautions

GENERAL PRACTICES

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid, refrigeration oil, and battery acid can permanently damage the eyes (see First Aid under Refrigeration Oil).
2. Never operate the unit with the compressor discharge valve closed.
3. Keep your hands, clothing and tools clear of the fans and belts when the unit is running. This should also be considered when opening and closing the compressor service valves.
4. Make sure gauge manifold hoses are in good condition. Never let them come in contact with a belt, fan motor pulley, 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 short, produce toxic gases that are severe respiratory irritants capable of causing death.
7. Make sure all mounting bolts are tight and are of correct length for their particular application.
8. Use extreme caution when drilling holes in the unit. The holes may weaken structural components, and holes drilled into electrical wiring can cause fire or explosion.
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 truck box or garage). Refrigerant tends to displace air and can cause oxygen depletion resulting in suffocation and possible death.
11. EPA Section 608 Certification is needed to work on refrigeration systems.

REFRIGERANT

Although fluorocarbon refrigerants are classified as safe refrigerants, certain precautions must be observed when handling them or servicing a unit in which they are used. When exposed to the atmosphere from 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 if necessary. Stay with victim until arrival of emergency medical personnel.

REFRIGERATION OIL

Avoid refrigeration oil contact with the eyes. Avoid prolonged or repeated contact of refrigeration oil with skin or clothing. Wash thoroughly after handling refrigeration oil to prevent irritation.

First Aid

In case of eye contact, immediately flush with plenty of water for at least 15 minutes. Wash skin with soap and water. CALL A PHYSICIAN.

ELECTRICAL HAZARDS

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 an operating refrigeration unit. Lethal voltage potentials can exist on connections in the high voltage tray of the control box.

Precautions

1. When working on high voltage circuits on the refrigeration unit, do not make any rapid moves. If a tool drops, do not grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
2. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
3. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
4. 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.
5. 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 used in the refrigeration unit are low voltage (24 volts dc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amperes) can cause severe burns if shorted or ground.

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

Specifications

Design Features

- M13 Controller
- Digital Thermometer
- Electronic Thermostat, adjustable from -26 F to 86 F
- Defrost Timer
- Hot Gas Defrost
- Defrost Termination Switch
- Manual Defrost Switch
- Receiver Tank with Outlet Service Valve
- 2HP Semihermetic Compressor 50/60 Hz
- Compressor Thermal Protection
- Hourmeter
- 100W Lamp Plug
- Draining Heater Wire Resistances
- Electric Resistant Heaters (750 W)

Standby AC Motor

Voltage	Phase	Frequency	Horsepower	Full Load Current
230/400	3	50/60 Hz	2	14.1/8.1A

Refrigeration Specifications

Total System Oil Charge		1250 cc (42.2 oz.)
Compressor Oil Type		Polyol Ester P/N 203513
Refrigerant Charge and Type		2.2 kg (4.8 lb) R-404A
Defrost Method		Hot Gas
Defrost Termination Switch:	Opens	8.9 ± 3C (48 ± 5.4 F)
	Closes	2.2 ± 3C (36 ± 5.4 F)
High Pressure Cutout Switch	Opens	450 ± 10 psi
	Closes	375 ± 10 psi
Low Pressure Cutout Switch	Opens	5 to 11 inch. Vacuum
	Closes	27.6 to 48.3 kPa (4 to 7 psi)
Defrost Timer:	Initiation Interval	From 1 minute to 10 hours
	Termination Interval	When Defrost Termination Switch opens



CAUTION: When the oil is removed from the compressor, oil level should be noted so that the same level can be maintained in the replacement compressor.



CAUTION: Polyol Ester compressor oil should be used in standard Thermo King units, and PAG-type or mineral oils should not be added to systems using R404A.

Condenser & Evaporator Fan Motors

	Voltage	Number	Power Rating in W.	Full Load RPM	Full Load Current
Evaporator	26 V	2	100	2800	5.2 A
Condensor	26 V	1	180	2800	8.9 A

Fuses

Voltage	Evaporator fan Fuse 1	Evaporator fan Fuse 2	Condenser fan Fuse 3	M-13 Fuse 4	M-13 Fuse 4/1	Transformer Fuse 5
24 V	10 A	10 A	15 A	3 A	3 A	5 A
Voltage	External lamp Fuse 6	External lamp Fuse 7				
24 V	1 A	1 A				

Hot Gas Solenoid Coils

Voltage	Current	Resistance
24 V	1.3 A	20 Ohms

Heaters

Voltage AC	Number	Power in W.	Full Load Current
220 V	2	750	3.5 A

Maintenance Inspection Schedule

First Week Inspection and Maintenance

AFTER FIRST WEEK OF OPERATION:

- Tighten the unit and mount bracket mounting bolts

Bi-monthly	Annually	Inspect/Service These Items
		ELECTRICAL
•	•	Check defrost initiation and termination.
•	•	Check thermostat cycle sequence.
•	•	Check operation of protection shutdown circuits.
	•	Check thermostat and thermometer calibration in 32 F (0 C) ice-water bath.
	•	Inspect wire harness for damaged wires or connections.
		REFRIGERATION
•	•	Check refrigerant level.
	•	Replace dehydrator.
		STRUCTURAL
•	•	Visually inspect unit and refrigerant hoses for fluid leaks.
•	•	Visually inspect unit for damaged, loose or broken parts.
•	•	Clean defrost drains.
•	•	Clean entire unit including evaporator coil and condenser coil.
•	•	Check all unit mounting bolts, brackets, lines, etc.

Unit Description

The Thermo King VM 405 PBBD2 refrigeration system is a one-piece nose mounted unit. It uses a semihermetic compressor in the condenser section for cooling operation.

The unit is designed for low and medium temperature small-sized compartments. It can cool and defrost on electric compressor operation to refrigerate one compartment with R404A. Heating is accomplished by connecting the heating resistances.

The control circuits operate on 24 Vdc rectified from an AC transformer. Each refrigeration system is protected by high and low pressure cutout switches.

Unit operation is performed from a remote control box. It includes an On/Off switch, manual defrost switch, thermometer, thermostat, thermostat adjustment, and indicator lights.

Compressor operation is controlled by the thermostat, energizing the compressor contact during cooling operation.

Defrost: A hot gas solenoid valve provides local heat to the evaporator by means of hot gas from the discharge line. An electronic defrost timer can initiate defrost automatically. Defrost is normally terminated by the defrost termination switch mounted on the evaporator coil. The defrost cycle can be terminated by pressing the On/Off switch.

DEFROST TIMER

The defrost timer automatically initiates the defrost cycle at preset intervals.

The Defrost Timer is powered directly by the standby power supply. This means that the Defrost Timer is counting whenever the unit is connected to the main supply (while Klixon is closed), even when the unit is switched off.

PROTECTION FEATURES

- High Pressure Cutout Switch

The High Pressure Cutout Switch is a pressure-sensitive switch located in the discharge line. If the discharge pressure rises above 450 psi (3100 kPa), the switch opens the circuit to the PR Relay to stop the unit. When the discharge pressure falls below 375 psi (2600 kPa), the switch closes.

- Low Pressure Cutout Switch

The Low Pressure Cutout Switch is a pressure-sensitive switch located in the suction line. If the pressure falls below 5 to 11 inch vacuum, the switch opens the circuit to the PR Relay to stop unit operation. The switch closes at 4 to 7 psi.

- Overload Relay Protection for Electric Motor

- Overload Relay Protection for heater resistance

- Fuses

- Power Cord LED

- Overload Relay LED

- Thermistor: Disconnects AC motor if its temperature reaches a threshold value.

OPERATION

General

These units cycle among Heat, Cool and Null to maintain the box temperature at the thermostat setpoint. The operating modes are: Cool, Null, Heat and Defrost.

The thermostat controls the operation of the unit by energizing and de-energizing the Power Relay PR.

When the Power Relay is energized, the condenser fans are powered up (as well as the compressor motor).

When the unit is connected to the main supply, the external lamp is powered up by 110 V.

Operating Modes

Cool

The thermostat energizes the Power Relay at box temperatures higher than setpoint. The thermostat keeps the Power Relay energized while the box temperature is higher than 4 F (2.2 C) above setpoint. The Power Relay energizes the evaporator and condenser fan relays, the drain heaters and the compressor contactor. The fans and the compressor run and the unit cools.

Null

The thermostat shifts from Cool to Null at box temperatures lower than setpoint. The thermostat shifts the unit from Cool to Heat at 4 F (2.2 C) below the setpoint. The thermostat shifts the unit from Heat to Null at setpoint.

Heat

The thermostat shifts the unit to Heat at temperatures more than 4 F (2.2 C) below the thermostat setpoint. The thermostat keeps the unit running in Heat until the temperature reaches the thermostat setpoint.

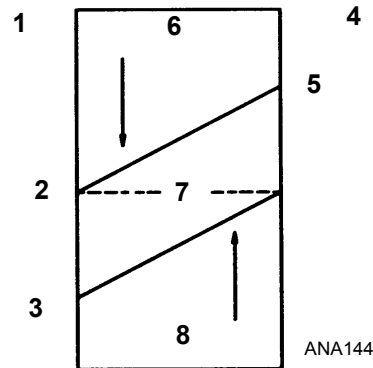
When the unit is in Heat mode, the thermostat drives the heater contactor, the evaporator fans and the electric resistant heaters, and the unit heats.

Defrost

The Defrost cycle can be initiated any time the evaporator coil temperature is below 36 F. Defrost is initiated automatically by the defrost timer, or manually by pressing the manual defrost switch.

When the Power Relay is energized, the drain heaters are activated and the defrost relay energizes the Solenoid Valve PS to route hot refrigerant gas to the evaporator. The defrost relay also interrupts power to the fan relays to stop the evaporator and condenser fans during defrost.

The Defrost cycle will continue until the evaporator coil temperature rises to 48 F, causing the defrost termination switch to open. Defrost cycle can also be terminated by pressing the On/Off switch twice.



1.	Temperature Drop
2.	Setpoint
3.	4 F
4.	Temperature Rise
5.	4 F
6.	Cool
7.	Null
8.	Heat

Operating Modes

Operating Instructions

Leaks

Inspect for refrigerant leaks and worn refrigerant lines.

Electrical

Electrical connections should be securely fastened. Wires and terminals should be free of corrosion, cracks or moisture.

Defrost Drain

Check the defrost drain hose and fittings to be sure that they are open so condensation can run out during defrosting. Check the bottom end of the drain hose to be sure that it is not plugged or crushed.

Structural

Visually check for physical damage.

Sightglass

Check for proper refrigerant charge level.

STARTING THE UNIT

Electric Operation

1. Connect the external power supply to the power receptacle. Make sure that the power supply voltage is correct for the unit. The Power Cord LED must be ON.
2. Press the On/Off Switch in the Control Box. The On/Off LED must be ON.
3. Adjust the thermostat setting.

After Start Inspection

Thermostat

Dial the thermostat setting above and below the box temperature to check thermostat operation.

Pre-Cooling

With the thermostat set at the desired temperature, allow the unit to run for one-half to one hour before loading the container. Pre-cooling will remove residual body heat and moisture from the box interior and provide a good test of the refrigeration system.

Defrost

When the unit has finished pre-cooling, the container interior (evaporator temperature dropped below 2.2 C/36 F), initiate a defrost cycle with the manual defrost switch. The defrost cycle should end automatically.

Loading Procedure

1. Be sure the unit is OFF before opening the door to minimize frost accumulation on the evaporator coil and heat gain inside the box.
2. Spot check and record load temperature while loading. Especially note any off-temperature product.
3. Load product so that there is adequate space for air circulation completely around the load. DO NOT block the evaporator inlet or outlet.
4. Products should be pre-cooled before loading. Thermo King units are designed to maintain loads at a consistent temperature, NOT to cool down hot loads.

Post Load Procedure

To remove excess moisture before storage:

1. Be sure all doors are closed and locked.
2. Adjust the thermostat to the desired temperature set-point.
3. Start the unit.
4. Half an hour after loading, defrost the unit by momentarily pressing the Manual Defrost switch. If the coil temperature drops below 36 F, the unit will defrost. The defrost cycle should stop automatically.

ELECTRONIC CONTROLS

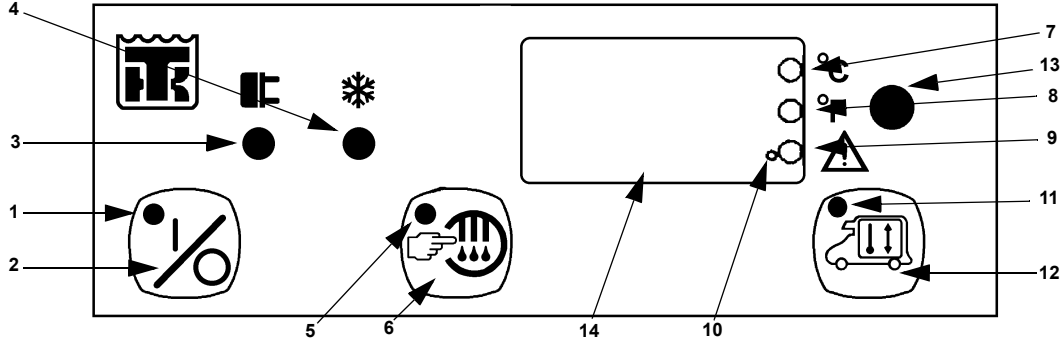
Units are equipped with an M13 controller. The controller regulates unit functions and displays operating information quickly and accurately.



WARNING: Do not operate the unit until you are completely familiar with the display screen and function of each control key.

The M13 controller automatically displays the return air temperature; provides temperature control from -26 to 86 F (-32 to 30 C) in 2 F (1 C) increments; and automatically defrosts every three hours.

NOTE: The defrost interval is set at the factory. The interval may be reset, if needed, by a certified Thermo King technician.



AKB72

Figure 1: M13 Controller

Table 1: M13 Components

1.	ON Indicator Light	5.	Defrost Indicator Light	9.	AC Overload Led	13.	Thermostat Dial
2.	ON-OFF Key	6.	Manual Defrost Key	10.	Setpoint Led	14.	Digital Display
3.	Power Cord Indicator Light	7.	Celsius Led Indicator	11.	Setpoint Key Indicator		
4.	Unit Operation Indicator Light	8.	Fahrenheit Led Indicator	12.	Setpoint Key		

M13 Unit Controls

On-Off Key Press this key to turn the unit ON and OFF. When the unit has been stopped by the HEAT or COOL Overload Relay, press this key to restart the unit.

ON Indicator When this light is on, it indicates that the unit is turned ON. When this light is off, it indicates that the unit is turned OFF.

Power Cord Indicator When this light is on, it indicates that the unit is connected to an AC voltage power supply.

Unit Operation Indicator Light When this light is on, it indicates that the unit is operating. This light indicates both cooling and heating modes. If the light is green, the unit is cooling. If the light is red, the unit is heating. When the unit is stopped by the thermostat, HPCO, or LPCO, the Unit Operation Indicator Light must be OFF and the ON Indicator must remain ON.

Manual Defrost Key Press this key to start a defrost cycle. The unit will not defrost unless the defrost termination switch is closed and the evaporator coil temperature is below 36 F (2 C).

Defrost Indicator When this light is on, it indicates that the unit is in defrost.

Digital Display This display is active only when the unit is turned on. The thermometer reading (return air sensor temperature) normally appears on the display.

Celsius Indicator When this light is on, it indicates that the temperature is being displayed in degrees Celsius.

Fahrenheit Indicator When this light is on, it indicates that the temperature is being displayed in degrees Fahrenheit.

AC Overload Indicator When this light is on, it indicates that the overload relay has opened and the unit has been stopped. This indicator must be reset by pressing the On-Off Key after allowing time for the overload relay to cool.

Setpoint Key Press this key to make the thermostat setpoint appear on the digital display. The thermostat setpoint will remain on the display for 10 to 15 seconds after the key is released. This gives the operator time to adjust the thermostat setpoint.

Thermostat Dial Turn this dial to adjust the thermostat setpoint.

NOTE: The Thermostat Dial will change the thermostat setpoint without pressing the Setpoint Key.

M13 Display Information

With the unit or the controller OFF, the display screen will be dark—nothing will appear on the display screen. When the unit ON/OFF key is pressed ON, the Unit Operation Indicator Light will be lit.

The unit will display the return air temperature or the setpoint temperature on the display screen, depending on the current operating mode.

When the unit is switched OFF, the screen is blank and the Unit Operation Indicator Light goes OFF.

M13 Display Operating Data

During normal operation, the return air temperature remains on the display screen. To display the setpoint, press the setpoint key.

NOTE: The setpoint will remain on the display screen for 10 seconds after the setpoint key has been pressed.

M13 Initiate Manual Defrost

You may initiate a manual defrost anytime the evaporator coil temperature is below 36 F (2 C).

1. Press the manual defrost key. The defrost will light, indicating that the unit is defrosting. The unit will automatically return to the proper operating mode when the defrost cycle is finished. The unit will return to cooling mode automatically when the coil temperature reaches 48 F (8.9 C).
2. To end the defrost cycle before automatic termination, press the ON/OFF key to OFF.

M13 Enter The Setpoint

The setpoint can be easily changed once you are familiar with the controls.

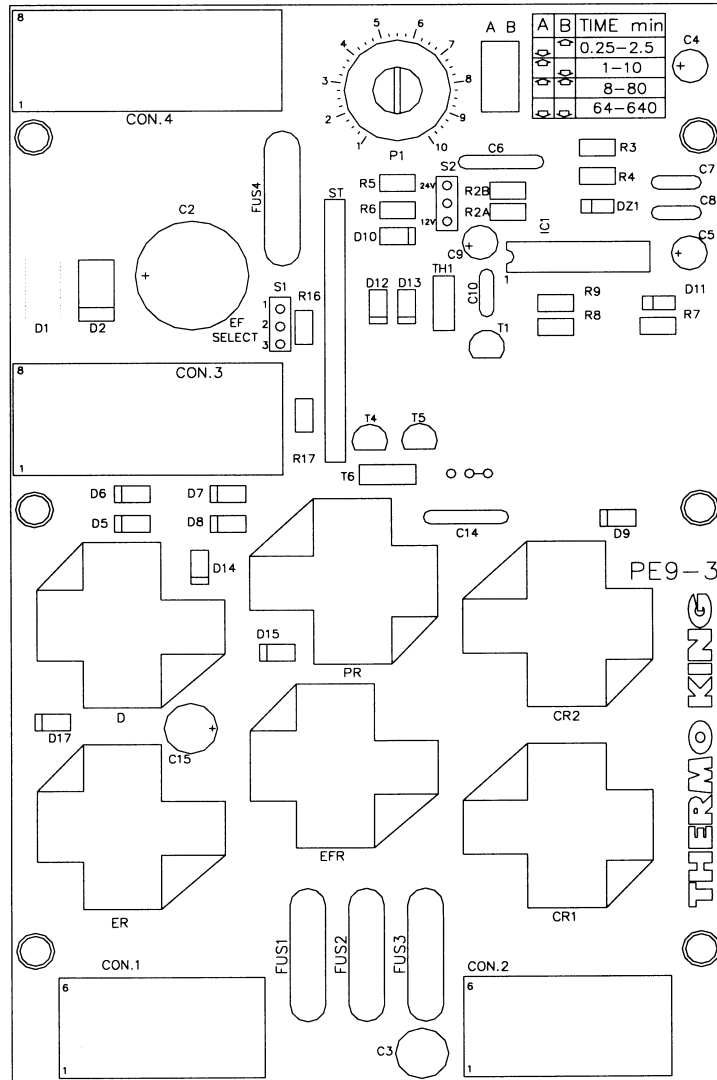
1. Press the setpoint key and the setpoint temperature is displayed on the screen.
2. Observe the controller display and turn the thermostat dial to the desired setpoint temperature.
3. Release the setpoint key. The return air temperature should appear on the display screen after 10 seconds.



CAUTION: Do not accidentally move the thermostat dial. The setpoint temperature can be changed by moving the dial without pressing the setpoint key.

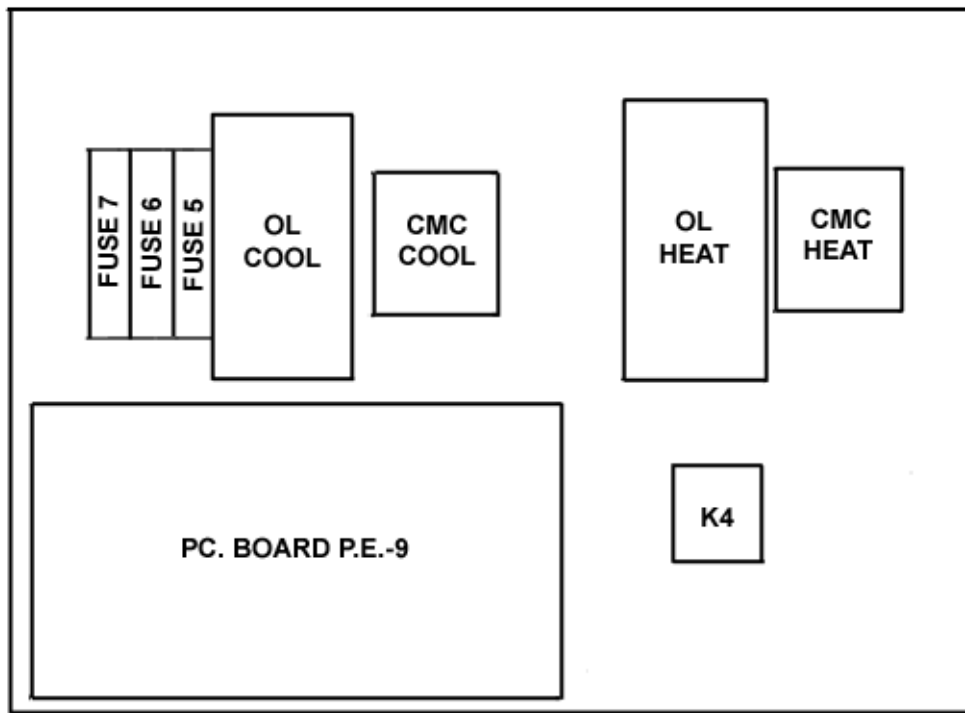
Electrical Maintenance

ELECTRIC BOX



ANA145

P.C. Board P.E.-9



ASA39B

Electric Box (with P.C. Board P.E.-9)

P.C. BOARD

All Printed Circuit Boards manufactured by Thermo King can be easily identified by the P/N stamped on them.

CONNECTORS

All connector codes (C-1, C-2, C-3, and C-4) are stamped on the P.C. Board. Pins on connectors are numbered counter-clockwise. (C-1 and C-2: 6 pin; C-3 and C-4: 8 pin).

FUSES

The fuses 1, 2, 3, and 4 are located on the P.C. Board.

Fuse 1: Protects evaporator fan (EF1) from overload.

Fuse 2: Protects evaporator fan (EF2) from overload.

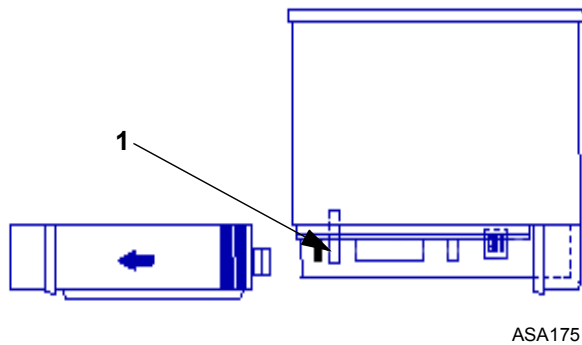
Fuse 3: Protects condenser fan motor and defrost solenoid coil (when defrost is energized) from overload.

Fuse 4: Protects Cab Control Box. It is located on the P.C. Board.

Fuse 4/1: Protects Cab Control box from overload. It is located inside the Cab Control box. Remove the rear cover to access the fuse.

Fuse 5: Protects transformer from overload. It is located on the Electric Box.

Fuses 6 and 7: Protect the external lamp from overload. They are located on the Electric Box.



1.	Fuse 4/1 in controller
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Fuse 4/1 Location

RELAYS

The relays below are located on the P.C. Board.

PR: Power Relay

The Power Relay is energized when the Cab Control Box On/Off switch is pressed (Unit Start) and the box temperature is higher than the setpoint temperature.

EFR: Fan Relay

When energized power cord voltage turns on the evaporator fans (EF1 and EF2).

D: Defrost Relay

The Defrost Relay controls the operation of the defrost cycle. It is energized when the Cab Control Box Defrost Switch or the defrost timer completes the cycle. It will

remain energized until the defrost process is terminated by the Defrost Termination Switch (DK).

CR1, CR2, and ER

These relays are used, but never commutate.

The relays and contactors below are located in the Electrical Box:

CMC COOL: Compressor Contactor

When energized, this relay turns on the AC motor of the semihermetic compressor.

OL COOL: AC Motor Overload Relay

This relay switches off the unit when the current draw through the AC motor is excessive.

CMC HEAT: Electric Resistance Heaters Contactor

When energized, this relay turns the electric resistant heaters.

OL HEAT: Resistance Line Overload Relay

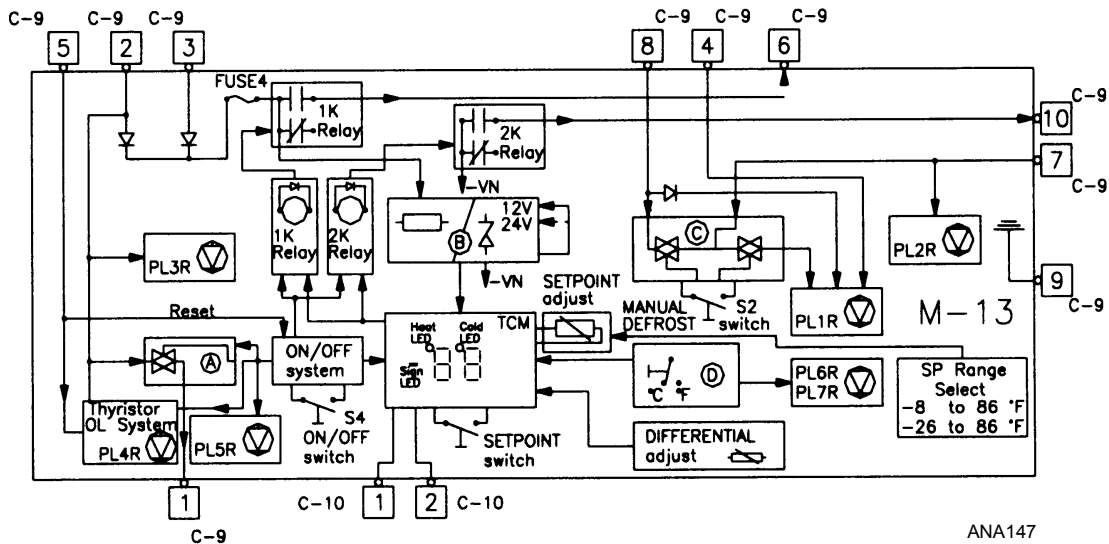
This relay switches off the unit when the current draw through the resistances is excessive.

K4: Auxiliary Fan Relay to control S/S Mode

The K4 Relay is energized when the unit is in COOL or in HEAT mode. When energized turns on the evaporator fans.

TROUBLESHOOTING THE M13 CONTROLLER

Before starting troubleshooting, verify that the 12/24V selector is placed in the 24V position and check the ground circuit through Pin 9 Connector C-9.



Block Diagram M13

IMPORTANT: This troubleshooting only covers M13 functions, and should not be considered as all-inclusive or meant to cover all other electric contingencies.

Symptoms	Remedy
Blank display when the On/Off switch is pressed.	Check voltage on Pin 2 C-9. Check Fuse 4 located inside the Cab Control Box. Replace Cab Control Box.
Unit is not cooling when the Box Temperature is higher than the Setpoint Temperature.	Check voltage on Pin 6 C-9. Replace Cab Control Box.
Unit operation LED if OFF when the unit is cooling.	Check voltage on Pin 7 C-9. Replace Cab Control Box.
Defrost cycle is not initiated when the Manual Defrost switch is pressed.	Box temp. must be higher than Setpoint temp. Evap. Coil temp. must be lower than 36 F (Klixon closed). Press the Manual Defrost switch and check voltage on Pin 8 C-9. Replace Cab Control Box.

Symptoms	Remedy
Defrost LED is OFF when the unit is in Defrost Mode.	Check for open circuit on yellow wire, between Pin 4 C-9 and Pin 2 C-2. Check voltage on Pin 8 C-9. Replace Cab Control Box.
Temperature displayed is out of range.	Check that the Cab Control Box 12/24V selector is in the 24V position. Check the thermostat sensor.
Unit is not working in Electric Mode.	Check the AC Overload Relay (AC Overload LED must be OFF). Check the fuses on PCB. Check voltage on Pin 2 C-9. Check voltage on Pin 1 C-9. Replace Cab Control Box.
Unit is stopped by the AC OL Relay, but the AC Overload LED is OFF.	Check voltage on Pin 5 C-9. Replace Cab Control Box.
Compressor does not run	Check for power at source Check for power at plug Check for power at compressor contactor Check for power at overload terminals (contactor closed) Check for power at motor terminals
Power at compressor terminals but does not run	Replace compressor
Compressor hums but does not run	Power source for single phasing Check capacitors
Check transformer	Check for power output
Check rectifier	Check for rectifier output

Defrost Maintenance

DEFROST DESCRIPTION

A defrost cycle can be started by pressing the manual defrost switch or automatically by the defrost timer, when the defrost termination switch is closed and the unit is in cool mode.

The defrost cycle operates energizing the Defrost Solenoid Coil (PS) and de-energizing the fan relay, which stops the evaporator and condenser fans.

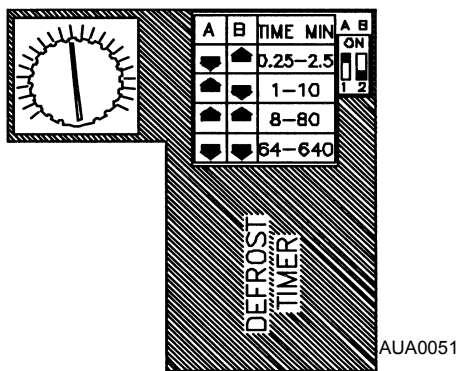
Energizing the Defrost Solenoid Valve diverts hot gas into the evaporator coil, melting ice. A defrost termination switch de-energizes the defrost relay when evaporator coil temperature rises above 48 F.

To initiate the defrost cycle, the evaporator coil temperature must be below 36 F.

DEFROST COMPONENTS

Defrost Timer Settings

The Defrost timer has two switches and a red, round selector. The timer is set from factory at 4 hours. To change the setting of the Defrost timer, proceed as follows:



Defrost Timer

The following table can be found on the printed circuit board:

Timing Table	A	B	Scale
0.25 - 2.5	↓	↑	0.25 to 2.5 minutes
1 - 10	↑	↓	1 to 10 minutes
8 - 80	↑	↑	8 to 80 minutes
64 - 640	↓	↓	1 to 10 hours

Choose a range from the timing table and set the A and B selectors to the desired position.

Example: Setting the A and B selectors to the positions A:↓ and B:↓ selects a range of time between 64 and 640 minutes (1 to 10 hours).

The red selector multiplies the minimum value of the chosen range by the value at which it is pointing.

If the selector points to position 2: $2 * 64 = 128$ minutes (approximately 2 hours).

If the selector points to position 4: $4 * 64 = 256$ minutes (approximately 4 hours).

Manual Defrost Switches

A Manual Defrost switch is located in the Cab Control Box. Pressing this switch initiates the defrost cycle if the defrost termination switch is closed and the unit is in Cool mode.

Defrost Termination Switch (Klixon)

The Defrost Termination switch is mounted in the evaporator coil and controls the defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 36 F, completing the defrost circuit to ground and preparing the electrical system for the defrost cycle.

When the unit does shift into a defrost cycle, the evaporator and condenser fan stop, and heat from the hot refrigerant gas melts the frost from the evaporator coil. The switch opens and terminates the defrost cycle when the evaporator coil temperature rises above 36 F.

Defrost Relay

The Defrost relay controls operation of the defrost cycle. When the Defrost Timer or the Manual Defrost switch completes the circuit through the defrost termination switch to ground, the defrost relay is energized. This energizes the Solenoid Valve and de-energizes the condenser fan.

The defrost relay stays energized until the defrost cycle is terminated by the defrost termination switch or the On/Off switch is pressed.

Defrost Solenoid Valve

The hot gas valve is an electrical valve that controls the flow of refrigerant through the refrigeration system.

When Solenoid Valve PS is energized, the hot gas valve is opened and it routes hot refrigerant gas to the evaporator.

TESTING THE DEFROST SYSTEM

To test the defrost system, run the unit on Cool until the evaporator coil temperature is below 36 ± 5.4 F and press the manual defrost switch.

If the unit doesn't switch to defrost cycle, proceed to step 1 (below).

1. Check the Evaporator Temperature.

Be sure that the evaporator coil temperature is actually below 36 ± 5.4 F, or the unit will not defrost. Use a test thermometer to check the evaporator temperature.

2. Check the defrost termination switch.

If the unit fails to defrost, place a jumper wire between both switch terminals. Press the Manual Defrost switch.

If the unit shifts to Defrost, the defrost termination switch is defective.

If the unit does not switch to Defrost, check for an open circuit in the 12 wire. If the 12 wire is not opened, proceed to step 3.

3. Check voltage on PCB terminal of GR (grey) wire.

If voltage is present, proceed to step 4.

4. Check for open circuit on wire GR that goes to Cab Control Box (Pin 8 C-9).

If the wire GR is not open, proceed to step 5.

5. Keeping the Manual Defrost switch pressed, check voltage on Pin 8 C-9.

If voltage is present on Pin 8 C-9, and the rest of the above mentioned points are correct, replace the Printed Circuit Board.

If voltage is not present on Pin 8 C-9, follow Cab Control Box troubleshooting directions.

Defrost Timer Test

The defrost timer initiates the defrost cycle.

1. Verify that the evaporator coil temperature is lower than 36 ± 5.4 F, otherwise jump up the Klaxon terminals.
2. Set the Defrost Timer to approximately 1 minute: A: ↓, B: ↓, red round selector position 4.
3. After approximately 1 minute, the defrost must be initiated: Defrost LED, Defrost Relay, and Solenoid Valve must be activated.

Refrigeration Maintenance

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.

The liquid line sight glass helps the operator to determine the amount of charge under established operating conditions. These units can be damaged by an over-charge of refrigerant.

The VM-405 PBBD2 compressor for R-404A is filled with Polyol Ester Oil P/N 203513. Refer to Refrigeration Specifications for more information.

CHARGING AN EVACUATED UNIT BY WEIGHT

1. Install a gauge manifold. Keep the unit off.
2. Recover the refrigerant and evacuate the system.
3. Place the refrigerant bottle on a scale and attach the manifold's service line.
4. Purge air from the service line as required. Open the bottle to withdraw liquid.
5. Record total refrigerant and container weight.
6. Check the unit data plate or unit Maintenance Manual for refrigerant weight required.
7. Midseat the compressor discharge service valve.
8. Open the discharge valve all the way on the gauge manifold and begin charging the unit. Refrigerant flow can be felt as small pulsations on the manifold service line.
9. Watch the scale and close the hand valve at the refrigerant bottle when the correct charge has been added. If refrigerant flow stops before charging is complete, add liquid to complete charging.

Adding Liquid in the Low Side to Complete Charging

1. Backseat the discharge service valve. Midseat the suction service valve.
2. Set the bottle to withdraw liquid. Close the manifold's high pressure hand valve.
3. Run the unit in cool and read suction pressure.
4. Open the manifold low pressure hand valve to allow liquid to enter and suction pressure to increase approximately 25 psi.
5. When the correct weight has been added, close the hand valve at the refrigerant bottle.
6. Remove the gauge manifold using the correct procedure.
7. Use good caps and seals and secure service port caps and valve stem covers before returning the unit to service.

Checking the Refrigerant Charge

If the unit has an insufficient charge of refrigerant, the evaporator will be “starved” and the box temperature will rise even though the unit is operating. Also, an insufficient charge does not circulate enough oil to properly lubricate the compressor. The charge may be determined by inspection of the refrigerant through the sight glass with the following conditions established:

1. Install gauge manifold set.
2. Run unit on Cool until the thermometer reads 0 F.
3. The discharge or head pressure gauge should read 270 psi on the gauge manifold.

NOTE: *The condenser coil may have to be partially covered in order to reach 270 psi in cool ambients. In extreme ambient temperatures a head pressure as high as 350 psi is acceptable.*

4. Under these conditions, the sight glass must indicate a full charge.

HIGH PRESSURE CUTOUT SWITCH

The high pressure cutout switch is located on the check valve assembly inside the condenser unit. If the discharge pressure rises above 450 psi on R-404A units, the switch opens the 7A (see unit diagram) circuit, de-energizing the Power Relay.

To test the switch, rework a gauge manifold:

1. Connect the gauge manifold to the compressor discharge service valve.

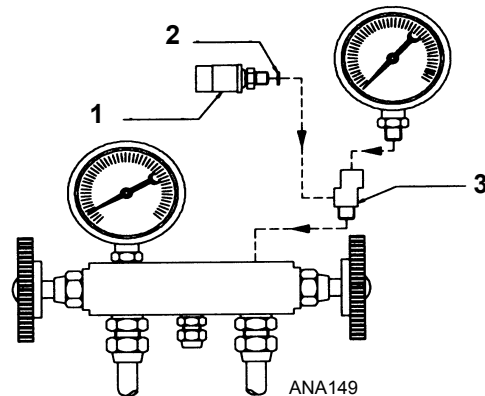
NOTE: *Service manifold hoses must have Schrader valve (tube valve) depressors.*

2. Set the thermostat well below the box temperature so that the unit will be on Cool mode.

3. Raise the discharge pressure of the compressor by blocking the condenser coil air flow. When the discharge pressure gets up to 450 psi on R-404A units, the High Pressure Cutout will switch off the unit.

NOTE: *The discharge pressure should never be allowed to exceed a pressure of 450 psi.*

4. Failure of the high pressure cutout system to stop compressor operation should be investigated first by checking the control circuit operation and second by High Pressure Cutout switch replacement.



1.	Relief valve (66-2202)
2.	O-Ring (33-1015)
3.	Adapter Tee Weather Head No. 552x3

High Pressure Cutout Manifold

Refrigeration Service Operations

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.

COMPRESSOR

Removal

1. Pump down the compressor. Front seat suction and discharge service valves.
2. Disconnect the discharge and suction hoses.
3. Keep the compressor ports and the suction and discharge lines for the compressor covered to prevent contamination of system components.
4. Remove the compressor mounting screws. Remove the compressor.

Installation

NOTE: Any compressor installed in this system must contain the proper amount of compressor oil (see the Specifications section). Always check to make sure that the compressor contains the proper amount of oil. Follow the system cleanup procedures to remove old oil from the system.

1. Place the compressor in position and install the mounting screws and the belt.
2. Connect suction line and discharge line.
3. Pressurize the system and test for leaks.
4. Evacuate the system and recharge.

CONDENSER COIL

Removal

1. Recover the refrigerant charge.
2. Remove the condenser cover.
3. Remove the condenser fan.
4. Remove the inlet and liquid lines.
5. Remove mounting screws and nuts.
6. Remove the condenser oil.

Installation

1. Clean the tubes for soldering.
2. Place the coil in the unit and install the screws and nuts.
3. Solder the inlet and liquid line connections.
4. Pressurize the system and test for leaks.
5. Mount condenser fan.
6. Evacuate the system.
7. Recharge the unit.
8. Reinstall the cover.s

FILTER DRIER

Removal

1. Pump down the low side of the system and equalize the pressure to slightly positive.
2. Disconnect the nuts at the ends of the drier.
3. Loosen the mounting hardware and remove the drier.

Installation

1. Place new O-rings in the fittings on the ends of the drier.
2. Install the new drier and tighten the mounting screws and nuts.
3. Install and tighten the inlet nut. Hold the drier with a back-up wrench on the hex behind the fitting.
4. Release a small amount of refrigerant to purge the air through the drier, and then tighten the outlet nut.
5. Pressurize the system and inspect for leaks. If no leaks are found, open the refrigeration valves and place the unit in operation.

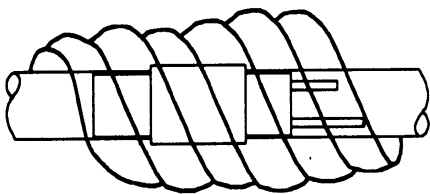
EVAPORATOR ASSY

Removal

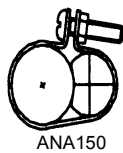
1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove evaporator fan motor assy.
3. Disconnect the expansion valve from the distributor and remove the expansion valve.
4. Remove the defrost termination switch.

Installation

1. Install the evaporator fan motor assembly.
2. Install the expansion valve (see drawing below).
3. Install the Low Pressure Cutout.
4. Install the defrost termination switch.
5. Connect refrigeration lines.
6. Pressurize the system and test for leaks. If no leaks are found, evacuate the system.
7. Connect the evaporator fan motor lead(s). Install the evaporator panel(s).
8. Open the refrigeration valves and place the unit in operation. Check the refrigeration charge and compressor oil and add as required.



Bulb Location



HIGH PRESSURE CUTOUT (HPCS)

Removal

1. Recover the refrigerant charge.
2. Disconnect the wires and remove the switch.

Installation

1. Apply a refrigerant locktite to the threads of the switch.
2. Install and tighten the switch and reconnect the connector.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, charge the system.

LOW PRESSURE CUTOUT SWITCH

Removal

1. Pump down the low side and stop the unit.
2. Unplug the switch connector and remove the switch.

Installation

1. Apply a refrigerant oil to the threads of the switch.
2. Install and tighten the switch and reconnect the connector.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, evacuate the low side.
5. Open the receiver tank outlet valve, start the unit and check the refrigerant charge.
6. If no leaks are found, evacuate the system.
7. Recharge the unit with refrigerant and check compressor oil.

HOT GAS SOLENOID VALVE

Removal

1. Recover the refrigerant charge.
2. Disconnect the coil wires.
3. Unsolder the refrigeration lines from the solenoid.
4. Unbolt the solenoid and remove the mounting bracket.

Installation

1. Bolt the solenoid to the mounting bracket.
2. Solder the refrigeration lines and electrical wires to the solenoid.
3. Pressurize the system and test for leaks.
4. Evacuate and recharge the system.

LOW SIDE PUMPDOWN PROCEDURE

1. Install a calibrated gauge manifold.
2. Run the unit in cool for 10 minutes or more.
3. Front seat the receiver tank outlet valve (RTOV).
4. Pump down the low side to a 25 inch vacuum. Stop the unit. Low side pressure should remain below a 15 inch vacuum for 2 minutes or more.

If Pressure Rises...

- To zero and stops: Low side leak to the atmosphere.
- Above zero: Refrigerant boiling out of the oil or internal high pressure to low pressure area leaks.

Perform With the Low Side Pumped Down and a Slight Positive Pressure Established

- Add or remove refrigerant oil
- Clean expansion valve screen

- Change expansion valve
- Replace drier.

Removing the Compressor or Compressor Head

1. Pump down the low side to a 15 inch vacuum or more.
2. Stop the unit.
3. Immediately front seat the discharge service valve.
4. Balance pressures through the manifold. Add additional pressure from the discharge service valve if necessary to establish 1 to 2 psig.
5. Front seat the suction service valve.



WARNING: Do NOT start the unit with the discharge service valve front seated. Severe personal injury may result.

COMPRESSOR PUMPDOWN PROCEDURES

1. Install a calibrated gauge manifold.
2. Run the unit in cool for 5 minutes or more.
3. Front seat the suction service valve and pump down the compressor to a 25 inch vacuum.
4. Stop the unit. Crankcase pressure should remain below zero psig for 15 seconds or more. If pressure rises, repeat pumpdown several more times.

If Pressure Still Rises...

- To zero and stops: Low pressure leak to the atmosphere.
- Above zero: Refrigerant boiling out of the oil or internal high to low pressure area leak through the reed plate.

Adding or Removing Compressor Oil

Pump down the compressor and adjust pressures slightly positive (1 to 2 psig).

Removing the Compressor or Compressor Head

1. Pump down the compressor to a 15 inch vacuum.
2. Stop the unit.
3. Immediately front seat the discharge service valve.
4. Balance pressures through the gauge manifold to 1 or 2 psig.
5. If 1 to 2 psig cannot be established, the refrigerant must be recovered or a low side pumpdown must be performed.



WARNING: Do *NOT* start the unit with the discharge service valve front seated. Severe personal injury may result.

INSTALLING AND PURGING A GAUGE MANIFOLD EQUIPPED WITH LOW LOSS FITTINGS

1. Remove both the discharge and suction service valve stem caps. Save and reuse the caps and sealing washers or gaskets.
2. Make sure both service valves are back seated.
3. Remove the service port caps for both the suction and discharge service valve. Save and reuse the caps and sealing washers or gaskets.
4. Attach the high pressure gauge line to the discharge service port finger tight.
5. Turn the discharge service valve stem 1/4 turn open to the service port.
6. Open both manifold hand valves.

7. Slowly screw a 1/4 inch flare fitting into the service line low loss fitting to purge the service line. Remove the flare fitting after purging.
8. Slowly screw a 1/4 inch flare fitting into the manifold low pressure line low loss fitting to purge the line. Remove the flare fitting after purging.
9. Install the manifold low pressure line on the suction service valve service port.
10. Turn the suction service valve stem 1/4 turn open to the service port.
11. Close both manifold hand valves.

REMOVING THE GAUGE MANIFOLD

1. Operate the unit in cool mode.
2. Back seat the discharge service valve stem.
3. Open both manifold hand valves.
4. Front seat the suction service valve and pump down the compressor. Turn off the unit.
5. Establish compressor crankcase pressure between 1 and 3 psig.
6. Remove the gauge lines and cap the service ports.
7. Back seat the suction service valve.
8. Install and tighten both stem caps.
9. Secure all manifold lines to the hose anchors when the manifold is not in use.

SETTING THE CPR VALVE

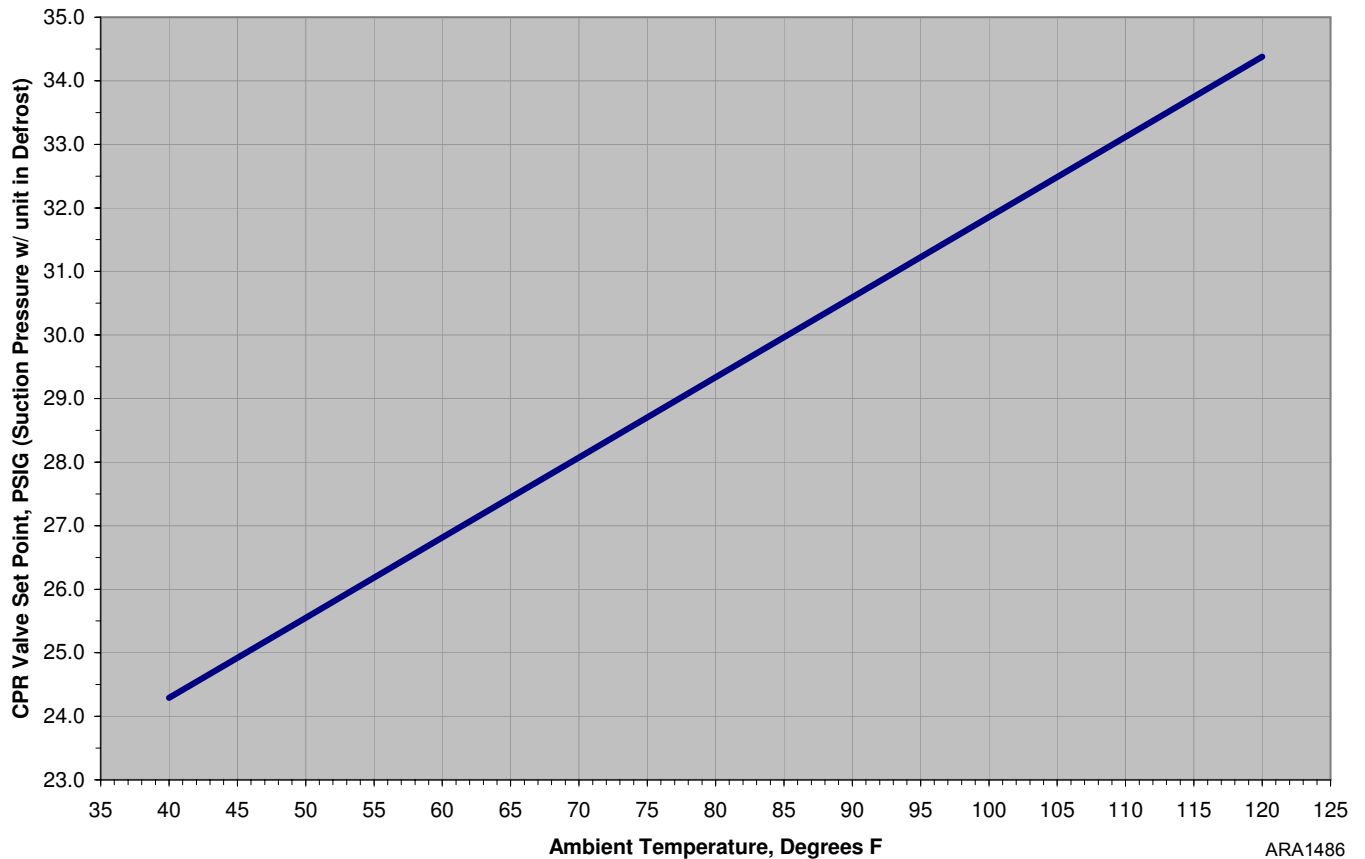
The CPR (Compressor Pressure Regulator) valve is also called the suction pressure regulator valve. Use the following procedure to set the CPR valve set point.

1. Install a calibrated gauge manifold.

2. Set the thermostat to 30 F.
3. Run the unit in cool until the box temperature is at 30 F.
4. Press the manual defrost key to place the unit in defrost.
5. Monitor the suction pressure and compare it to the suction pressure for the current ambient temperature as shown in the following chart.
6. If the suction pressure differs from what is shown in the chart, remove the protective cap from the CPR valve and turn the adjuster as necessary to obtain the suction pressure shown in the chart.
7. Take the unit out of defrost and repeat steps 3 through 5 to recheck the suction pressure and readjust the CPR valve if necessary. Reinstall the protective cap when finished.
8. Remove the gauge manifold set.

VM405 PBBD2 CPR Valve Set Point Chart

Box Temperature = 30 Degrees F



ARA1486

Structural Maintenance

UNIT INSPECTION

Inspect the unit during the pre-trip inspection and during scheduled maintenance inspections for loose or broken wires or hardware, compressor oil leaks, or other physical damage which might affect the unit performance and require the repair or replacement of parts.

EVAPORATOR COIL

Clean the evaporator coil during scheduled maintenance inspection by blowing compressed air through the coil in the direction opposite the normal air flow. Inspect the coil and fins for damage and repair if necessary.



CAUTION: *Air pressure should not be high enough to damage the coil fins.*

CONDENSER COIL

Clean the condenser coil during scheduled maintenance inspections by blowing compressed air from the back side of the coil out toward the front of the unit (the direction opposite normal air flow). Inspect the coil and fins for damage and repair if necessary.

UNIT MOUNTING BOLTS

Periodically check and torque the unit mounting bolts.

Mechanical Diagnosis

If the desired box temperature cannot be obtained, any of the following may be indicated:

EXCESSIVE HEAT LOAD. An excessive heat load on the system will be caused by too many, or excessively long, door openings. Excessive heat loads will also be caused by loose doors, loose body panels, warm loads and poor insulation.

DIRT ON COILS. Dirt on the condenser or evaporator coils acts as an insulator reducing the capacity of the unit.

SHORTAGE OF REFRIGERANT. Shortage of refrigerant reduces the capacity of the unit. Find and remedy the cause of the shortage and recharge the system. **DO NOT** operate the unit if there is an indication of low charge. **DO NOT** operate below 30 F (-1 C) box temperature if the refrigerant is foaming in the sight glass on the liquid line.

EXCESSIVE OIL. Too much compressor oil in the system may result in lower than normal suction pressure as well as lowered capacity.

MOISTURE IN THE SYSTEM. Symptom: Expansion valve freeze-up—will not refrigerate. Usually this can be checked by warming the expansion valve with either a hand or hot towels to see if the valve opens. Evacuate the system in the same manner used during installation. Install a new drier.

EXPANSION VALVE LOSES ITS CHARGE. If the expansion valve loses its charge, the valve will close causing the system to go into vacuum. Replace the valve.

AIR IN THE SYSTEM. Air is not condensable. Its presence in the system increases head pressure. When the compressor is stopped, air will gather at the high point of the high side. Recover and evacuate the system.

TEMPERATURE OF THE LIQUID LINE. During normal operation, the liquid line will be slightly warmer than the surrounding air. An extremely hot line indicates either a shortage of refrigerant or a lack of a liquid seal at the receiver outlet. A cold line indicates a restriction, and some flashing takes place in the liquid line sight glass.

DIRTY OR WET DRIER. If the outlet line of the drier is colder than the inlet line, the drier is either saturated with moisture or is dirty and must be replaced.

DIRT IN THE EXPANSION VALVE SCREEN. Recover the refrigerant charge, remove the screen and clean. If the moisture is in the refrigeration system, it will collect at the expansion valve and freeze. This is indicated by abnormally low suction pressure. Clean the system, replace the drier, evacuate the system pressurize and check for leaks. If no leaks are found, charge the system.

ICE ON THE EVAPORATOR COIL. Run the unit through a defrost cycle to remove the ice.

COMPRESSOR LIFE. Operating without sufficient oil in the system, or at low temperatures over the road at high compressor speeds, can cause short compressor life.

AIR FLOW. Do not load product directly in front of the air return or discharge. Ensure that the fan is correctly positioned in the orifice to achieve maximum air flow.

Electrical Mechanical Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Compressor does not run	Improperly wired	Check wiring against diagram
	Low line voltage	Check line voltage—determine location of voltage drop
	Relay contacts not closing	Check and replace relay if defective
	Open circuit in motor winding	Check motor leads. If leads OK, replace motor
	Power relay open	Check relay, replace if defective
	Compressor wiring defective	Close power supply start or disconnect switch
	Fuses blown	Replace fuses
	Thermostat stuck open	Refer to M13 troubleshooting
	High pressure cutout switch open	Eliminate cause of excessive pressure
	Compressor piston stuck	Replace compressor
	Low pressure cutout open	Recharge, leak test
	Shortage of refrigerant	Check for leaks, repair as required, and recharge
	Overload relay open	Turn On-Off switch OFF and back ON
Unit short cycles	Shortage of refrigerant (low pressure cutout)	Repair leak and recharge
	Evaporator fan rotating in wrong direction	Check DC motor polarity
	Restricted expansion valve (low pressure cutout)	Replace expansion valve
	Refrigerant overcharge (high pressure cutout)	Remove excess charge
	Cycling on high pressure cutout	Check air flow and fan
	Clogged condenser coil	Clean coil

CONDITION	POSSIBLE CAUSE	REMEDY
Unit operates long or continuously	Shortage of refrigerant	Repair leak and recharge
	Discharge valve leaking	Replace compressor
	Dirty condenser	Clean condenser
	Air in system	Evacuate the system
	Compressor inefficient	Replace compressor
	Plugged expansion valve	Clean or replace
	Iced or plugged coil	Defrost or clean
	Defective truck body insulation	Correct or replace
	Too many door openings	Keep doors closed
	Load too warm	Precool hot product
	Excessive superheat at expansion valve	Replace expansion valve
	Door seals worn	Repair/replace
Box temperature too high	Refrigerant shortage	Repair leak and recharge
	Thermostat set too high	Reset control
	Expansion valve or strainer plugged	Clean or replace
	Restricted lines	Clean restriction. Tubing pinched shut
	Hot load	Precool hot product
	Expansion valve superheat too high or too low	Replace expansion valve
Head pressure too high	Refrigerant overcharge	Remove excess
	Air in system	Evacuate system
	Dirty condenser	Clean
	Restricted condenser	Clean condenser
	Condenser fan not running	Check fan motor
	Condenser fan rotating backwards	Check fan motor polarity

CONDITION	POSSIBLE CAUSE	REMEDY
Head pressure too low	Refrigerant shortage	Repair leak and recharge
	Compressor suction or discharge valve inefficient	Replace compressor
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Mounting bolts loose	Tighten
	Refrigerant flooding back	Adjust oil level or refrigerant charge. Check expansion valve for proper superheat
Compressor loses oil	Shortage of refrigerant	Repair leak and recharge
	Plugged expansion valve or strainer	Clean or replace
	Wrong oil viscosity	Use proper oil
	Short cycling	Refer to Unit Short Cycles
	Superheat too high	Replace expansion valve
Frosted or sweating suction line	Expansion valve set too low, admitting excess refrigerant	Replace expansion valve
	Frosted evaporator coil	Defrost coil
	Dirty evaporator coil	Clean or remove debris
	Evaporator fans fail	Repair fans
Hot liquid line	Shortage of refrigerant	Repair leak and recharge
Frosted liquid line	Restricted dehydrator or strainer	Replace restricted part
Condenser coils cool when unit is in cool	Refrigerant undercharge	Repair leak and recharge
	Compressor inefficient	Replace compressor
Unit in vacuum. Frost on expansion valve only	Ice plugging expansion valve orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace drier
	Plugged expansion valve strainer	Clean strainer
	Sensor bulb lost charge	Replace expansion valve

Refrigeration Diagnosis

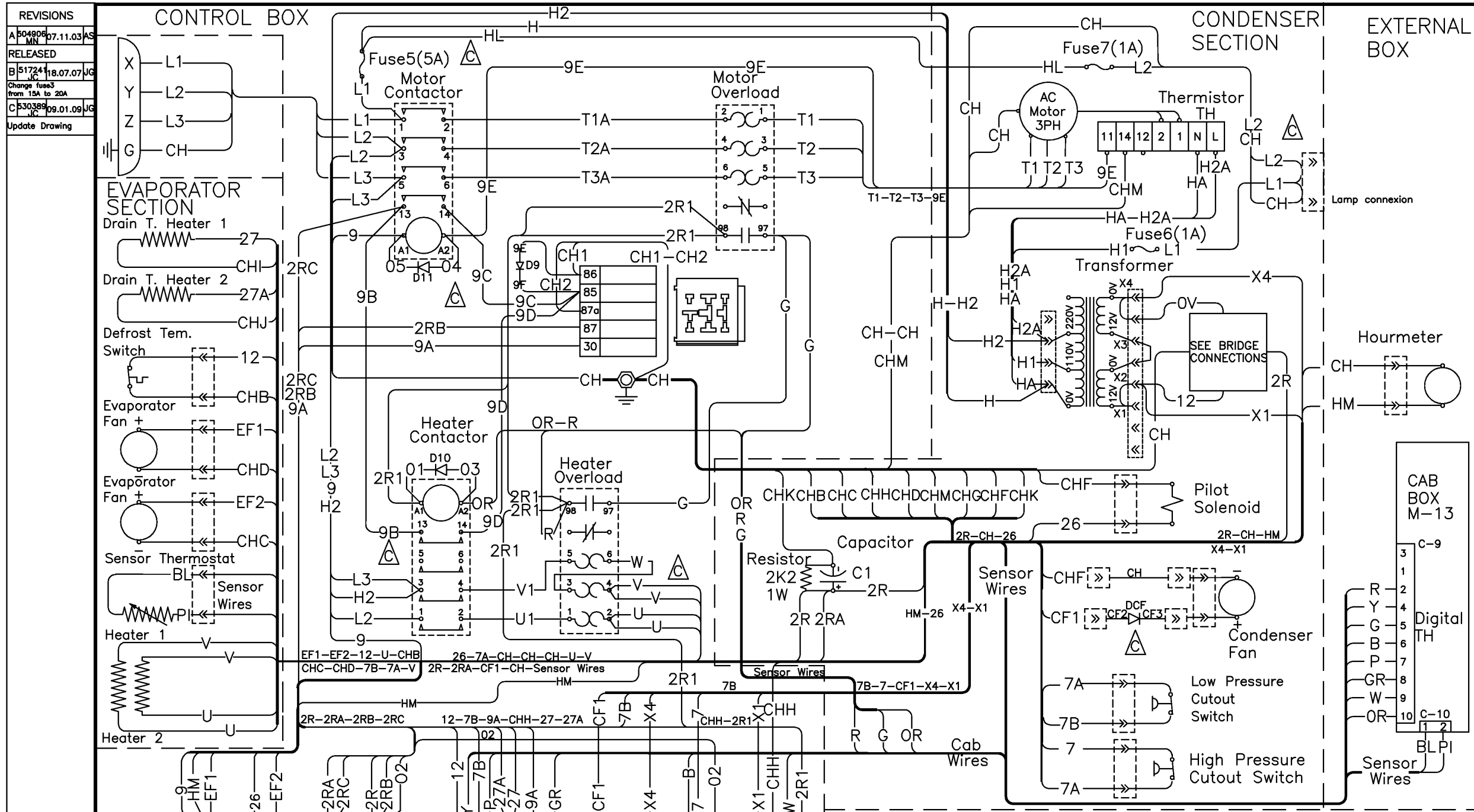
Rapid cycling	Unit cools in defrost cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Sight glass empty	Suction line frosting back	Noisy compressor	Unit not refrigerating	Unit not defrosting	SYMPTOM	POSSIBLE CAUSES
	•				•						•	•		Overcharge of refrigerant	
		•				•		•	•					Shortage of refrigerant	• •
		•					•	•						No refrigerant	• •
	•													Air through condenser too hot (ambient)	
	•													Air flow through condenser restricted	
		•			•				•					Air through condenser too cold (ambient)	
		•									•	•		Air in refrigerant system	
	•													Condenser fan blades bent or broken	
														Air short cycling around evaporator coil	
					•					•				Air through evaporator restricted	
					•			•		•	•			Evaporator needs defrosting	
		•												Compressor discharge valves leaking	
				•										Compressor suction valves leaking	
													•	Too much compressor oil in system	
												•		Compressor bearing loose or burned out	
		•										•		Broken valve plate in compressor	
					•								•	Expansion valve power element lost its charge	
					•					•				Expansion valve feeler bulb improperly mounted	
					•					•		•		Expansion valve feeler bulb making poor contact	

SYMPTOM										POSSIBLE CAUSES				
Rapid cycling	Unit cools in defrost cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Sight glass empty		Suction line frosting back	Noisy compressor	Unit not refrigerating	Unit not defrosting
					•					•				Expansion valve open too much
						•						•		Expansion valve closed too much
					•					•				Expansion valve needle eroded or leaking
					•		•					•		Expansion valve partially closed by ice, dirt or wax
					•						•			Liquid refrigerant entering compressor
					•		•							Restricted line on the low side
	•				•		•					•		Restricted line on the high side
					•		•					•		Restricted dehydrator
•		•												Reverse fan rotation
	•											•	•	Faulty pilot solenoid
	•											•		Loose or broken electrical connections
		•												Condenser fan motor not operating
					•		•			•	•	•		Evaporator fan motor not operating

Wiring Diagrams and Schematic Index

Dwg No.	Drawing Title	Rev.	Page
1E21449	Schematic Diagram	C	41
1E21448	Wiring Diagram	C	42
1E21507	Refrigeration Diagram	A	43

Wiring Diagram



Wire Cab Box	Power	Capacitor	Fuse 1	Fuse 2	Fuse 3	Fuse 4	Fuse 4/1	Transformer Connections
R OR Y G B P GR W BL PI	24V	C1 30.000eF 40V	C2 2200eF 35V	C3/C15 47eF 100V	10A	10A	20A	3A 3A
ON PRINTED CIRCUIT BOARD ON PRINTED CIRCUIT BOARD CAB BOX								

ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S
LIST OF MATERIAL					
DRAWN	M J Nus	DATE	07_Nov_03		
CHECKED	A. SENDINO	DATE	07_Nov_03		
APPROVED	M J Nus	DATE	07_Nov_03		
THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.					
			SCALE		
			SHEET 1 OF 1		
			MATERIAL:		
			FINISH:		
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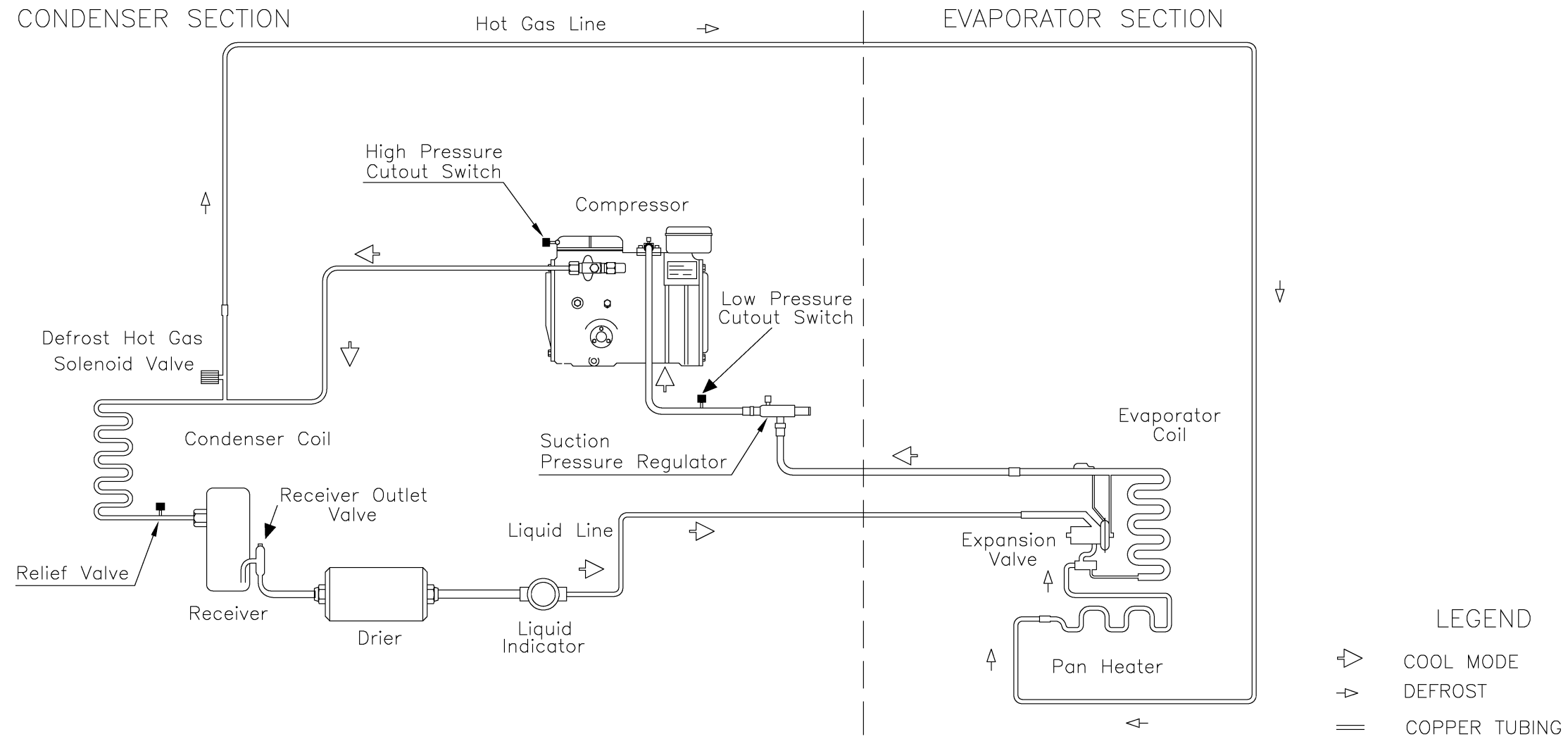
DIAGRAM WIRING
VM-405 PBBD2
3 PH; 24V

Ref. 1E21449

DRAWING NUMBER	REV.
1E21448	C

Refrigeration Diagram

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP
504906	A	RELEASED	17/11/03	AG	AS	JL



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S
LIST OF MATERIAL					
DRAWN A. GIL	DATE 17/11/03	REFRIGERATION DIAGRAM VM 405-PBBD2			
CHECKED A. SENDINO	DATE 17/11/03				
APPROVED JORDI L.	DATE 14/06/04				
THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.			SHEET <u>1</u> OF <u>1</u>	DRAWING NUMBER 1E21507	REV. A
SCALE		MATERIAL:		FINISH:	
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