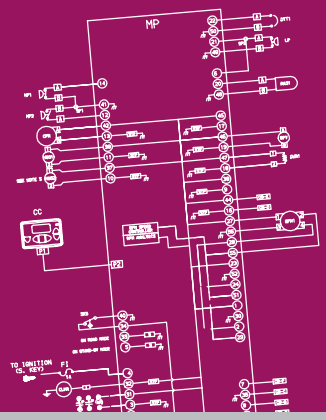
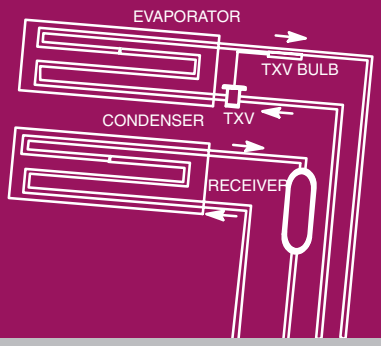
Carrier Truck Refrigeration





OPERATION & SERVICE

for

20X

Truck Refrigeration Units

62-10891 Rev -

Carrier

TRANSICOLD

OPERATION AND SERVICE MANUAL

20X

TRUCK REFRIGERATION UNITS

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SAFETY SUMMARY

GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. The general safety notices are presented in the following three sections labeled: First Aid, Operating Precautions and Maintenance Precautions. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

Your Carrier Transicold refrigeration unit has been designed with the safety of the operator in mind. During normal operation, all moving parts are fully enclosed to help prevent injury. During all pre-trip inspections, daily inspections, and problem troubleshooting, you may be exposed to moving parts. Stay clear of all moving parts when the unit is in operation and when the ON/OFF switch is in the ON position.

FIRST AID

No injury, no matter how slight, should go unattended. Always obtain first aid or medical attention immediately.

OPERATING PRECAUTIONS

Always wear safety glasses. Wear hearing protection as required.

Keep hands, clothing and tools clear of the evaporator and condenser fans.

No work should be performed on the unit until the unit is turned off and the battery power supply is disconnected.

Always work in pairs. Never work on the equipment alone.

In case of severe vibration or unusual noise, stop the unit and investigate.

MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the unit. This unit is equipped with Auto-Start. The unit may start at any time. When performing any check of the system make the unit is turned off and the battery power supply is disconnected.

Be sure unit is turned off before working on motors, controllers, solenoid valves and electrical control switches. Tag vehicle ignition to prevent accidental energizing of circuit.

Do not bypass any electrical safety devices, e.g. bridging an overload, or using any sort of jumper wires. Problems with the system should be diagnosed, and any necessary repairs performed, by qualified service personnel.

When performing any arc welding on the unit or container, disconnect all wire harness connectors from the microprocessor. Do not remove wire harness from the modules unless you are grounded to the unit frame with a static safe wrist strap.

In case of electrical fire turn unit off and extinguish with CO_2 (never use water).

REFRIGERANTS

The refrigerant contained in your unit can cause frostbite, severe burns, or blindness when in direct contact with the skin or eyes. For this reason, and because of legislation regarding the handling of refrigerants during system service, we recommend that you contact your nearest Carrier Transicold authorized repair facility whenever your unit requires refrigeration system service .

SPECIFIC WARNING AND CAUTION STATEMENTS

To help identify the label hazards on the unit and explain the level of awareness each one carries, an explanation is given with the appropriate consequences:

DANGER – means an immediate hazard which WILL result in severe personal injury or death.

WARNING – means to warn against hazards or unsafe conditions which COULD result in severe personal injury or death.

CAUTION – means to warn against potential hazard or unsafe practice which could result in minor personal injury, product or property damage.

The statements listed below are applicable to the refrigeration unit and appear elsewhere in this manual. These recommended precautions must be understood and applied during operation and maintenance of the equipment covered herein.

⚠ WARNING

Beware of unannounced starting of the unit. The unit may cycle the fans and compressor unexpectedly as control requirements dictate. Press OFF key on the cab command.

⚠ WARNING

Beware of V-belt and belt-driven components as the unit may start automatically.

⚠ WARNING

Ensure power to the unit is OFF and vehicle engine is OFF and negative battery cable is connected before replacing compressor.

⚠ WARNING

Slowly open the plug on the suction and discharge valves of the new compressor to vent the nitrogen holding charge.

⚠ WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 2350 psig (160 bars). Do not use oxygen in or near a refrigerant system as an explosion may occur.

⚠ WARNING

Ensure vehicle engine is OFF and negative battery cable is disconnected before replacing compressor.

⚠ CAUTION

Under no circumstances should anyone attempt to repair the microprocessor components or Cab Command! Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

⚠ CAUTION

If starting unit for the first time after installation the compressor pressure regulating valve will need to be reset.

⚠ CAUTION

If starting unit for the first time after installation or starting after adding/removing an optional feature or if Owners operating parameters have changed, the Configuration will need to be reset.

⚠ CAUTION

Compressor failure will occur if inert gas brazing procedures are not used on units with R404A and POE oil. For more information see Technical Procedure 98-50553-00 – Inert Gas Brazing.

⚠ CAUTION

To prevent trapping liquid refrigerant in the manifold gauge set be sure set is brought to suction pressure before disconnecting.

⚠ CAUTION

When working with refrigerant use safety glasses and gloves to avoid burns. Hoses and copper tubing can be hot when unit is running.

⚠ CAUTION

Refrigerant R404a is a blend. Charging as a vapor will change the properties of the refrigerant. Only liquid charging through the king valve is acceptable.

⚠ CAUTION

Do not damage or over tighten the enclosing tube assembly. Place all parts in the enclosing tube in proper sequence in order to avoid premature coil burn-out.

⚠ CAUTION

Observe proper polarity when installing battery. Negative battery terminal must be grounded.

⚠ CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

⚠ CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the microprocessor. Use proper board handling techniques. (See Section 4.14).

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

⚠ WARNING

Beware of unannounced starting of the unit. The unit may cycle the fans and compressor unexpectedly as control requirements dictate. Press OFF key on the Cab Command.

This manual contains Operating Data, Electrical Data and Service Instructions for the Carrier Transicold Model 20X truck refrigeration units listed in Table 1-1.

Additional support manuals are listed in Table 1-2.

Remove the skins and look on the roadside of the unit to locate the model/serial nameplate. (See Figure 1-1)

1.2 GENERAL DESCRIPTION

The unit (Figure 1-1) is of the split system type with the condenser mounted outside the truck body, evaporator mounted in the body, and a Cab Command control center mounted in the driver's compartment. One type of compressor drive is available:

D Road operation: the road compressor is located in the engine compartment and is driven by the engine of the vehicle when in operation over−the−road.

1.3 CONDENSING SECTION

The condensing section (see Figure 1-1) contains the condenser fan & coil, filter−drier, hot gas solenoid valve, receiver, and a condenser pressure control valve.

1.3.1 Condenser Coil

The condenser is of the tube and fin type and acts as a heat exchanger in which the compressed refrigerant gas is condensed into a liquid and lowered in temperature. Air movement over the condenser is provided by a fan mounted in the condensing section.

1.3.2 Filter Drier

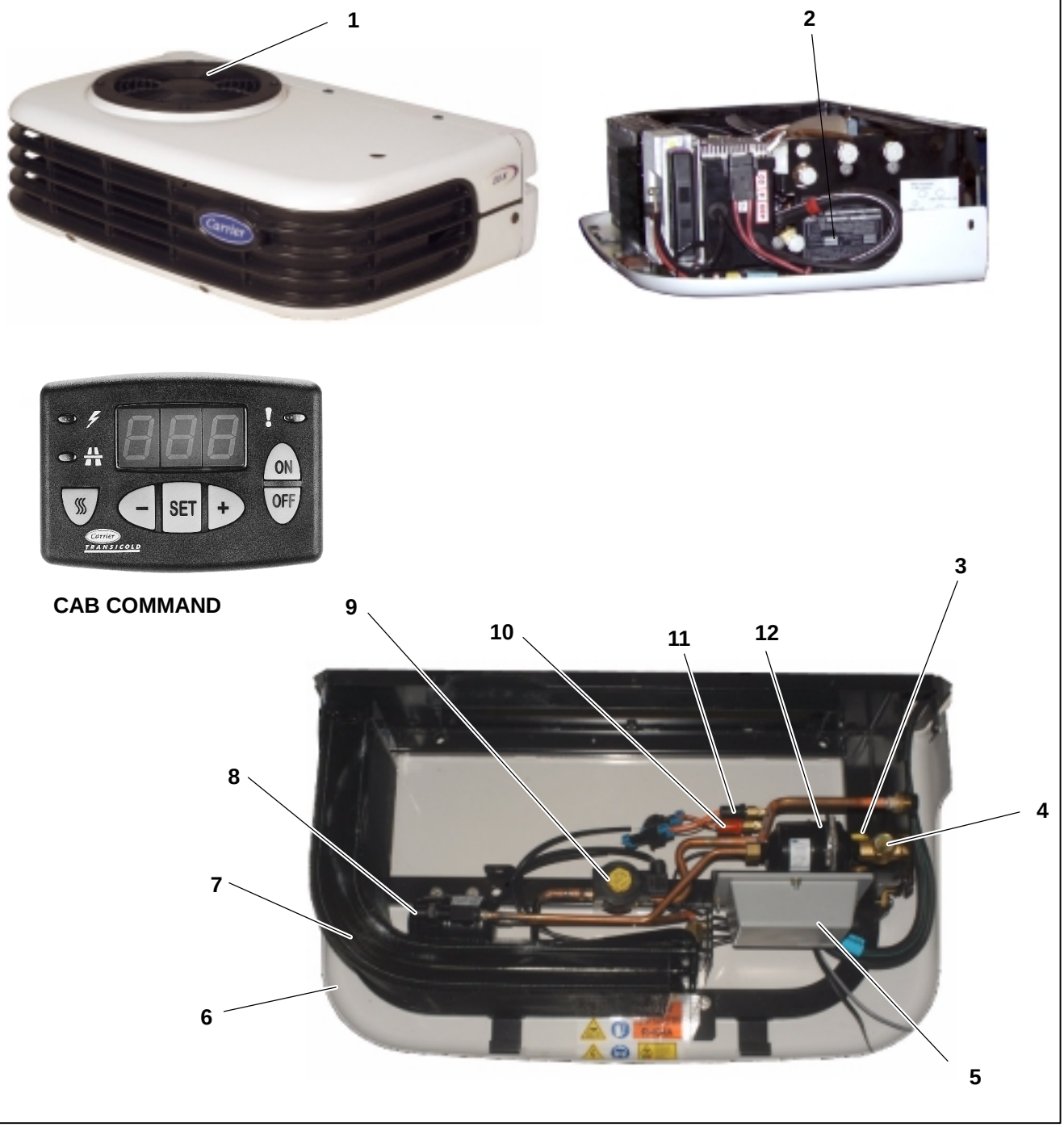
The drier is a cylindrical shell containing a drying agent and screen. It is installed in the liquid line and functions to keep the system clean and remove moisture from the refrigerant.

Table 1-1 Model Chart

Model No.	Description	R404a		Road Compressor	Condenser Weight	Evap. Wt.
TRC120R03D	Road Only	3.1 lbs	1.4 kg	TM 13	66.2 lb (30 kg)	66 lb (30 Kg)

Table 1-2. Additional Support Manuals

Manual Number	Equipment Covered	Type of Manual
62−10890	20X	Parts List
62−10892	Direct Drive Truck Units With Cab Command	Operator's Manual
62−10893	Direct Drive Truck Units With Cab Command	Easy To Run



1. Condenser Fan
2. Nameplate
3. Hot Gas Solenoid Valve (HGS1)
4. Sight Glass
5 Control Box
6. Frame
7. Condenser Coil
8. Receiver
9. Condenser Pressure Control Valve (HGS2)
10. High Pressure Switch (HP1)
11. Condenser Pressure Control Switch (HP2)
12. Filter Drier

Figure 1-1 Condenser And Cab Command

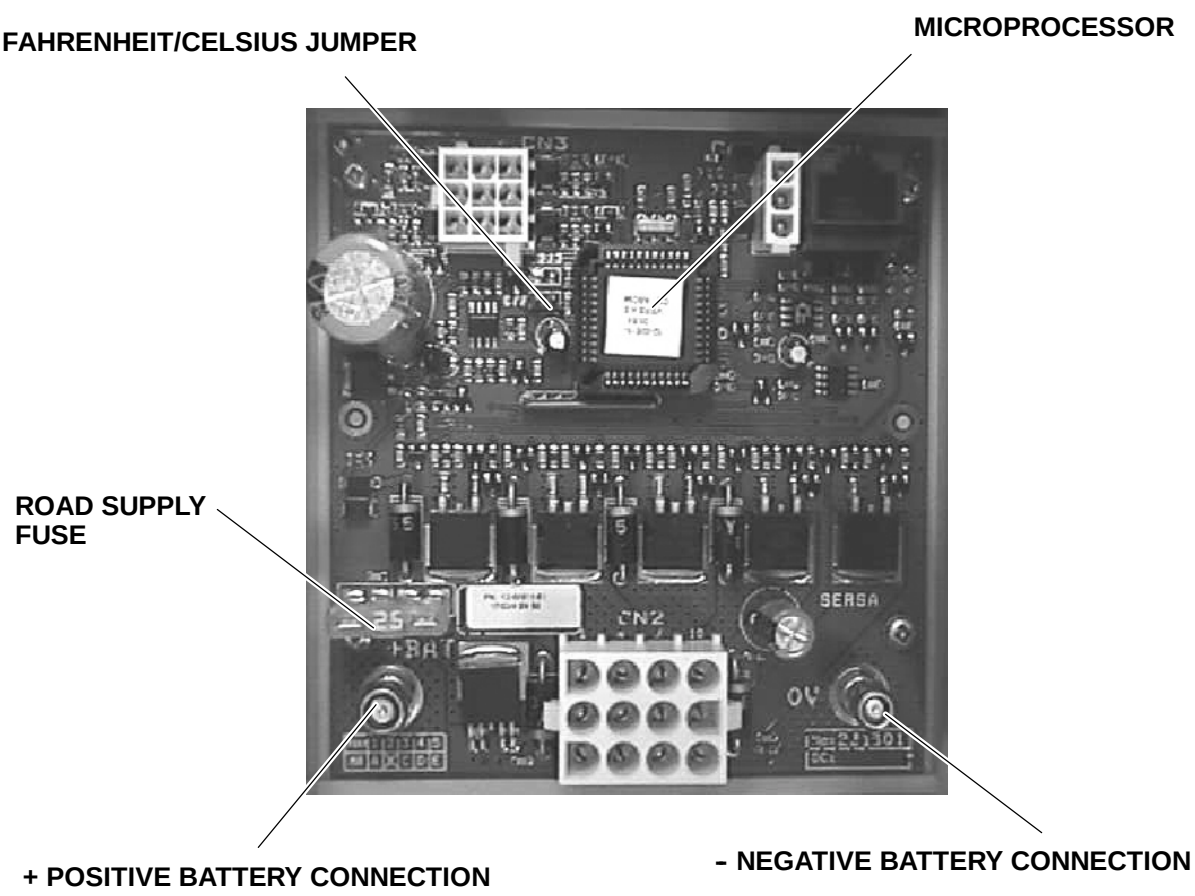
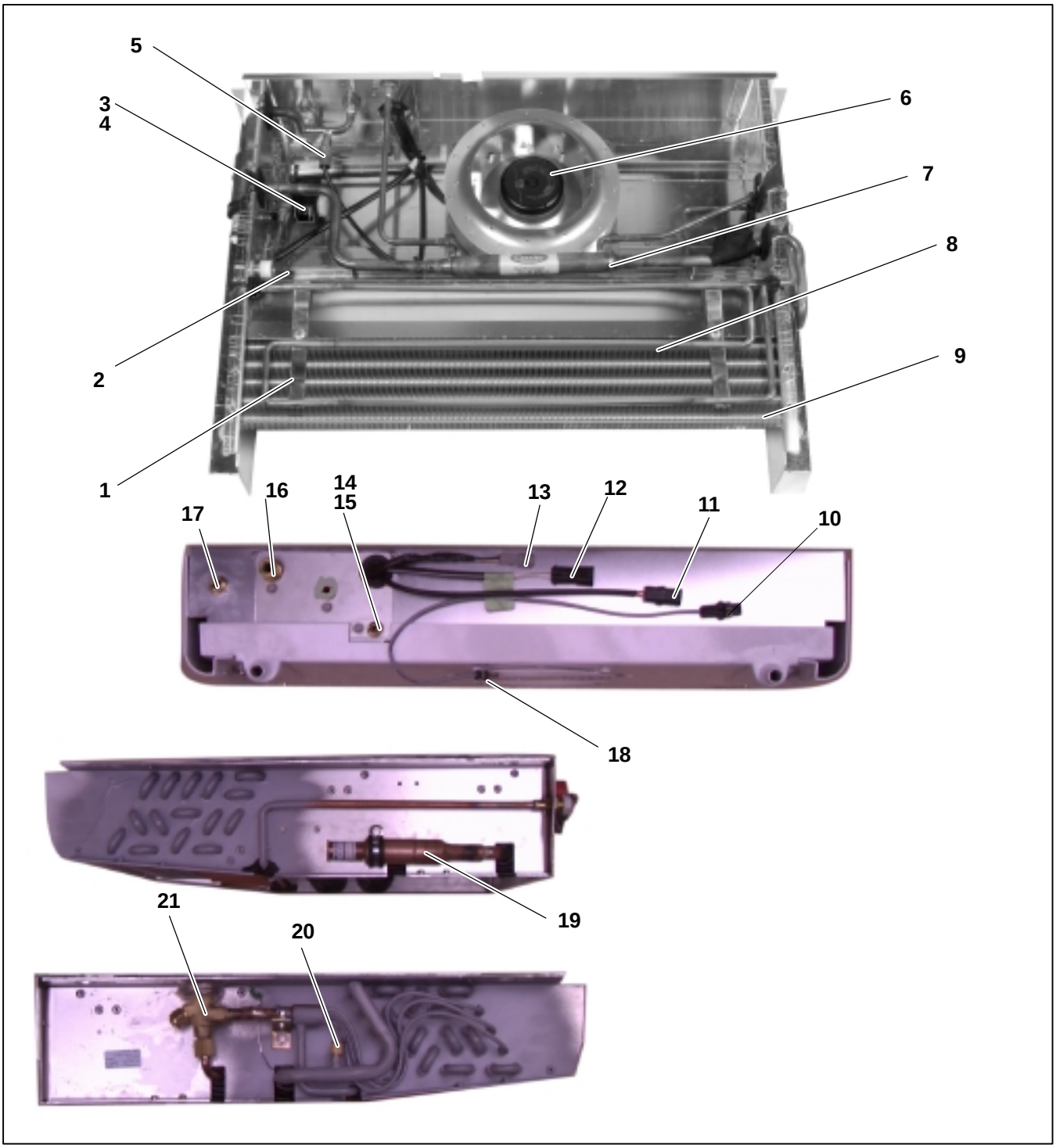


Figure 1-2 Microprocessor



1. Evaporator coil
2. Defrost Termination Thermostat (DTT)
3. Quench Valve (BPV)
4. Quench Valve Thermostat (BPT)
5. Low Pressure Switch (LP)
6 Evaporator Fan Blower
7 Heat Exchanger
8 Defrost Element
9 Frame
10 RAS sensor connector
11 Quench Valve connector
12 Defrost Termination connector
13 Fan connector
14 Liquid Line Check Valve
15 Liquid Line
16 Suction Line
17 Hot gas line
18 Return Air Sensor
19. Compressor Pressure Regulating Valve (CPR)
20 TXV Schraeder
21. Expansion Valve (TXV)

Figure 1-3 Evaporator

1.3.3 Hot Gas Solenoid Valve (HGS1)

HGS1 is normally closed and prevents discharge gas from entering the evaporator. The valve opens to allow hot gas refrigerant to be delivered from the compressor to the evaporator during heat or defrost modes.

1.3.4 Condenser Pressure Control Valve (HGS2)

The condenser pressure control valve (or condenser closing valve) is a normally open valve that is powered when the condenser pressure control switch (HP2) is closed. With the solenoid coil de-energized, the valve is in the cool mode and the compressor discharge gas is delivered to the condenser. In the cool mode, heat is removed from the air inside the truck body and rejected to the surrounding air. With the solenoid coil energized, the valve is in the heat mode and the compressor discharge gas is diverted to the evaporator and rejected to the air inside the truck body.

1.3.5 Compressor

The compressor withdraws refrigerant gas from the evaporator and delivers it to the condenser at an increased pressure. The pressure is such that refrigerant heat can be absorbed by the surrounding air at ordinary temperatures.

1.3.6 Receiver

Liquid refrigerant from the condenser is delivered to the receiver. The receiver serves as a liquid reservoir when there are surges due to load changes in the system; as a storage space when pumping down the system and as a liquid seal against the entrance of refrigerant gas into the liquid line.

NOTE

If receiver king valve is not equipped with a service access port, install a charging connection (Carrier Transicold P/N 40−60059−02) and (2) clamps (Carrier Transicold P/N 34−60019−02) in liquid line before continuing with leak checking or charging instructions. (Refer to Figure 4-2.)

1.3.7 High Pressure Switch (HP1)

HP1 is a normally closed switch which monitors the system for high pressure and shuts down the unit when pressure rises above predetermined setting. For HP1 settings see Section 1.6.2.

1.3.8 Condenser Pressure Control Switch (HP2)

HP2 is a normally open switch which closes to signal the microprocessor to activate the condenser fan. HP2 also cycles the condenser pressure control valve (HGS2) and the quench valve (BPV) in addition to the condenser fan in order to maintain discharge pressure for heating capacity. For HP2 settings see Section 1.6.2.

1.4 EVAPORATOR SECTION

The evaporator assembly consists of an evaporator fan, evaporator coil, thermostatic expansion valve, defrost termination thermostat, low pressure switch, a compressor pressure regulating valve and a quench valve.

1.4.1 Thermostatic Expansion Valve

The thermostatic expansion valve is an automatic device which controls the flow of liquid to the evaporator according to changes in superheat of the refrigerant leaving the evaporator. The thermal expansion valve maintains a relatively constant degree of superheat in the gas leaving the evaporator regardless of suction pressure. Thus, the valve has a dual function; automatic expansion control and preventing liquid from returning to the compressor. For TXV superheat settings see Section 1.6.2. To adjust the TXV, refer to Section 4.12.2.

1.4.2 Compressor Pressure Regulating Valve (CPR)

The CPR valve is installed on the suction line to regulate the suction pressure entering the compressor. The CPR valve is set to limit the maximum suction pressure. For CPR settings refer to section 1.6.2.

1.4.3 Quench Valve (BPV)

The quench valve is a normally closed solenoid valve controlled by the quench thermostat (BPT) mounted on the compressor discharge line. The valve allows metered liquid refrigerant to enter the suction line in the evaporator in order to provide compressor cooling. For BPT settings refer to section 1.6.2.

1.4.4 Evaporator Coil

The evaporator is of the tube and fin type. The operation of the compressor maintains a reduced pressure within the coil. At this reduced pressure, the liquid refrigerant evaporates at a temperature sufficiently low enough to absorb heat from the air. Air movement over the evaporator is provided by an electric fan.

1.4.5 Low Pressure Switch (LP)

The low pressure switch is a normally closed switch which signals the microprocessor to shut down the unit when the system is outside the low pressure limit. For LP settings refer to section 1.6.2.

1.4.6 Heat Exchanger

The heat exchanger is of the tube in tube type connected in the main suction line and liquid line. Within the heat exchanger, the cold suction gas is used to cool the warm liquid refrigerant. This results in greater system efficiency and helps to prevent liquid refrigerant return to the compressor.

1.5 SYSTEM OPERATING CONTROLS AND COMPONENTS

The unit is furnished with a microprocessor control system. Once the setpoint is entered at the Cab Command, the unit will operate automatically to maintain the desired temperature within very close limits. See 2.1.1.

⚠ WARNING

Beware of unannounced starting of the evaporator or condenser fans. The unit may cycle fans unexpectedly as control requirements dictate.

⚠ CAUTION

Under no circumstances should anyone attempt to repair the microprocessor module or Cab Command! Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

Figure 1-4 Cab Command

1.6 UNIT SPECIFICATIONS

1.6.1 Compressor Data

Model	**TM 13**
Displacement	7.94 in^3 (131 cc)
No. Cylinders	6
Weight	14.8 lbs (6.7 kg)
Oil Charge	0.422 pint (200 ml)
Approved Oil	Carrier POE #46-60002-02

1.6.2 Refrigeration System Data

a. Defrost Timer

Automatic triggering or at preset intervals :
0 (Disabled), auto, 1h, 2h, 3h, 4h, 5h, 6h

b. High Pressure Switch (HP1)

Cutout at : 465 psig ± 10 psig (32 bars)

Cut-in at : 360 psig ± 10 psig (25 bars)

c. Condenser Pressure Control Switch (HP2)

Cutout at : 245 psig ± 10 psig (17 bars)

Cut-in at : 329 psig ± 10 psig (22 bars)

d. Refrigerant charge

Refer to Table 1-1.

e. Compressor Pressure Regulating Valve (CPR) (At end of defrost)

28 1 psig (1.91 Bar)

f. Thermostatic Expansion Valve (TXV)

Superheat setting at commissioning:
8_C at box temperature of 0_C.
4_C at box temperature of -20_C.

g. Low Pressure switch (LP)

Cutout at : -5.7 inHG ± 3psig (-0.19 bar)

Cut-in at : +14.5 psig ± 3 psig (1 bar)

h. Quench Thermostat (BPT)

Opens at: 260_F (127_C)

Closes at: 212_F (105_C)

1.6.3 Electrical Data

a. Fan Motors

Evaporator Fan Motor (EFM)		Condenser Fan Motor (CFM)	
Bearing Lubrication	Factory Lubricated	Bearing Lubrication	Factory Lubricated
Horse Power	0.1 kw		
Operating Amps	7 to 9 amps	Operating Amps	10 amps
Speed	2100 rpm (rated)	Speed	3300 rpm

b. Compressor Clutch (CLHR)

Amp Draw = 3.75A
Resistance = 3.2Ω

c. Hot Gas Solenoid Valve (HGS1) Coil

Amp Draw = 1.33 Amp
Resistance = 9.2Ω

d. Condenser Pressure Control Valve (HGS2) Coil

Amp Draw = 1.65 Amp
Resistance = 7.3Ω

e. Quench Valve (BPV) Coil

Amp Draw = 1.16 Amp
Resistance = 10.3Ω

1.6.4 Torque Values

Assembly	ft-lb	kg-m
Condenser - frame	7	1.0
Mounting Bolts	44 to 60	6 to 8

1.7 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions by automatically shutting down the unit when such conditions occur. This is accomplished by the following fuses and safety devices.

	Unsafe Conditions	Safety Device	Automatic restart with fault cleared	Device setting
1	Excessive drop in pressure	Automatic reset of low pressure switch (LP)	YES	Cutout : –5.7 inHG ± 3psig (–0.19 bar) Timer 5 min
2	Excessive current draw on all microprocessor outputs (evaporator and condenser fan)	Electronic relay	YES	Self-protected opening
3	Excessive current draw control circuit	Fuse on electronic board	NO	Self-protected opening
4	Excessive current draw motor compressor	Overload relay	YES	See electrical wiring diagram
5	Excessive current draw evaporator and condenser fan motors	Electronic relay	YES	Self-protected opening
6	Excessive compressor discharge pressure	Automatic reset of High pressure switch (HP1)	YES	Timer: 5 min
7	Excessive current draw unit in road operation	Road Supply Fuse	NO	Opens at 25 A (12 V)
8	Excessive current draw unit in road operation	Main Road Fuse F1 (a)	NO	Opens at 40 A (12 V)
9	Clutch malfunction - road (excessive current draw)	Electronic relay	YES	Self-protected opening Opens 311_ F (155° C)
10	Clutch malfunction - road (insufficient current draw)	Electronic relay	YES	Detection of min. threshold at 750 mA
11	Low battery voltage	Microprocessor	YES	Cutout/cut-in at 10 V
12	Excessive current draw on ignition circuit (Neiman)	Fuse FI	NO	Opens at 1 A

(a) This fuse is located close to the vehicle battery (12 v).

1.8 REFRIGERATION CIRCUIT

1.8.1 Cooling (See Figure 1-5)

When cooling, the unit operates as a vapor compression refrigeration system. The main components of the system are the reciprocating compressor, air-cooled condenser, thermostatic expansion valve, direct expansion evaporator, and hot gas solenoid (two-way).

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser tubes.

The condenser fan circulates surrounding air over the outside of the condenser tubes. Heat transfer is thus established from the refrigerant gas (inside the tubes) to the air ambient (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat. This removal of heat causes the refrigerant to liquefy; liquid refrigerant flows from the condenser to the receiver.

The refrigerant then flows through the filter-drier, where an absorbent keeps it dry and clean. The refrigerant then flows through a sight glass with moisture indication to the check valve and then to the liquid / gas heat exchanger.

The liquid then flows to the thermostatic expansion valve (with external pressure equalizer) which regulates the flow rate of refrigerant in the evaporator in order to obtain maximum use of the evaporator heat transfer surface.

The evaporator tubes have aluminium fins to increase heat transfer; therefore heat is removed from the air circulated through the evaporator. This cold air is circulated throughout the refrigerated compartment to maintain the box at the desired temperature.

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize. The vapor at low temperature and pressure enters the heat exchanger then enters the compressor pressure regulating valve (CPR) which regulates refrigerant pressure entering the compressor, where the cycle starts over.

The discharge pressure is regulated with HP2.

The quench valve opens as required to maintain a maximum discharge temperature. (Refer to section 1.6.3 for settings.)

1.8.2 Heat And Defrost (See Figure 1-6)

When refrigerant vapor is compressed to a high pressure and temperature in a compressor, the mechanical energy necessary to operate the compressor is transferred to the gas as it is being compressed. This energy is referred to as the “heat of compression” and is used as the source of heat during the heating or defrost cycle.

When the microprocessor activates heating or defrost, the hot gas solenoid valve energizes and the condenser pressure control valve energizes, closing the port to the condenser and opening a port which allows heated refrigerant vapor to flow directly to the evaporator coil .

The main difference between heating and defrosting is that when in heating mode the evaporator fans continue to run thus circulating the air throughout the compartment to heat the product. When in defrost, the evaporator fans stop, thus allowing the heated vapor to defrost any ice build-up on the coil.

When the pressure is above the setting of the condenser pressure control switch (HP2), the condenser pressure control valve (HGS2) is closed to prevent additional pressure rise in the system. When pressure is below the setting of the condenser pressure control switch, the valve is opened to pressurize the receiver and force additional refrigerant into the system and increase heating capacity.

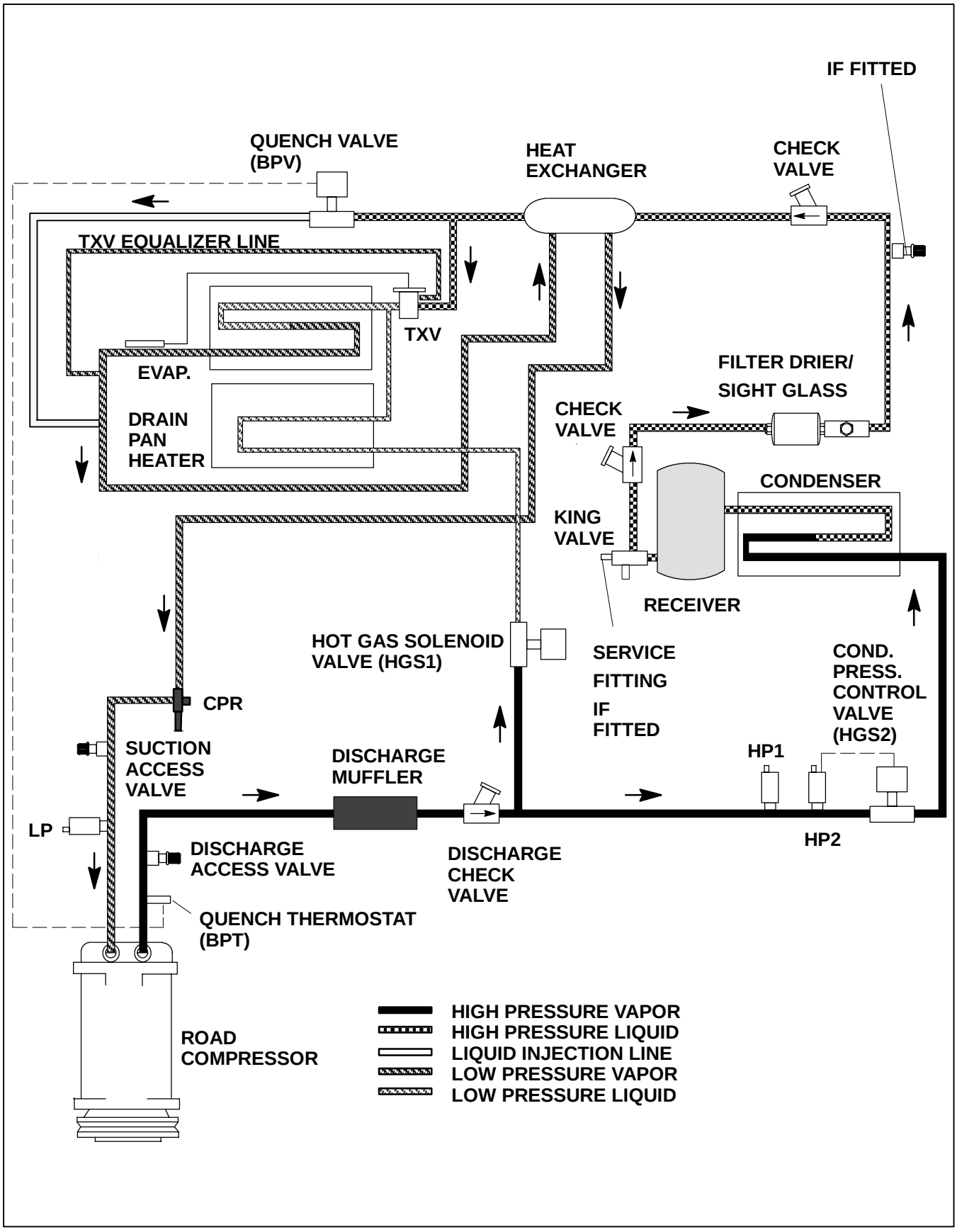


Figure 1-5 Refrigeration Circuit Cooling Cycle

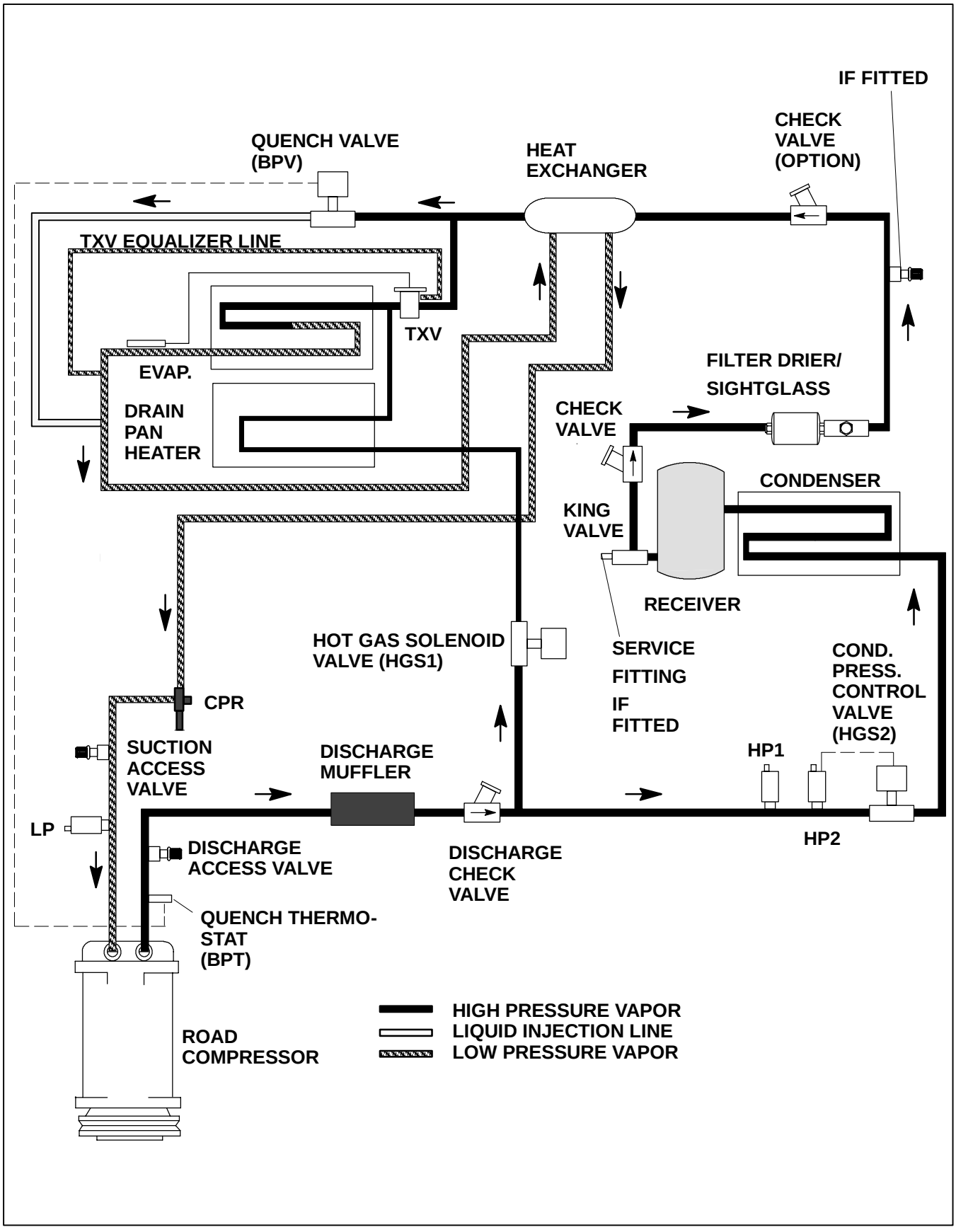


Figure 1-6 Refrigeration Circuit Heating And Defrost Cycle

SECTION 2

OPERATION

2.1 CONTROL SYSTEM

2.1.1 Introduction

⚠ CAUTION

Under no circumstances should anyone attempt to service the microprocessor components or Cab Command. Should a problem develop with the control system, contact your nearest Carrier Transicold dealer for replacement components.

The Control System consists of the microprocessor (Figure 1-2), Cab Command (Figure 2-1) and interconnecting wiring.

a. The Microprocessor includes the temperature control software and necessary input/output circuitry to interface with the unit controls.

b. The Cab Command is remotely mounted in the truck. The Cab Command includes the LCD display and keypad. The keypad and display serve to provide user access and readouts of microprocessor information. The information is accessed by keypad selections and viewed on the display.

2.1.2 Microprocessor Module

The microprocessor controls the following functions:

a. Maintains the box temperature at setpoint by regulating the cooling, heat, off mode and automatic defrost cycles.

b. Permanently displays the return air temperature and on request the setpoint temperature.

c. Digital display and selection of data.

For further details on digital message display, see section 2.5.

2.1.3 Cab Command

The Cab Command is mounted in the cab and allows the driver to carry out the control operations:

- manual start up and shut-down of the unit
- automatic start-up of the unit
- adjust the setpoint
- initiate manual defrost

The driver can display the box temperature, and see whether the setpoint is being maintained by checking the green indicator. The indicator lights up red in the event of a malfunction.

When the battery voltage is too low, a fail-safe system shuts down the unit. Unit restart is automatic and time-delayed if the voltage rises to the normal level.

Figure 2-1 Cab Command

a. Display

The digital display consists of 3 alphanumeric characters. The default value displayed is the box temperature. The microprocessor enables selection of the display in degrees Celsius or Fahrenheit. The display also includes settings for defrost operation (dF). The display also includes three LEDs:

888	Digital Display
	Standby operation LED (Not applicable for units covered by this manual)
	Road operation LED
!	Unit operating LED D Green : cycling (left-hand side) D Red : malfunction (right-hand side)

Unit operating LEDs

Green Light Status

Under normal operation, the green LED will indicate the temperature control status as follows:

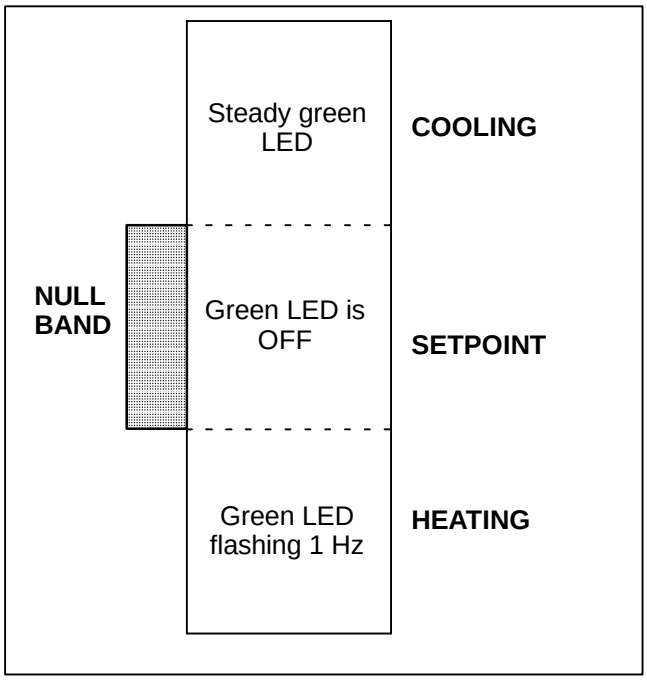


Figure 2-2 Green Light Status

Red Light Status

When an alarm has been detected, the red unit indicating light flashes at 1 Hz. The light will continue to flash at 1 Hz until the alarm is cleared. At that point the steady green indicator light will light and the alarm will become inactive.

b. Keypad

The keypad consists of six keys that enable the operator to activate various functions, display operating data and modify operating parameters.

	Manual defrost control key
	Unit start-up key

	Unit shut-down key The unit can also be shut down with the ignition key.

Unit data and function modification keys

	The SET key, together with the + and – keys, enables display and modification of unit operating data. The display scrolls through parameters each time the SET key is pressed.
	Decrease key for selected data
	Increase key for selected data

2.2 START–UP

2.2.1 Inspection

Before starting the truck engine check the following:

a. Check condenser coil for cleanliness
b. Check condition of refrigerant hoses
c. Check condition and tension of compressor belt(s)
d. Check condition of condenser fan blades and motor.
e. Check truck battery fluid level
f. Check truck battery and terminal connections – clean and tighten as necessary
g. Check defrost water drains from evaporator
h. Check evaporator coil for cleanliness
i. Check condition of evaporator fan blades and motor.

2.2.2 Starting

CAUTION

If starting unit for the first time after installation the compressor pressure regulating valve will need to be reset (refer to paragraph 4.11)

CAUTION

If starting unit for the first time after installation or starting after adding/removing an optional feature or if Owners operating parameters have changed the Configuration will need to be reset (refer to paragraph 2.8)

Start the vehicle engine.

	Press the ON key to start the unit **Start up is time delayed for 40 seconds.)** The digital display of the Cab Command displays the box temperature.
	Check that temperature setpoint is correct by pressing the SET key. The setpoint temperature is highlighted on the digital display.

2.3 SETPOINT ADJUSTMENT

	Displays the setpoint temperature
	Decrease the setpoint
	Increase the setpoint
	Validate setpoint temperature and return to display of box temperature.

NOTE

If no key is pressed within 5 seconds of adjusting settings the system reverts to displaying the box temperature. Only validated changes are recorded.

2.4 MANUAL DEFROST

Check that box temperature is 40°F (4.4°C) or lower.

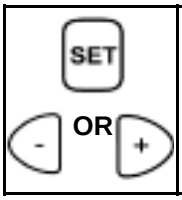
	Press manual defrost key to initiate manual defrost.

2.5 ALARM DISPLAY

In the event of a malfunction the unit will shut down and the Cab Command will display an error message or alarm message. The message will remain displayed until the malfunction is corrected. A listing of the error messages and alarm codes is provided in Table 2-1.

2.5.1 Accessing Alarm Messages

To access the alarm messages:

	Press SET for 5 seconds : enables access to alarm messages. In the event of more than one alarm, press the + or – keys to list them.

2.5.2 Low Battery Voltage Alarms

There is a 40 second time delay during start–up. After this delay if the battery voltage drops below 10.5V ±0.5V, the microprocessor will react 20 seconds later and the unit will go out of temperature control mode. The microprocessor will check the voltage after another 20 seconds. If battery voltage still has not risen, the unit will remain out of temperature control mode for another 10 minutes, the battery alarm will be activated and the Cab Command will display the message “bAt”. Unit will return to temperature control mode if battery voltage has risen after 10 minutes. If the battery voltage has not risen after this 10 minute period the unit will remain out of temperature control mode another 2 minutes and the microprocessor will check the battery voltage every 2 minutes. Unit will return to temperature control mode in its current configuration when battery voltage rises to 10.5V ±0.5V.

Table 2-1 Alarm Messages

Malfunction Codes	Description	ALARM ONLY	ALARM AND UNIT SHUT DOWN
A00	Red LED flashes No malfunction. Unit in operation.		
A01	High or Low pressure switch		X
A02	High or Low pressure switch		X
A04	Clutch malfunction	X	
A06	Condenser fan motor fault	X	
A07	Evaporator fan motor fault	X	
A09	Hot gas solenoid valve malfunction (HGS1)	X	
A10	Quench valve malfunction (BPV)	X	
A11	Condenser pressure control valve (HGS2)	X	
A15	Setpoint adjusted out of the range –20.2 to 86°F (–29°C/+30°C) or below the programmed low threshold	X	
BAT	Low battery voltage	X	
EE	Probe malfunction or evaporator temperature out of limits [–49° to 174°F (–45° to 79°C)]	X	
Err	Programming error on part of operator		X
– – –	Setpoint lower than maximum setpoint but in the range of –20°F to 86°F.		X

2.6 CHECKING THE EEPROM VERSION

ON	Start up unit
SET	Press the SET key for 5 seconds. Press again to display eeprom version number.
SET	Press SET key to return to box temperature.

2.7 STOPPING THE UNIT

OFF	Press the OFF key or turn the ignition key to off position.

2.8 MICROPROCESSOR CONFIGURATION

⚠ CAUTION

If starting unit for the first time after installation or starting after adding/removing an optional feature or if Owners operating parameters have changed, the Configuration will need to be reset.

2.8.1 FUNCTIONAL SETTINGS

The procedure for adjusting the functional parameters is as follows:

1. The temperature display is selectable between Fahrenheit and Celsius. Units are configured for Celsius from the factory. To set the display to Fahrenheit, the selection jumper must be removed and discarded. See Figure 1-2.

NOTE

The board contains another set of pins similar to the Degrees C/Degrees F selection jumper, marked as J1. This jumper is not used for unit operation, but it is used during the microprocessor controller manufacturing process. **DO NOT CONNECT THE J1 PINS TOGETHER.**

2. The following steps must be performed with the unit OFF:

OFF	Shut-down unit.
THEN ON	Hold both keys momentarily in order to display parameters.
- OR +	Modify parameters. (See a. and b. below)
SET	Validate modified settings.

NOTE

If no buttons are depressed within 5 seconds of pressing the Defrost and On Keys (Step 2 of the above procedure) or modifying parameters, the Cab Command reverts to box temperature display and the configuration procedure is aborted.

a. The defrost duration parameter is displayed. This setting determines the length of time in minutes the unit will remain in defrost once defrost is initiated. The defrost duration can be selected by scrolling through available options (10, 20, 25, 30 or 45 minutes) using the (+) or (–) keys. Selection MUST be validated by pressing the SET key.

b. The defrost interval parameter is displayed next. This setting determines the time between defrosts in hours. The defrost interval can be selected by scrolling through available options (0, 1, 1.5, 2, 2.5, 3, 4, 5, 6 hours) using the (+) or (–) keys. Selection MUST be validated by pressing the SET key.

3. The next steps must be performed with the unit ON:

ON	Unit start-up
THEN THEN - +	Press the +, then – then DEFROST keys. All keys should be held momentarily after pressing in the correct sequence.
- OR +	Modify parameters. (See a., b. and c. below)

NOTE

If no buttons are depressed within 5 seconds of pressing the ON key or modifying parameters, the Cab Command reverts to box temperature display and the configuration procedure is aborted.

a. The minimum setpoint parameter is displayed. The minimum setpoint can be selected by scrolling through available options [–20°F (–28.9°C), –4°F (–20°C), 32°F (0°C)] using the (+) or (–) keys. Factory setting is –20°F. Selection MUST be validated by pressing the SET key.

b. The null mode differential temperature is displayed next. This setting determines the temperature difference between box temperature and setpoint that controls compressor cycling. The differential can be selected by scrolling through available options [1.8°F (1°C), 3.6°F (2°C), or 5.4°F (3°C)] using the (+) or (–) keys. Factory setting is 3.6°F (2°C). Selection MUST be validated by pressing the SET key.

c. The ON/OFF (Continuous airflow) parameter for the evaporator fan is displayed next. This feature determines whether the evaporator fan is on or off when the unit cycles off upon reaching setpoint. The factory setting is OFF. Change setting by using the (+) or (–) keys. Selection MUST be validated by pressing the SET key.

d. The return air temperature will be displayed after the above sequence.

SECTION 3

TEMPERATURE CONTROL

3.1 SEQUENCE OF OPERATION

General operation sequences for cooling, null, and heating are provided in the following paragraphs. The microprocessor automatically selects the mode necessary to maintain box temperature at setpoint.

3.1.1 Perishable Mode

The unit operates in the perishable mode with set points above 10°F (–12°C)

a. With return air temperature above setpoint and decreasing, the unit will be cooling with the compressor and evaporator fans operating. (See Section 1.8.1 for a description of the refrigeration circuit during cooling.) The condenser fan will operate for the first three minutes after start up then operate under the control of the condenser pressure control switch (HP2). The green unit operating LED will operate in accordance with Figure 2-2.

b. If discharge temperature increases to the setpoint of the quench thermostat (BPT), the thermostat will close, energizing the quench valve (BPV). This will allow liquid into the suction line in order to cool compressor. Once the discharge temperature decreases to the setpoint of the BPT, the thermostat will open, DE–energizing the BPV.

c. Once temperature decreases to the setpoint the unit will enter the null mode. If the continuous air flow parameter is set to ON, the evaporator fans will continue to operate with all other components OFF. If the continuous air flow parameter is OFF, the evaporator fans and all other components will be OFF. A 5 minute delay is required before restart is allowed.

d. If temperature increases during the null mode, the unit will restart in cooling.

e. If temperature continues to decrease the unit will enter the heating mode with the compressor and evaporator fans operating and the hot gas solenoid valve (HGS1) energized (open). The condenser fan and condenser pressure control valve (HGS2) will operate under the control of the condenser pressure control switch (HP2). If the engine coolant option is installed, the optional heaters will also be energized. (See Section 1.8.2 for a description of the refrigeration circuit during heat and defrost.)

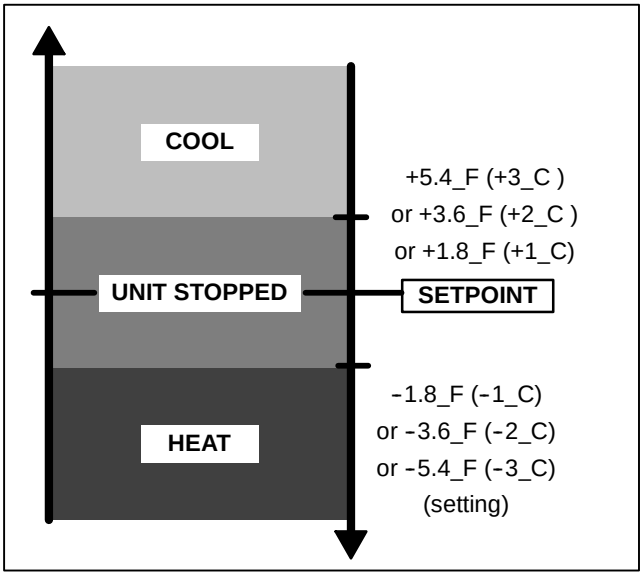


Figure 3-1 Operating Sequence – Perishable Mode

3.1.2 Frozen Mode

The unit operates in the frozen mode with setpoints at or below 10°F (–12°C). Operation in the frozen mode is the same as in the perishable mode except no heating takes place.

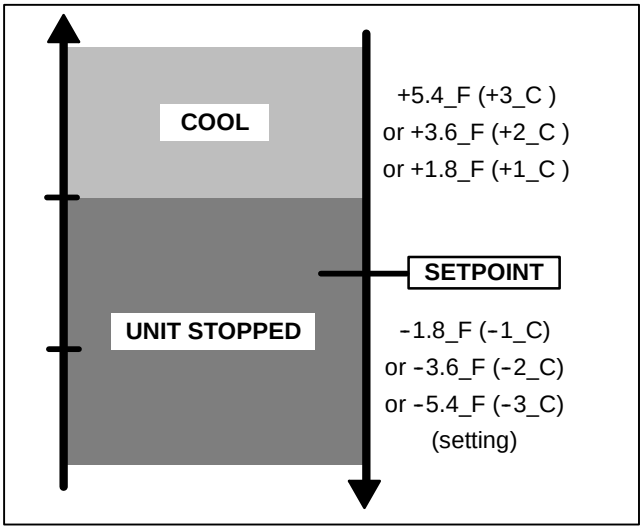


Figure 3-2 Operating Sequence – Frozen Mode

3.2 DEFROST CYCLE

Defrost is an independent cycle overriding cooling and heating functions in order to melt frost and ice from the evaporator when necessary. Defrost may be initiated by the microprocessor or manually by the operator. In defrost mode, the microprocessor displays “dF” on the cab command and setpoint is no longer displayed.

During defrost, the evaporator fans shut down and operation of the condenser fan is controlled by the microprocessor. (See Section 1.8.2 for a description of the refrigeration circuit during heat and defrost.)

3.3 MINIMUM OFF TIME

Once the unit has cycled off, it will remain off for the minimum off time of 5 minutes. This prevents rapid cycling due to changes in air temperature. Air temperature in the box changes rapidly but it takes time for the product temperature to change.

SECTION 4

SERVICE

⚠ WARNING

Beware of unannounced starting of the unit. The unit may cycle the fans and compressor unexpectedly as control requirements dictate. Press OFF key on the cab command

⚠ CAUTION

Compressor failure will occur if inert gas brazing procedures are not used on units with R404a and POE oil. For more information see Technical Procedure 98-50553-00 – Inert Gas Brazing.

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

4.1 MAINTENANCE SCHEDULE

Regular servicing is required in order to optimize the life and reliability of your unit. The recommended scheduled maintenance intervals and categories are provided in Table 4-1 while descriptions of the service procedures to be carried out under each category are provided in Table 4-2

Table 4-1 Maintenance Schedules

Kilometers (X 1000)	5	30	60	90	120	150	180	210
Miles	3 000	18 000	36 000	54 000	72 000	90 000	108 000	126 000
Service A	J	J	J	J	J	J	J	J
Service B		J	J	J	J	J	J	J
Service C			J		J		J	
Service D					J			

Refrigerant : Type R404a.

Compressor oil type: Compressors are supplied with CARRIER POLYESTER (POE) oil. Oils of PAG type are **strictly incompatible** with the operation of this unit, **never use an oil other than that approved by CARRIER**.

Table 4-2 Service Category Descriptions

Service A	1 .Check that the vehicle engine idles correctly with unit operating. Check compressor mounting hardware. 2 .Check the tightness of bolts and screws and that the unit is correctly fastened onto the box.
Service B	1 . Clean evaporator & condenser. (Paragraphs 4.15 & 4.16) 2. Check and if required replace the filter-drier. (Paragraph 4.8) 3. Check the operation of cab command. 4. Check the defrost DCut-in DFan shut-down DCut-out DDefrost water drain
Service C	1. Check the operation of the evaporator and condenser fans. 2. Check the shockmounts (if any) installed on the road compressor mounting kit. 3. Change the compressor oil. Use polyester oil (POE) approved by CARRIER. Refer to paragraph 1.6.1.

4.2 INSTALLING R-404a MANIFOLD GUAGE SET

An R-404a manifold gauge/hose set with self-sealing hoses is required for service of models covered within this manual. The manifold gauge/hose set is available from Carrier Transicold. (Carrier Transicold P/N 07-00294-00, which includes items 1 through 6, Figure 4-1). To perform service using the manifold gauge/hose set, do the following:

4.2.1 Preparing Manifold Gauge/Hose Set For Use

a. If the manifold gauge/hose set is new or was exposed to the atmosphere it will need to be evacuated to remove contaminants and air as follows:

b. Back seat (turn counterclockwise) both field service couplers (see Figure 4-1) and midseat both hand valves.

c. Connect the yellow hose to a vacuum pump and an R-404a cylinder.

d. Evacuate to 10 inHg (254mmHg) and then charge with R-404a to a slightly positive pressure of 1.0 psig (0.07 Bar).

e. Front seat both manifold gauge set hand valves and disconnect from cylinder. The gauge set is now ready for use.

4.2.2 Connecting Manifold Gauge/Hose Set

To connect the manifold gauge/hose set for reading pressures, do the following:

a. Connect low side field service coupler to the suction access valve. (See Figure 4-1.)

b. Turn the field service coupling knob clockwise, which will open the system to the gauge set.

c. Read system pressures.

d. Repeat the procedure to connect the other side of the gauge set to the discharge access valve.

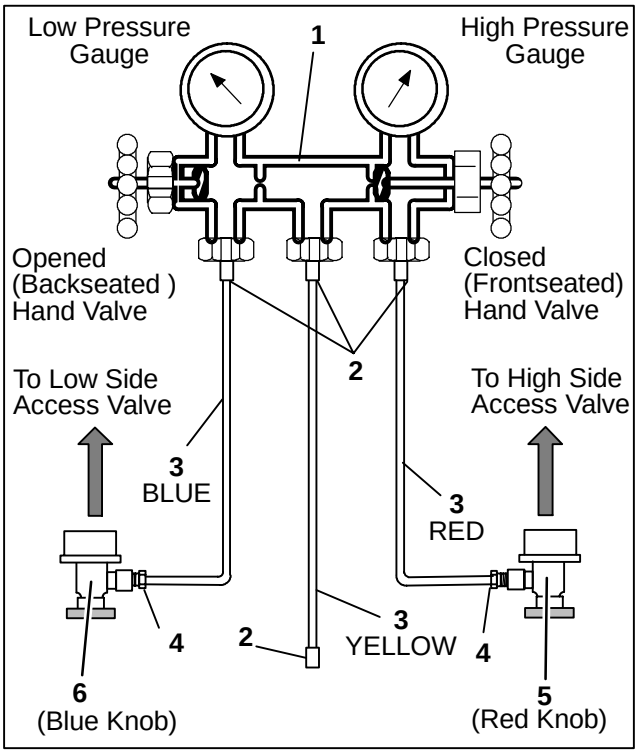
4.2.3 Removing the Manifold Gauge Set

1. While the compressor is still ON, turn the high side field service coupler knob counter clockwise to close the system to the gauge set.
2. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to low side pressure. This returns any liquid that may be in the high side hose to the system.

⚠ CAUTION

To prevent trapping liquid refrigerant in the manifold gauge set be sure set is brought to suction pressure before disconnecting.

3. Turn the low side valve counter clockwise. Remove the couplers from the access valves.
4. Install both access valve caps. (Finger tight only)



1. Manifold Gauge Set
2. Hose Fitting (0.5-16 Acme)
3. Refrigeration and/or Evacuation Hose (SAE J2196/R-134a)
4. Hose Fitting w/O-ring (M14 x 1.5)
5. High Side Field Service Coupler
6. Low Side Field Service Coupler

Figure 4-1 Manifold Gauge Set (R-404a)

4.3 REMOVING THE REFRIGERANT CHARGE

CAUTION

When working with refrigerant use safety glasses and gloves to avoid burns. Hoses and copper tubing can be hot when unit is running.

NOTE

Once the system is open, it must be evacuated and dehydrated. (See section 4.5)

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant.

Connect a refrigerant recovery system (Carrier P/N MVS-115-F-L-CT (115V) or MVS-240-F-L-CT (240V)) to the unit to remove refrigerant charge. (See Figure 4-2.) Refer to instructions provided by the manufacturer of the refrigerant recovery system.

4.3.1 Removing Complete Charge

Connect a refrigerant recovery system to the suction and discharge access valves to remove refrigerant charge. Refer to instructions provided by the manufacturer of the refrigerant recovery system.

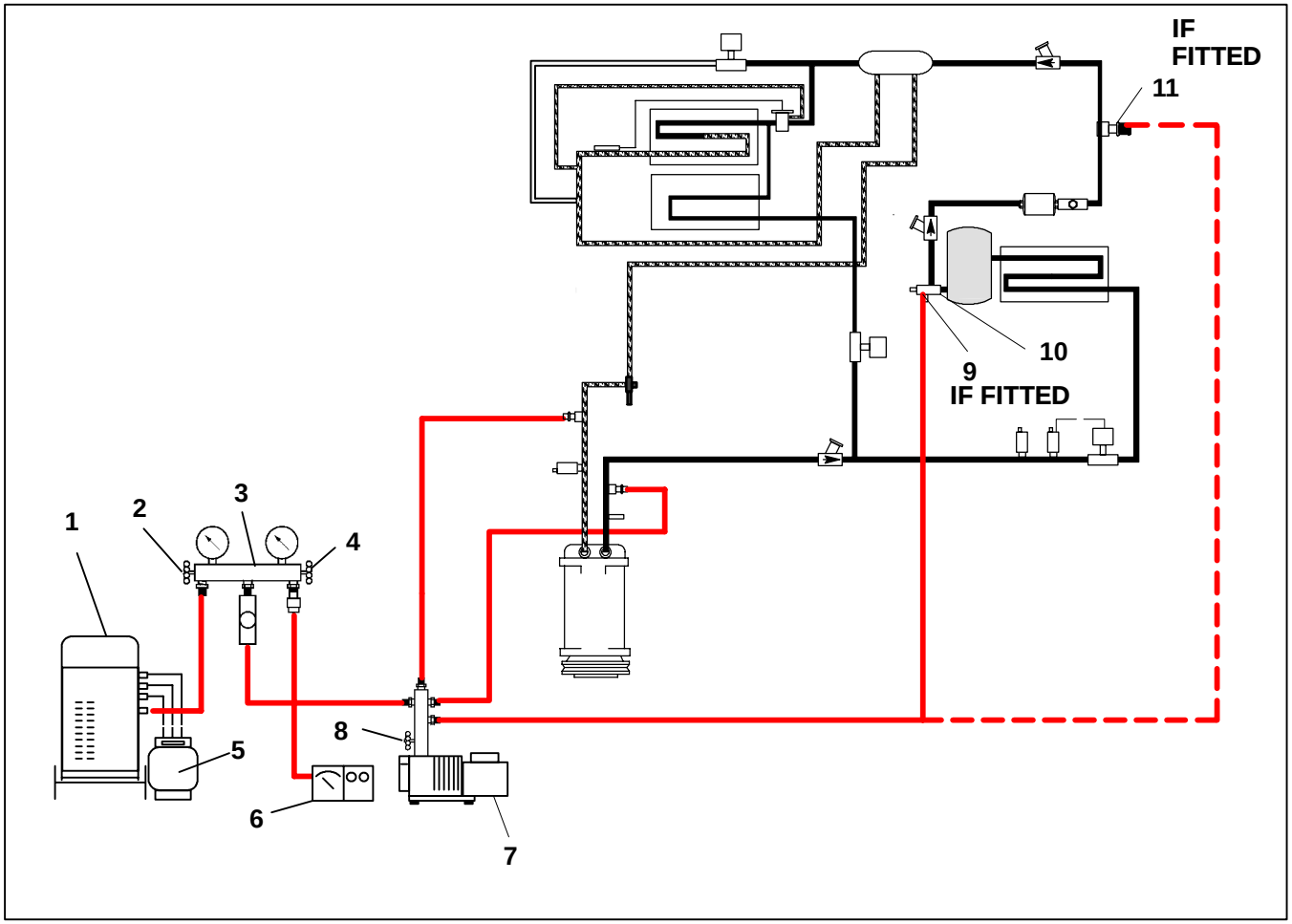
4.4 REFRIGERANT LEAK CHECKING

CAUTION

Refrigerant R404a is a blend. Charging as a vapor will change the properties of the refrigerant. Only liquid charging through the king valve is acceptable.

NOTE

If receiver king valve is not equipped with a service access port, install the charging connection kit (Carrier Transicold P/N 76-61188-00) in liquid line before continuing with leak checking or charging instructions. (Refer to Figure 4-2.)



1 Refrigerant Recovery Unit
2 Suction Valve (Low Side)
3 Evacuation Manifold
4 Discharge Valve (High Side)
5 Refrigerant Cylinder
6 Electronic Vacuum Gauge
7 Vacuum Pump
8 Vacuum Pump Valve
9 King Valve Access Port
10 King Valve
11 Liquid Line Charging Port

Figure 4-2 Vacuum Pump Connection

A refrigerant leak check should always be performed after the system has been opened to replace or repair a component. To check for leaks in the refrigeration system, perform the following procedure:

NOTE

Use only R404a to pressurize the system. Any other gas or vapor will contaminate the system which will require additional purging and evacuation of the high side (discharge) of the system.

a. The recommended procedure for finding leaks in a system is with an electronic leak detector. (Carrier P/N 07−00295−00). Testing joints with soap suds is only satisfactory for locating large leaks.

b. Charge system with refrigerant to build up pressure between 30 to 50 psig (2.1 to 3.5 Bar). Remove refrigerant cylinder and leak check all connections.

c. Remove refrigerant using a refrigerant recovery system (See 4.3) and repair any leaks. Evacuate and dehydrate the unit. (Refer to section 4.5.)

4.5 EVACUATION AND DEHYDRATION

4.5.1 General

Moisture can seriously damage refrigerant systems. The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, “freezing-up” of metering devices by free water, and formation of acids, resulting in metal corrosion.

4.5.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.4)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5 cfm = 8m#H volume displacement, P/N 07-00176-01) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator). (Carrier P/N 0700414−00).

NOTE

Use of a compound gauge is not recommended because of its inherent inaccuracy.

c. Keep the ambient temperature above 60_F (15.6_C) to speed evaporation of moisture. If ambient temperature is lower than 60_F (15.6_C), ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise system temperature.

d. Additional time may be saved during a complete system evacuation by replacing the filter−drier with a section of copper tubing and the appropriate fittings. Installation of a new filter−drier may be performed during the charging procedure.

4.5.3 Procedure For Evacuation And Dehydrating System

a. Remove refrigerant using a refrigerant recovery system.

b. The recommended method to evacuate and dehydrate the system is to connect three evacuation hoses to the vacuum pump and refrigeration unit as shown in Figure 4-2. (Do not use standard service hoses, as they are not suited for evacuation purposes.) as shown in to the vacuum pump and refrigeration unit. Connect an evacuation manifold, with special evacuation hoses, to the vacuum pump, electronic vacuum gauge, and to the refrigerant recovery system.

c. Make sure vacuum gauge valve is closed and vacuum pump valve is open.

d. Test the evacuation system for leaks by backseating the king valve (or closing the field coupler connected to the liquid line charging port), turning suction and discharge access valves counter clockwise to close, and drawing a deep vacuum with the vacuum pump and gauge valves open. Shut off the pump and check to see if the vacuum holds. Repair leaks if necessary.

e. Midseat king valve or field couple connected to the liquid line charging port. Turn suction and discharge access valves clockwise to open.

f. Open the vacuum pump and electronic vacuum gauge valves, if they are not already open. Start the vacuum pump. Evacuate unit until the electronic vacuum gauge indicates 2000 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait a few minutes to be sure the vacuum holds.

g. Break the vacuum with 404a. Raise system pressure to approximately 2 psig (0.14 Bar).

h. Remove refrigerant using a refrigerant recovery system.

i. Repeat steps f. through h.

j. If required, remove the copper tubing and install a new filter−drier. Evacuate unit to 500 microns. Close off vacuum pump valve and stop pump. Wait five minutes to see if vacuum holds. This checks for residual moisture and/or leaks.

k. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on a scale. See Table 1-1 for correct charge. Continue to Section 4.6.2.

4.6 CHARGING THE REFRIGERATION SYSTEM

CAUTION

Refrigerant R404a is a blend. Charging as a vapor will change the properties of the refrigerant. Only liquid charging through the king valve is acceptable.

NOTE

If receiver king valve is not equipped with a service access port, install the charging connection kit (Carrier Transicold P/N 76−61188−00) in liquid line before continuing with leak checking or charging instructions. (Refer to Figure 4-2.)

4.6.1 Checking The Refrigerant Charge

a. Start unit in cooling mode and run approximately ten minutes.

b. Partially block off air flow to condenser coil so discharge pressure rises to 325 psig (22 Bar).

c. The unit is correctly charged when there are no bubbles in the sight glass.

4.6.2 Installing A Complete Charge

NOTE

The ambient (air entering the condenser) air temperature should be above 40°F (4.4°C)

a. Evacuate the refrigeration circuit leave in a deep vacuum. (Refer to section 4.5)

b. Place refrigerant 404a cylinder on scale. Connect the discharge gauge field coupler of the manifold test set to the king valve or liquid line charging port. Connect the suction pressure hose of the manifold gauge set to the manifold dead head port. Connect a charging line between the center tap of the second gauge set and the refrigerant drum. Midseat discharge knob. Open the liquid valve on the drum and purge all hoses. Frontseat discharge knob. See Figure 4-3.

c. Note weight of refrigerant cylinder.

d. Open liquid valve on refrigerant cylinder. Open king valve or field coupling attached to liquid line charging port half way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scale. See Table 1-1 for correct charge.

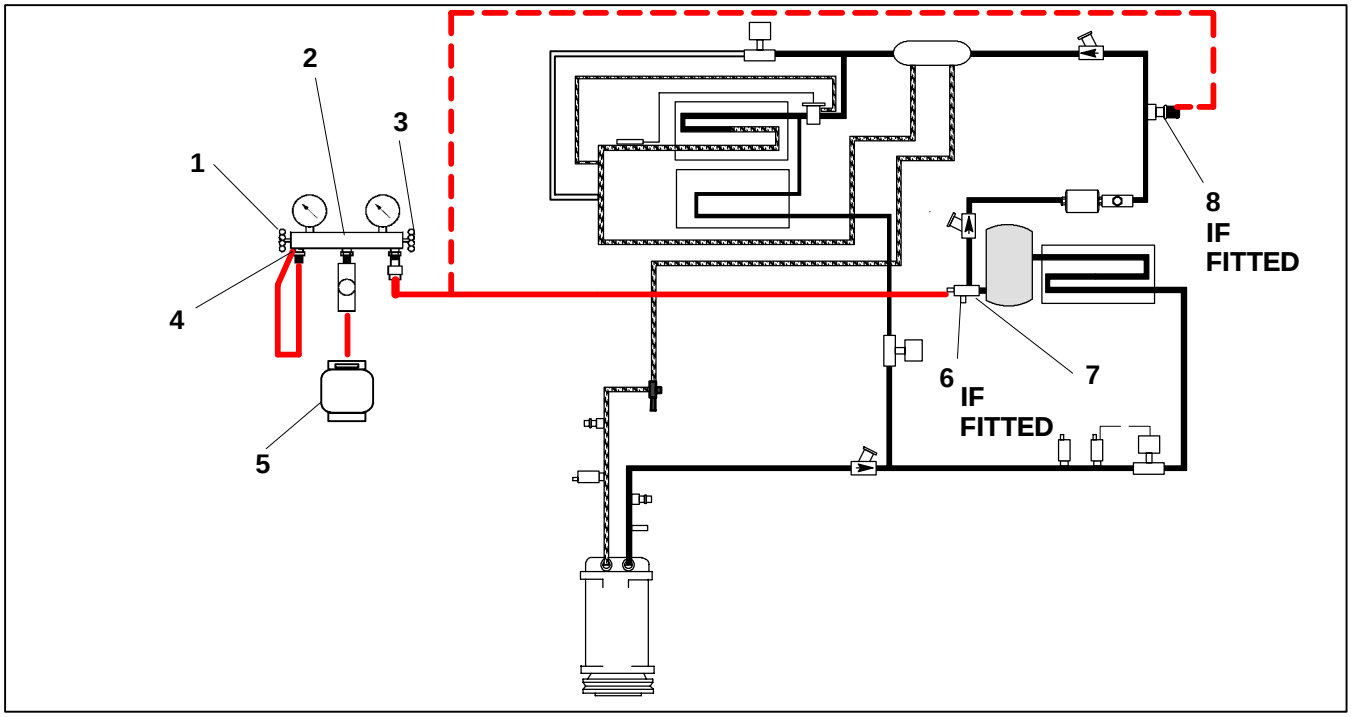
NOTE

It may be necessary to finish charging the unit using the partial charge method, due to pressure rise in the high side of the system. (Leave gauges and hoses in place and refer to paragraph 4.6.3)

e. If scale indicates the correct charge has been added, close liquid line valve on drum and manifold valves.

f. Backseat the king valve or field coupler attached to liquid line charging port. Remove charging hoses and check charge in accordance with paragraph 4.6.1.

g. Start unit and check for non−condensables. (See 4.7.)



1 Suction Valve (Low Side)
2 Manifold Gauge Set
3 Discharge Valve (High Side)
4 Dead Head Port
5 Refrigerant Cylinder
6 King Valve Access Port
7 King Valve
8 Liquid Line Charging Port

Figure 4-3 Procedure for Adding A Complete Charge

4.6.3 Adding A Partial Charge

CAUTION

Refrigerant R404a is a blend. Charging as a vapor will change the properties of the refrigerant. Only liquid charging through the king valve is acceptable.

NOTE

If receiver king valve is not equipped with a service access port, install the charging connection kit (Carrier Transicold P/N 76−61188−00) in liquid line before continuing with leak checking or charging instructions. (Refer to Figure 4-2.)

NOTE

The ambient (air entering the condenser) air temperature should be above 40°F (4.4°C)

a. Check sight glass to determine charge. See 4.6.1. If undercharged, proceed with step b.

b. Place drum of refrigerant on scale and note weight. Backseat suction and discharge access valves and install a manifold gauge set in order to monitor system. Purge lines. Connect the field coupler of the discharge gauge of a second manifold test set to the king valve access port or liquid line charging port. Connect the suction pressure hose to the manifold dead head port. Connect a charging line between the center tap of the second gauge set and the refrigerant drum. Midseat discharge knob. Open the liquid valve on the drum and purge all hoses. Frontseat discharge knob. See Figure 4-4.

c. Start unit with compressor turning at 2400 rpm.

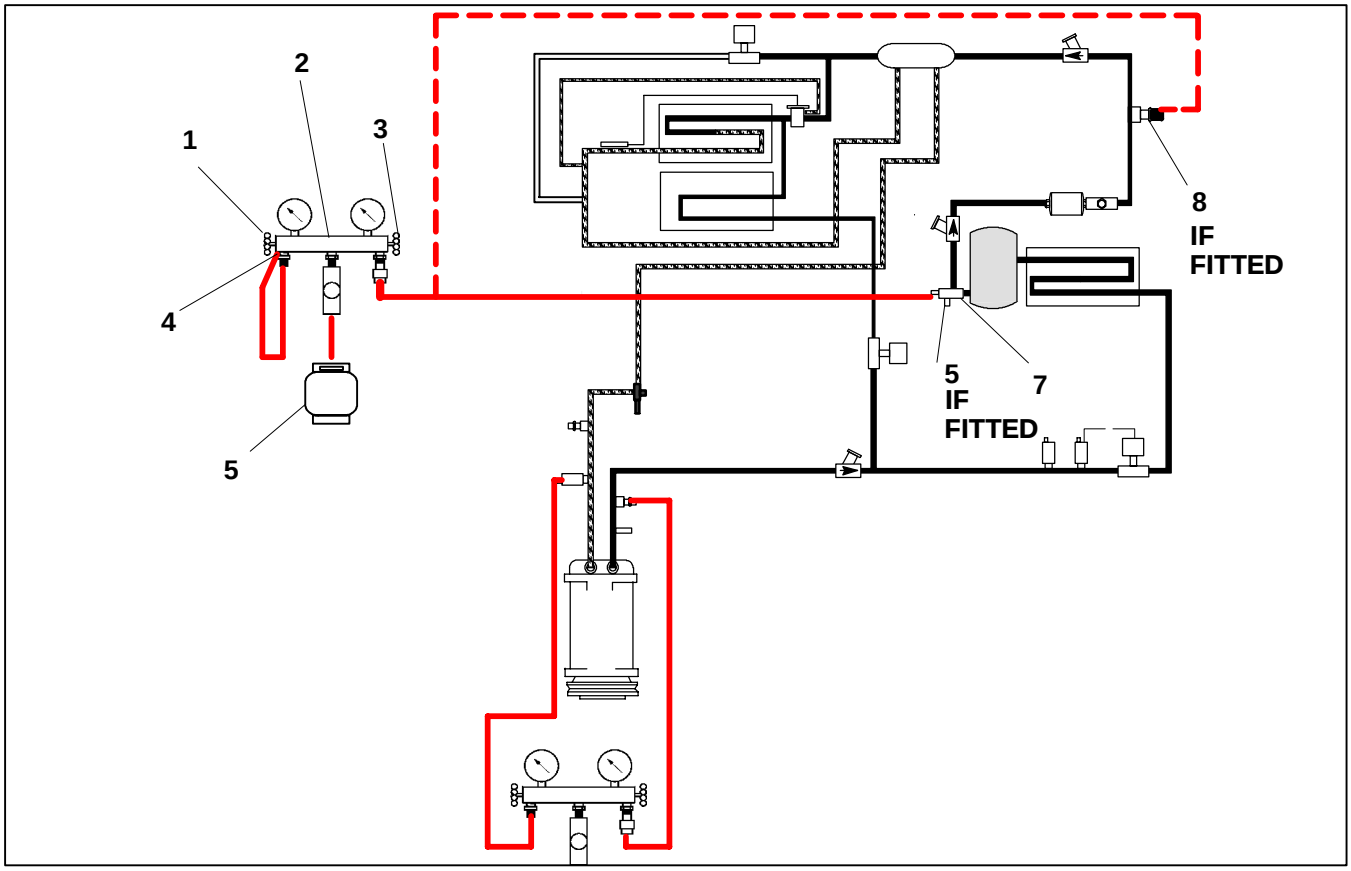
d. Frontseat the king valve. Monitor the second set of manifold gauges. When the king valve pressure drops below the pressure in the refrigerant drum, midseat the manifold gauge set discharge valve and allow liquid refrigerant to flow into the system.

e. While monitoring the sight glass, carefully weigh refrigerant into the system. It is not possible to accurately determine when the system is full because unit is in discharge state; therefore, never allow more than 0.5 lb. (0.23 kg) of refrigerant into system at a time.

f. After monitoring 0.5 lb. (0.23 kg) of refrigerant into the system, close the valve of the manifold gauge set connected to the king valve. Open the king valve and allow the system to balance out to determine charge.

g. Follow the procedures of Section 4.6.1 and repeat above procedure as required to clear the sight glass.

h. Start unit and check for non−condensables.



1 Suction Valve (Low Side)
2 Manifold Gauge Set
3 Discharge Valve (High Side)
4 Dead Head Port
5 Refrigerant Cylinder
6 King Valve Access Port
7 King Valve
8 Liquid Line Charging Port

Figure 4-4 Procedure For Adding A Partial Charge

4.7 CHECKING FOR NON–CONDENSABLES

To check for non–condensables, proceed as follows:

a. Stabilize system to equalize pressure between the suction and discharge side of the system.

b. Check temperature at the condenser and receiver.

c. Check pressure at the king valve access port or the liquid line charging port.

d. Check saturation pressure as it corresponds to the condenser/receiver temperature using the Temperature-Pressure Chart, Table 4-3.

e. If gauge reading is 3 psig (0.2 Bar) or more than the calculated P/T pressure in step d., non–condensables are present.

f. Remove refrigerant using a refrigerant recovery system. (Refer to section 4.3)

g. Evacuate and dehydrate the system. (Refer to section 4.5.)

h. Charge the unit. (Refer to section 4.6.)

4.8 CHECKING AND REPLACING FILTER-DRIER

4.8.1 Checking Filter-Drier

Check for any obstruction of the filter-drier by feeling the inlet and outlet connections of the liquid line on the filter cartridge. If the temperature of the outlet connection seems lower than the temperature of the inlet connection, replace the filter-drier.

4.8.2 Replacing The Filter-Drier

Remove refrigerant charge (See section 4.3). Remove the drier mounting clip, then replace the filter-drier. Following drier replacement, evacuate and recharge unit (refer to sections 4.5 & 4.6).

4.9 HIGH PRESSURE (HP1) AND CONDENSER PRESSURE (HP2) SWITCHES

4.9.1 Removing Switch

a. A SCHRAEDER valve is located under each switch to allow removal and installation without removing the refrigerant charge.

b. Remove switch and test in accordance with paragraph 4.9.2.

c. Replace or reinstall switch.

4.9.2 Checking Pressure Switch

⚠ WARNING

Do not use a nitrogen cylinder without a pressure regulator. (See Figure 4-5) Cylinder pressure is approximately 2350 psig (160 bars). Do not use oxygen in or near a refrigerant system as an explosion may occur.

a. Remove switch as outlined in paragraph 4.9.1.

b. Connect ohmmeter across switch terminals. Ohmmeter will indicate resistance if switch is closed (HP1) or open (HP2) after relieving pressure.

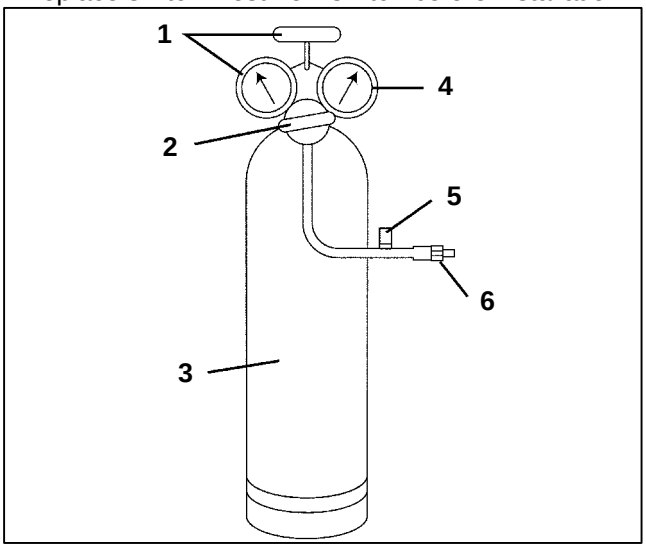
b. Connect switch to a cylinder of dry nitrogen (see Figure 4-5).

c. Set nitrogen pressure regulator higher than switch–over point on switch being tested. Pressure switch settings points are provided in paragraph 1.6.2.

d. Close valve on cylinder and open bleed-off valve.

e. Open cylinder valve. While observing meter, slowly close bleed-off valve and increase pressure until the switch opens (HP1) or closes (HP2). Slowly open bleed-off valve (to decrease pressure) until switch reverts to normal position.

f. If switch does not activate within tolerances provided, replace switch. Test new switch before installation.



1. Cylinder valve and gauge
2. Pressure regulator
3. Nitrogen cylinder
4. Pressure gauge (0 to 400 psig = 0 to 28 bars)
5. Bleed-off valve
6. 1/4 inch connection

Figure 4-5 Typical Setup For Testing Pressure Switches HP1 And HP2

4.10 HOT GAS SOLENOID VALVE (HGS1), CONDENSER PRESSURE CONTROL VALVE (HGS2) AND QUENCH VALVE (BPV)

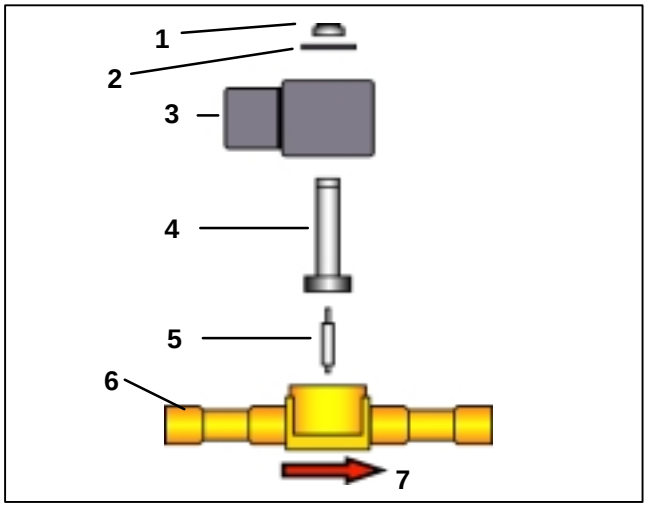
4.10.1 Replacing Solenoid Coil

It is not necessary to remove the refrigerant charge to replace the coil (see Figure 4-6).

a. Remove coil snap cap, voltage plate and coil assembly. Disconnect leads and remove coil junction box if necessary.

b. Verify coil type, voltage and frequency. This information appears on the coil voltage plate and the coil housing.

c. Place new coil over enclosing tube and then install voltage plate and snap cap.



1. Snap cap
2. Voltage plate
3. Coil assembly
4. Enclosing tube
5. Plunger assembly
6. Valve body assembly
7. Direction of flow

Figure 4-6 Hot Gas Valve, Condenser Pressure Control Valve or Quench Valve (Hot Gas Valve Shown)

4.10.2 Replacing Valve Internal Parts

a. Remove the refrigerant charge. (See Section 4.3).

b. Remove coil snap cap, voltage cover and coil assembly. Remove the enclosing tube.

c. Check for foreign material in valve body.

d. Check for damaged plunger and o-ring. If o-ring is to be replaced, always put refrigerant oil on o-rings before installing.

⚠ CAUTION

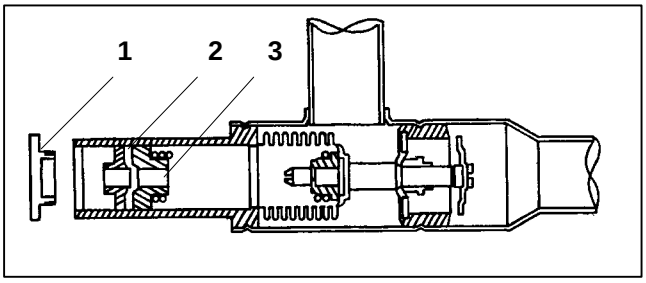
Do not damage or over tighten the enclosing tube assembly. Place all parts in the enclosing tube in proper sequence in order to avoid premature coil burn-out.

e. Tighten enclosing tube.

f. Install coil assembly, voltage cover and snap cap.

g. Evacuate, dehydrate and recharge unit. See Sections 4.5 and 4.6.

h. Start unit and check operation.



1. Cap
2. Jam Nut
3. Set Screw

Figure 4-7 Compressor Pressure Regulating Valve

4.11 ADJUSTING THE COMPRESSOR PRESSURE REGULATING VALVE (CPR)

The CPR valve is not factory pre-set and needs adjustment.

When adjusting the compressor pressure regulating valve (CPR) (see Figure 4-7), the unit must be running in heating or defrost mode and at 2400 rpm (compressor speed). This will ensure a suction pressure above the proper CPR setting. To adjust the CPR valve, proceed as follows :

a. Install a gauge on the suction line .

b. Remove cap from CPR valve.

c. With an 8 mm Allen wrench, loosen the jam nut.

d. Using the 8 mm Allen wrench, adjust the set screw. To raise the suction pressure turn the set screw clockwise; to lower the suction pressure, turn counterclockwise. Refer to paragraph 1.6.2 for CPR valve setting.

e. When the setting has been adjusted, tighten the jam nut securely against the set screw. This will prevent any movement of the set screw due to vibrations in the unit. Replace the cap.

4.12 THERMOSTATIC EXPANSION VALVE

MOP expansion valve characteristics :

SRule : in order to avoid compressor overcharge, a MOP expansion valve (expansion valve with limited flow) is used.

SOperating : the expansion valve will not open more than the MOP setpoint. Any temperature increase at the bulb should not open the expansion valve further.

The thermal expansion valve is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic response of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.

NOTE

Due to the time involved in adjusting the superheat, it is more economical to replace the valve rather than to adjust it.

4.12.1 Replacing expansion valve

a. Remove refrigerant charge (See section 4.3).

b. Remove insulation from expansion valve bulb and then remove bulb from suction line.

c. Loosen flare nut and disconnect equalizer line from expansion valve.

d. The txv bulb is located below the center of the suction line. This area must be clean to ensure positive bulb contact. Strap bulb to suction line and insulate both.

e. Braze the equalizer tubes to expansion valve.

f. Evacuate, dehydrate and recharge unit. (See Sections 4.5 and 4.6).

g. Check superheat (See Section 1.6.2.f.).

4.12.2 Measuring Superheat

a. Remove insulation from expansion valve bulb and suction line. See Figure 4-8

b. Loosen one TXV bulb clamp and make sure area under clamp (above TXV bulb) is clean.

c. Place thermocouple above (parallel to) the TXV bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 4-8

d. Connect an accurate gauge to the ¼" port on the suction service valve.

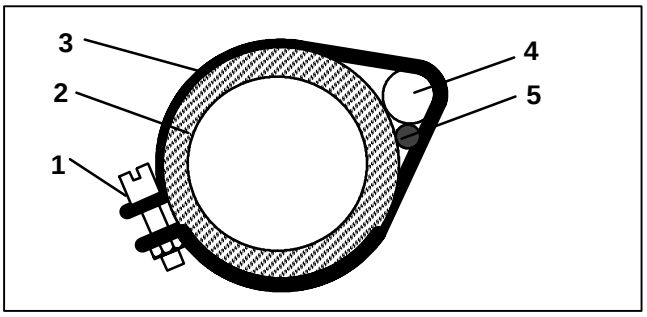
e. Run unit until stabilized at –4_F (-20_C) box temperature.

f. From the temperature/pressure chart (Table 4-3), determine the saturation temperature corresponding to the evaporator outlet pressure.

g. Note the temperature of the suction gas at the expansion valve bulb.

h. Subtract the saturation temperature determined in Step f. from the average temperature measured in Step g.. The difference is the superheat of the suction gas. Refer to paragraph 1.6.2 for superheat setting.

i. If required, adjust superheat by turning the adjusting screw located under the cap on the side of the valve.



1. Nut and Bolt (Clamp)
2. Suction Line (end view)
3. TXV Bulb Clamp
4. TXV Bulb
5. Thermocouple

Figure 4-8 Thermostatic Expansion Valve Bulb And Thermocouple

4.13 DIAGNOSTIC TOOL

NOTE

The Cab Command diagnostic tool comes with two jumpers. These are not applicable to the 20X system and should not be used in this application.

Figure 4-9 Cab Command Diagnostic Tool (CTD P/N 07-00440-00)

a. Testing a cab command cable that is already installed on the unit and routed into the truck cab requires the use of both pieces of the diagnostic tool.

b. Unplug the cab command cable from the microprocessor and also from the back of the cab command module.

c. Plug one end of the cable into the primary tool and the other end into the remote tool.

d. Begin the test by turning on the power switch and observing the sequence of green lights. As each circuit is tested, the corresponding light is illuminated. If a fault is found in the cable, the light that corresponds to that particular circuit is not illuminated.

e. To test a cable that is not installed on a unit, simply plug each end of the cable into the primary tool and perform the test as above.

4.14 MICROPROCESSOR

⚠ WARNING

Under no circumstances should anyone attempt to repair the microprocessor module or Cab Command! Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

Although there is less danger of electrical static discharge (ESD) damage in the outdoor environment, where the processor is likely to be handled, proper board handling techniques should be stressed. Boards should always be handled by their edges, in much the same way one would handle a photograph. This not only precludes the possibility of ESD damage, but also lowers the possibility of physical damage to the electronic components. Although the microprocessor boards are fairly rugged when assembled, they are more fragile when separated and should always be handled carefully.

When welding is required on the unit frame, or on the front area of the truck, ALL wiring to the microprocessor MUST be disconnected. When welding is performed on other areas of the truck and van, the welder ground connection MUST be in close proximity to the area being welded. It is also a good practice to remove both battery cables before welding on either the unit frame or the truck to prevent possible damage to other components such as the alternator and voltage regulator.

4.15 EVAPORATOR COIL CLEANING

The use of recycled cardboard cartons is increasing. The recycled cardboard cartons create much more fiber dust during transport than ”new” cartons. The fiber dust and particles are drawn into the evaporator where they lodge between the evaporator fins. If the coil is not cleaned on a regular basis, sometimes as often as after each trip, the accumulation can be great enough to restrict air flow, cause coil icing, repetitive defrosts and loss of unit capacity. Due to the ”washing” action of normal defrost the fiber dust and particles may not be visible on the face of the coil but may accumulate deep within.

It is recommended to clean an the evaporator coil on a regular basis, not only to remove cardboard dust, but to remove any grease oil film which sometimes coats the fins and prevents water from draining into the drain pan.

Cardboard fiber particles after being wetted and dried several times can be very hard to remove. Therefore, several washings may be necessary.

a. Spray coil with a mild detergent solution such as any good commercial-grade automatic dish washer detergent and let the solution stand for a few minutes. Reverse flush (opposite normal air flow) with clean water at mild pressure. A garden hose with spray nozzle is usually sufficient. Make sure drain lines are clean.

b. Run unit until defrost mode be initiated to check for proper draining from drain pan.

4.16 CONDENSER COIL CLEANING

Remove all foreign material from the condenser coil by reversing the normal air flow. (Air is pulled in through the front.) Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

Table 4-3. R-404a Temperature-Pressure Chart

Temperature		Pressure				Temperature		Pressure		
_F	_C	Psig	Kg/cm^2	Bar		_F	_C	Psig	Kg/cm^2	Bar
-40	-40	4.5	0.32	0.31		32	0	72.5	5.10	5.00
-35	-37	7.1	0.50	0.49		34	1	75.6	5.32	5.21
-30	-34	9.9	0.70	0.68		36	2	78.8	5.54	5.43
-25	-32	12.9	0.91	0.89		38	3	82.1	5.77	5.66
-20	-29	16.3	1.15	1.12		40	4	85.5	6.01	5.90
-18	-28	17.7	1.24	1.22		42	6	89.0	6.26	6.14
-16	-27	19.2	1.35	1.32		44	7	92.5	6.50	6.38
-14	-26	20.7	1.46	1.43		46	8	96.2	6.76	6.63
-12	-24	22.3	1.57	1.54		48	9	99.9	7.02	6.89
-10	-23	23.9	1.68	1.65		50	10	103.7	7.29	7.15
-8	-22	25.6	1.80	1.77		55	13	115.4	8.11	7.96
-6	-21	27.3	1.92	1.88		60	16	126.1	8.87	8.69
-4	-20	29.1	2.05	2.01		65	18	137.4	9.66	9.47
-2	-19	30.9	2.17	2.13		70	21	149.4	10.50	10.30
0	-18	32.8	2.31	2.26		75	24	162.1	11.40	11.18
2	-17	34.8	2.45	2.40		80	27	175.5	12.34	12.10
4	-16	36.8	2.59	2.54		85	29	189.6	13.33	13.07
6	-14	38.9	2.73	2.68		90	32	204.5	14.38	14.10
8	-13	41.1	2.89	2.83		95	35	220.2	15.48	15.18
10	-12	43.3	3.04	2.99		100	38	236.8	16.65	16.33
12	-11	45.6	3.21	3.14		105	41	254.2	17.87	17.53
14	-10	48.0	3.37	3.31		110	43	272.4	19.15	18.78
16	-9	50.4	3.54	3.47		115	46	291.6	20.50	20.11
18	-8	52.9	3.72	3.65		120	49	311.8	21.92	21.50
20	-7	55.5	3.90	3.83		125	52	332.9	23.41	22.95
22	-6	58.1	4.08	4.01		130	54	355.0	24.96	24.48
24	-4	60.9	4.28	4.20		135	57	378.1	26.58	26.07
26	-3	63.7	4.48	4.39		140	60	402.3	28.28	27.74
28	-2	66.5	4.68	4.59		145	63	427.6	30.06	29.48
30	-1	69.5	4.89	4.79		150	66	454.0	31.92	31.30

SECTION 5

TROUBLESHOOTING

⚠ WARNING

Beware of unannounced starting of the unit. The unit may cycle the fans and operating compressor unexpectedly as control requirements dictate. Press OFF key on the cab command and turn vehicle engine off.

⚠ CAUTION

Under no circumstances should anyone attempt to service the microprocessor module and cab command. Should a problem develop with the control system, contact your nearest Carrier Transicold dealer for replacement components.

5.1 INTRODUCTION

Under normal circumstances, unit problems will be indicated by an active alarm in the alarm list. Suggested troubleshooting actions for each alarm indication are provided in Table 5-1. Suggested corrective actions for mechanical type problems are listed under subject headings in Table 5-2.

Table 5-1 Alarm Indications

ALARM	Description	CORRECTIVE ACTION	Reference Paragraph
A00	No Malfunction	All components functioning normally	--
A01 (A02 – Alternating Alarm)	Low Pressure Switch (LP) Open or	Unit undercharged	4.6.1
		Liquid line filter–drier restricted	4.8.1
		TXV strainer plugged with foreign material/ice.	4.12
		TXV malfunction	4.12
		Verify operation of evaporator fans.	--
		Failed switch	4.9.2
	High Pressure Switch (HP1) Open	Unit overcharged	4.6.1
		Verify operation of condenser fan	--
		Noncondensables in system	4.7
		Failed switch	4.9.2
A04	Compressor Clutch (CLHR) Malfunction	Current draw of road clutch coil either high or low	Replace
A06	Condenser Fan Motor (CFM) high amp draw	Verify motor rotates freely	--
		Replace motor	--
A07	Evaporator Fan Motor (EFM) high amp draw	Verify motor rotates freely	--
		Replace motor	--
A09	Hot Gas Solenoid Valve (HGS1) high amp draw	Current draw of coil high or low (approx 1.33 amp)	--
			--
		Replace coil	4.10.1
A10	Quench Valve (BPV) high amp draw	Current draw of coil high or low (approx 1.2 amp)	--
		Replace coil	4.10.1
A11	Condenser Pressure Control Valve (HGS2) high amp draw	Current draw of coil high or low (approx 1.6 amp)	--
		Replace coil	4.10.1

Table 5-1 Alarm Indications - Continued

ALARM	Description	CORRECTIVE ACTION	Reference Paragraph
A15	Setpoint adjusted out of the range –20.2 to 86°F (–29°C/+30°C) or below the programmed low threshold	Check setpoint	2.3
EE	Return Air Sensor	Return air sensor defective	Replace
bAt	Low Battery Voltage	Vehicle battery voltage low	Correct
		Check alternator system	--
Err	Setpoint error.	Programming error. Reset.	2.3

Table 5-2 Mechanical Indications

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.2 REFRIGERATION		
5.2.1 Unit Will Not Cool		
Compressor malfunction	Compressor drive (clutch) defective Compressor defective	Replace
Refrigeration system	Defrost cycle has not terminated Abnormal pressure Hot gas solenoid malfunction (HGS1)	5.2.5 5.2.6 4.10
5.2.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor defective	Replace
Refrigeration system	Abnormal pressure Expansion valve malfunction Non–existent or restricted evaporator airflow	5.2.6 5.2.10 5.2.9
5.2.3 Unit Operates Long or Continuously in Cooling		
Box	Hot Load Defective box insulation or air leak	Insufficient pull down time Correct
Refrigeration system	Abnormal pressure Temperature controller malfunction	5.2.6 5.2.8
Compressor	Defective	Replace
5.2.4 Unit Will Not Heat or Heating Insufficient		
Refrigeration	Abnormal pressure Temperature controller malfunction Hot gas solenoid malfunction (HGS1)	5.2.6 5.2.8 4.10
Compressor	Compressor drive (clutch) defective Compressor defective	Check Replace
5.2.5 Defrost Malfunction		
Automatic defrost will not initiate	Defrost thermostat (DTT) open or defective Hot gas solenoid valve malfunction Defrost disabled through cab command	Replace 4.10 2.8.1
Manual defrost will not initiate	Microprocessor defective Defrost thermostat (DTT) open or defective	Replace Replace
Defrost cycle initiates but does not defrost	Hot gas solenoid malfunction (HGS1) Condenser Pressure Control valve malfunction (HGS2)	4.10 4.10
Frequent defrost	Wet load Defrost settings set to low.	-- 2.8.1
Does not terminate or cycles on defrost	Defrost thermostats (DTT) shorted closed	Replace

Table 5-2 Mechanical Indications - Continued

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.2.6 Abnormal Pressure **5.2.6.1 Cooling**		
High discharge pressure	Condenser coil dirty Noncondensables in system Refrigerant overcharge Condenser fan/motor defective	4.16 4.7 4.6.1 Replace motor
Low discharge pressure	Compressor defective Hot gas solenoid malfunction Low refrigerant charge	Replace 4.10 4.6.1
High suction pressure	Compressor defective Hot gas solenoid malfunction Compressor pressure regulator misadjusted (CPR)	Replace 4.10 4.11
Low suction pressure	Filter–drier partially plugged Low refrigerant charge Expansion valve malfunction No evaporator air flow or restricted air flow Excessive frost on coil	4.8 4.6.1 5.2.10 5.2.9 Check
Suction and discharge pressures tend to equalize when unit is operating	Compressor defective Hot gas solenoid malfunction	Replace 4.10
5.2.6.2 Heating		
High discharge pressure	Overcharged system Condenser fan or HP2 pressure switch defective Noncondensables in system Condenser motor/fan defective	4.6.1 4.9 4.7 Replace motor
Low discharge pressure	Compressor defective Hot gas solenoid valve malfunction	Replace 4.10
Low suction pressure	Low refrigerant charge Compressor pressure regulating valve misadjusted (CPR) Condenser Pressure Regulating valve fault (HGS2)	4.6.1 4.11 4.10
5.2.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	Tighten Replace Replace 5.2.10 Check
Condenser or evaporator fan	Loose shroud Bearings defective Fan loose on shaft Bent shaft	Check Check Check
5.2.8 Cab Command Malfunction		
Cab Command non–operational	Fuse open Microprocessor malfunction Microprocessor/Cab command cable	Replace Replace 4.14
5.2.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Heavy frost on coil Coil dirty	Check 4.15
No or partial evaporator air flow	Evaporator fan loose or defective Evaporator fan rotating backwards Evaporator air flow blocked in box Fan motor malfunction	Check Check Check Replace

Table 5-2 Mechanical Indications – Continued

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.2.10 Expansion Valve		
Low suction pressure with high superheat	Low refrigerant charge External equalizer line plugged Broken capillary Superheat setting too high	4.6.1 Repair Repair 4.12.2
Low superheat and liquids lugging in compressor	Superheat setting too low External equalizer line plugged Pin and seat of expansion valve eroded or held open by foreign material	4.12.2 Repair 4.12
Fluctuating suction pressure	Improper bulb location or installation Insulation missing from sensing bulb Low superheat setting	4.12 Replace 4.12.2
High superheat	Expansion valve setting	4.12.2
5.2.11 Malfunction Hot Gas Solenoid, Condenser Pressure Regulating Valve, or Quench Valve		
Valve does not function properly	No power to valve Improper wiring or loose connections Valve improperly assembled Coil or coil sleeve improperly assembled Movement of plunger restricted due to: a. Corroded or worn parts b. Foreign material lodged in valve c. Bent or dented enclosing tube	Check Check 4.10
Valve shifts but refrigerant continues to flow	Foreign material lodged under seat Defective seat	4.10

SECTION 6
ELECTRICAL SCHEMATIC WIRING DIAGRAM

6.1 INTRODUCTION

This section contains Electrical Schematic Wiring Diagram covering the Models listed in Table 1-1. The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein.

⚠ WARNING

Beware of unannounced starting of the unit. The unit may cycle the fans and operating compressor unexpectedly as control requirements dictate. Press OFF key on the cab command and disconnect power plug.

⚠ WARNING

Under no circumstances should anyone attempt to repair the microprocessor components or Cab Command! Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

⚠ CAUTION

Observe proper polarity when installing battery, negative battery terminal must be grounded.

⚠ CAUTION

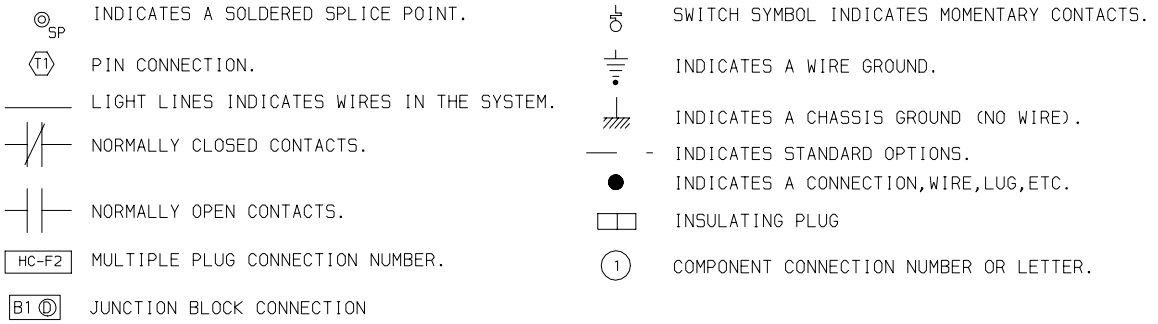
Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

⚠ CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the microprocessor. Use proper board handling techniques. (See Section 4.14).

NOTES :

1. UNIT SHOWN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
   COLOR: WHITE - DC CONTROL CIRCUITS
   GREEN - DC GROUNDS CIRCUITS
   RED - POSITIVE BATTERY CIRCUITS
   BLACK - NEGATIVE BATTERY CIRCUITS
3. ADDRESS SYSTEM: EXAMPLE: CN2-8/CFM-A INDICATES A WIRE BETWEEN CONNECTOR CN2 (PIN 8) AND PLUG CFM (PIN A).



LOCATION	SYMBOL	DESCRIPTION	LOCATION IN UNIT
B-9	LP	LOW PRESSURE SWITCH	EVAPORATOR
B-8	BPT	QUENCH THERMOSTAT	ROAD COMPRESSOR
P-9	BPV	QUENCH VALVE	EVAPORATOR
A-5	CC	CAB COMMAND	CAB
P-7	CFM	CONDENSER FAN MOTOR	CONDENSER
P-4	CLHR	CLUTCH	ENGINE COMPARTMENT
P5	EFM	EVAPORATOR FAN MOTOR	EVAPORATOR
C-3	F1	MAIN ROAD FUSE	VEHICLE BATTERY
B-10	FI	IGNITION FUSE	ENGINE COMPARTMENT
D-3	FUSE	ROAD SUPPLY FUSE	CONDENSER
B-9	HP1	HIGH PRESSURE SWITCH	CONDENSER
B-7	HP2	CONDENSER PRESSURE SWITCH	CONDENSER
P-8	HGS1	HOT GAS SOLENOID VALVE	CONDENSER
P-9	HGS2	CONDENSER PRESSURE CONTROL VALVE	CONDENSER
B-7	RAS	RETURN AIR SENSOR	EVAPORATOR

Figure 6-1 Electrical Schematic Wiring Diagram - Based On Dwg. No. 62-61350 Rev E

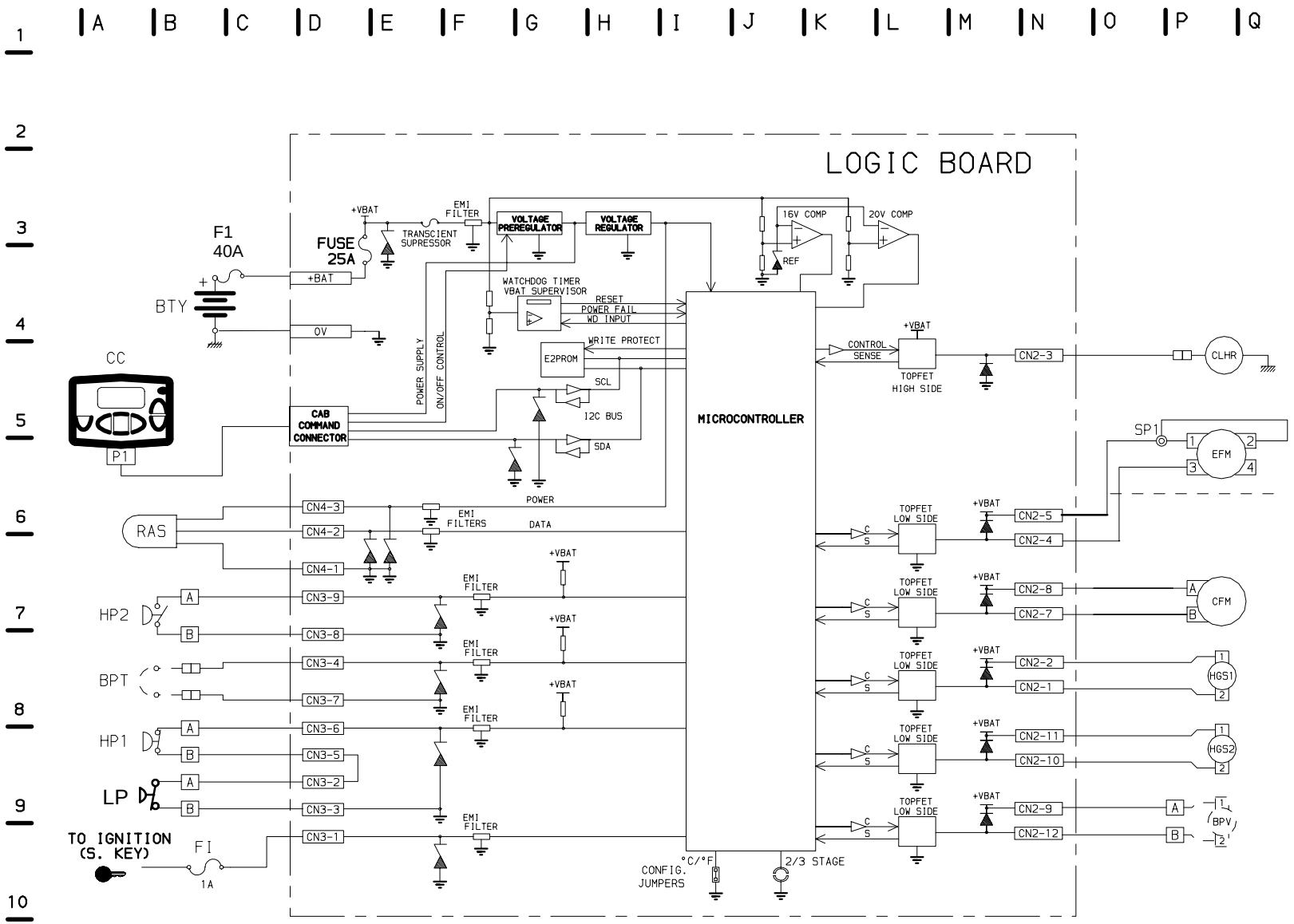


Figure 6-2 Electrical Schematic Wiring Diagram - Based On Dwg. No. 62-61350 Rev E

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