Carrier
TRANSICOLD

Direct Drive Refrigeration Unit

Z 20S
Z 30S

PRELIMINARY DOCUMENTATION

OPERATION AND SERVICE

08/98

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

DIRECT DRIVE REFRIGERATION UNITS

Z 20 S

Z 30 S

UNITED TECHNOLOGIES CARRIER TRANSICOLD

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

WARNING

Beware of unannounced starting of the fans and V-belts caused by the thermostat and the start/stop cycling of the unit.

This manual contains Operating Data, Electrical Data and Service Instructions for the truck refrigeration units listed in Table 1-1. Also Table 1-1 charts some significant differences between these models.

The Z 20S / Z 30S models are multi-piece units designed for truck applications.Two type of drive are available:

• Road operation (Z 30S only) :
- driven by the engine of the vehicle when in operation over-the-road.

• Road/Standby Version :
- driven by the engine of the vehicle when in operation over-the-road and by connecting the unit to the mains power on shut-down.

The model/serial nameplate is located inside of the unit on the frame (Figure 1-1).

The standard control system is a microprocessor controller (See section 1.7). Once the controller (remote Command within the cab of the truck) is set to the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects cooling or heating cycles as necessary to maintain the desired temperature.

The evaporator assembly consists of an evaporator coil, an expansion valve, one defrost thermostat (termination switches) and an electrical evaporator fan motor, one starting valve and one injection valve on Z30S with R404A – injection valve optional on R134a.

Table 1-1 - Description

Model	Refrigerant R134a		Road compressor*	Standby compressor	Standby Motor	
	LB	KG			1ph/3ph, 50hz	1ph/3ph, 60hz
Z 20S	4	1.8	TM 15	York 209 SC	1.1 kW	-
Z 30S	4	1.8	TM 16	TM 16	1.5 kW	1.5 kW

Model	Refrigerant R404A		Road compressor	Standby compressor	Standby motor	
	LB	KG			1ph/3ph, 50hz	1ph/3ph, 60hz
Z 30S	4	1.8	TM 15	TM 15	1.5 kW	Not available

* In certain cases, road compressors TM 15 and TM 16 cannot be installed in the engine compartments. The SD5H09 compressor can be used in these cases, although performance will be impaired (please see your CARRIER representative for further details).

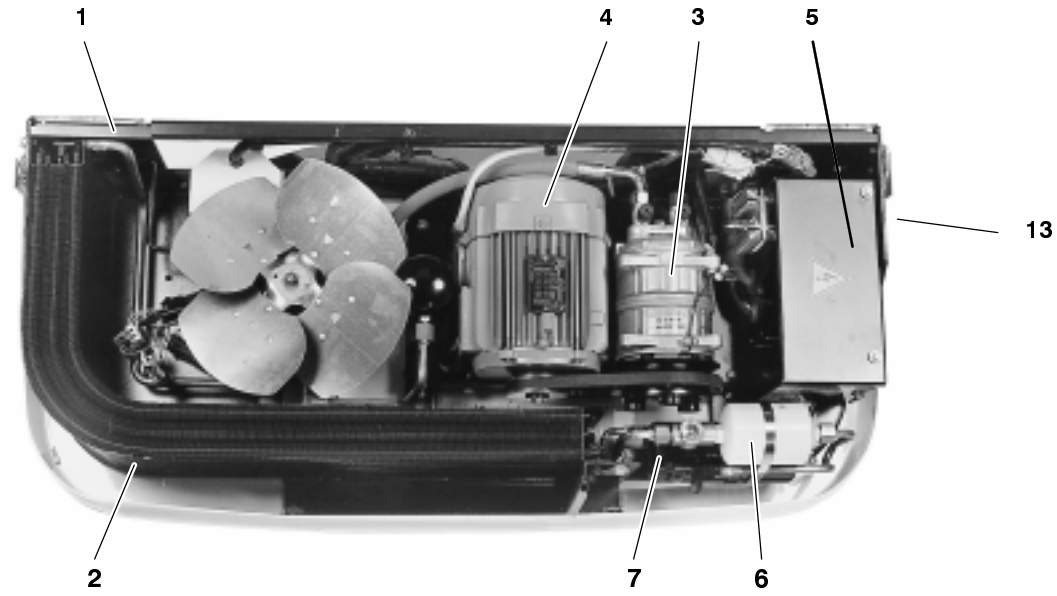


Figure 1-1 - Top view of Z 30S

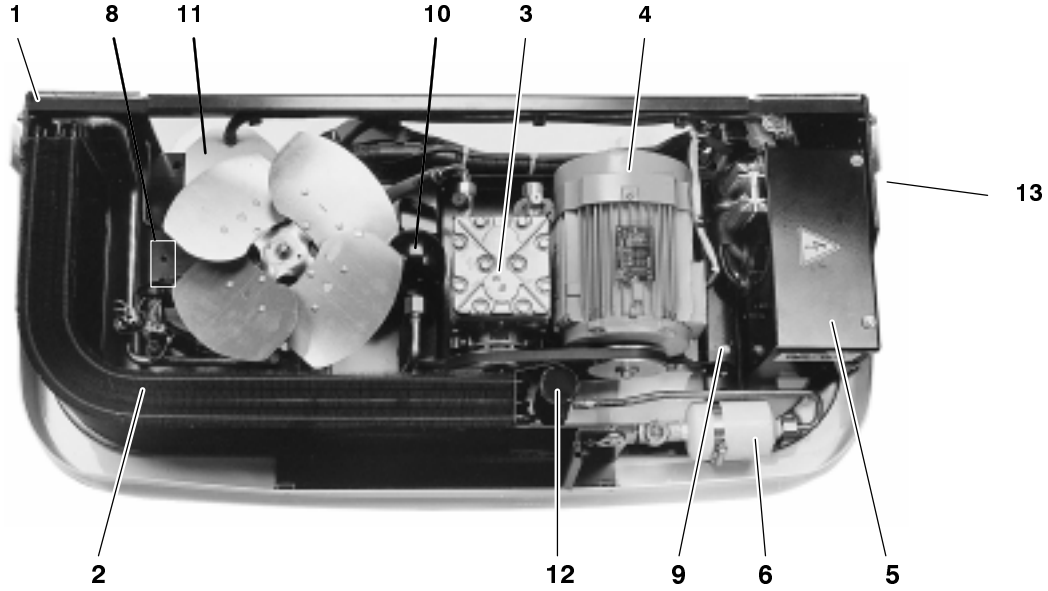


Figure 1-2 - Top view of Z 20S

1. Frame
2. Condenser
3. Compressor (see table 1-1)
4. Standby motor
5. Control box
6. Filter-drier
7. Receiver (Z 30S)
8. Condenser closing solenoid (option)
9. Platform suspended on shock mount
10. Oil separator
11. Transformer
12. Receiver integrated with condenser (Z 20S)
13. Nameplate

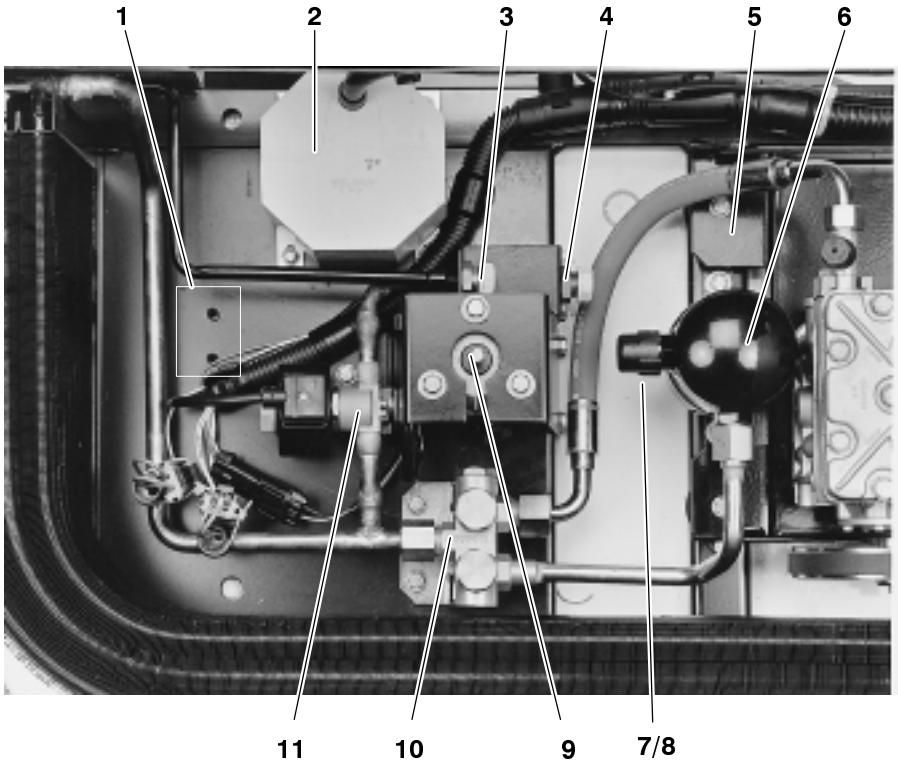


Figure 1-3 - Top view Z 20S (detail)

1. Condenser closing solenoid (option)
2. Transformer
3. Liquid line
4. Hot gas line
5. Platform suspended on shock mount
6. Oil separator
7. Road compressor discharge line
8. Road compressor oil return line
9. Condenser fan motor
10. Discharge valve section
11. Hot gas solenoid

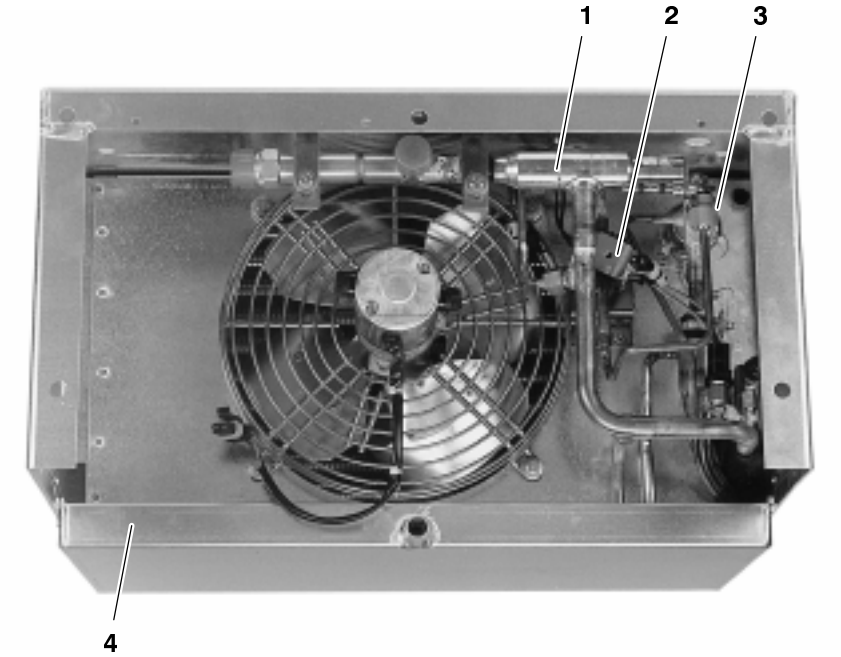


Figure 1-4 - Rear view evaporator

1. Pressure regulator (CPR) (Z 30S R404A only)
2. Quench valve (option on R134a) (standard on R404A)
3. Expansion valve
4. Evaporator coil

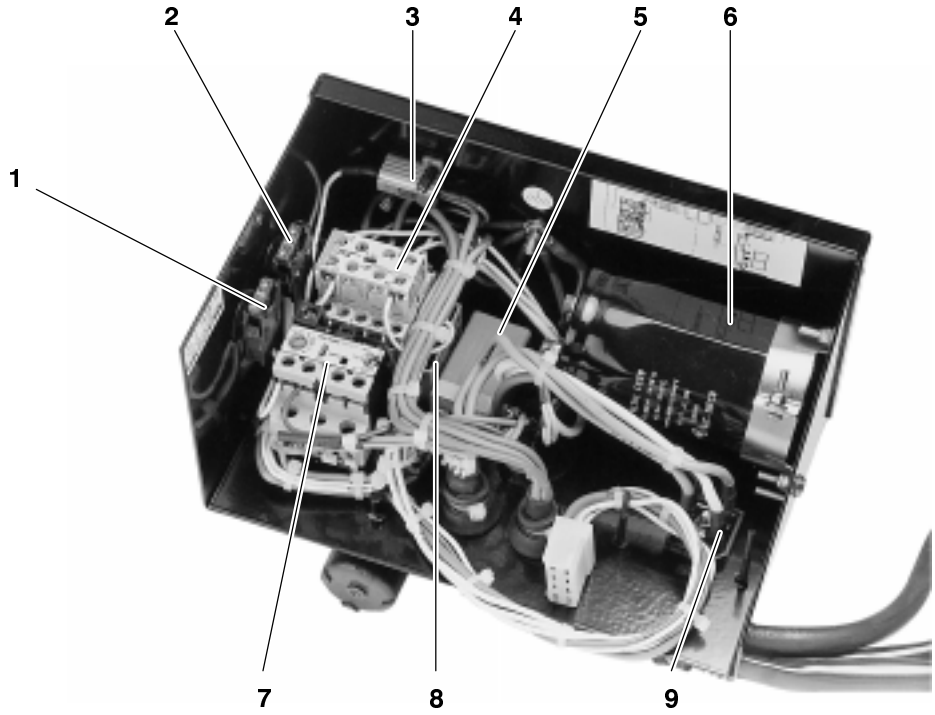


Figure 1-5 -View single-phase Road/Standby control box (up to serial number P704190)

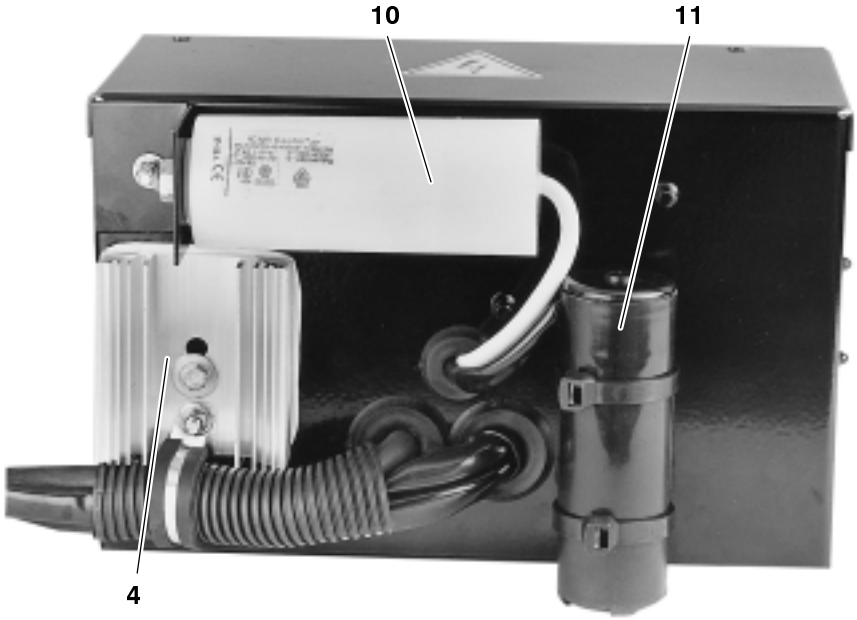


Figure 1-6 - Rear view single-phase Road/Standby control box (up to serial number P704190)

1. Standby clutch fuse
2. Standby fuse
3. Discharge resistor
4. Main + auxiliary contactor
5. Run relay
6. Filter capacitor
7. Overload relay
8. Diode
9. Diode bridge
10. Permanent capacitor
11. Starter capacitor
12. Heat sink (diode bridge)

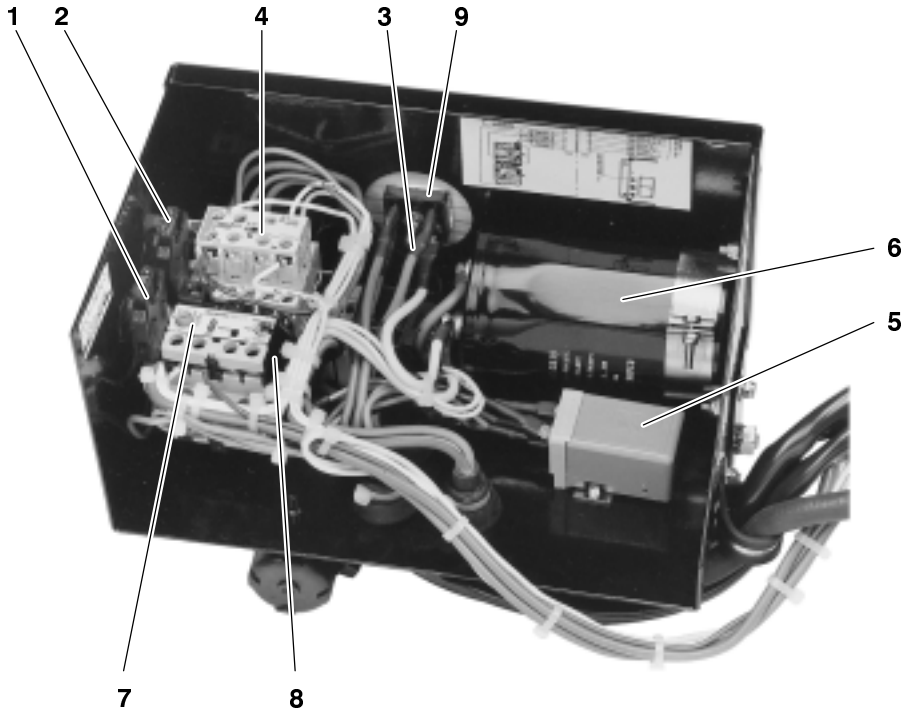


Figure 1-7 - View of single-phase Road/Standby control box (after serial number P704190)

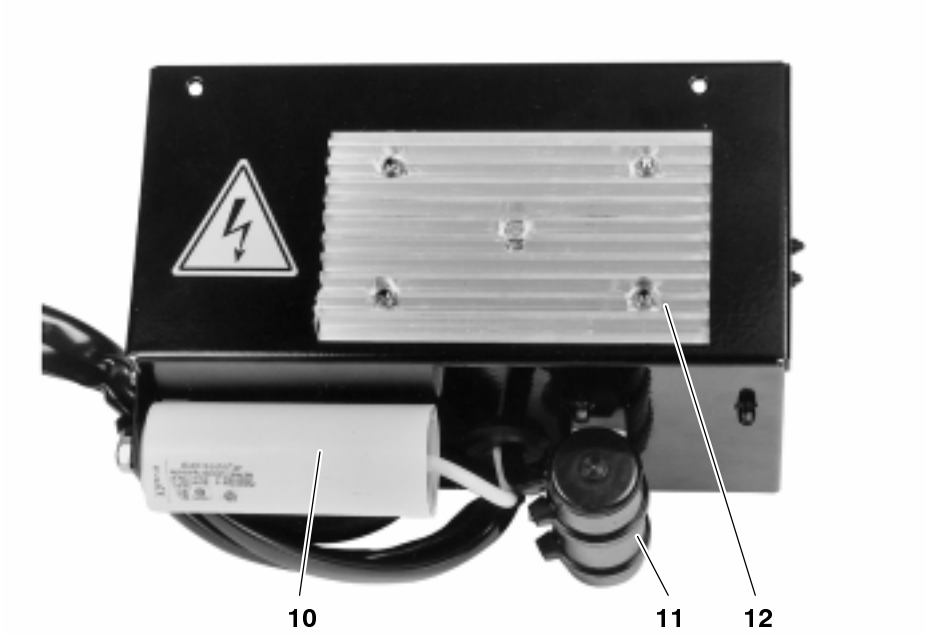


Figure 1-8 - Rear view of single-phase Road/Standby control box (after serial number P704190)

1. Standby clutch fuse
2. Standby fuse
3. Discharge resistor
4. Main + auxiliary contactor
5. Starter relay
6. Filter capacitor
7. Overload relay
8. Diode
9. Diode bridge
10. Permanent capacitor
11. Starter capacitor
12. Heat sink (diode bridge)

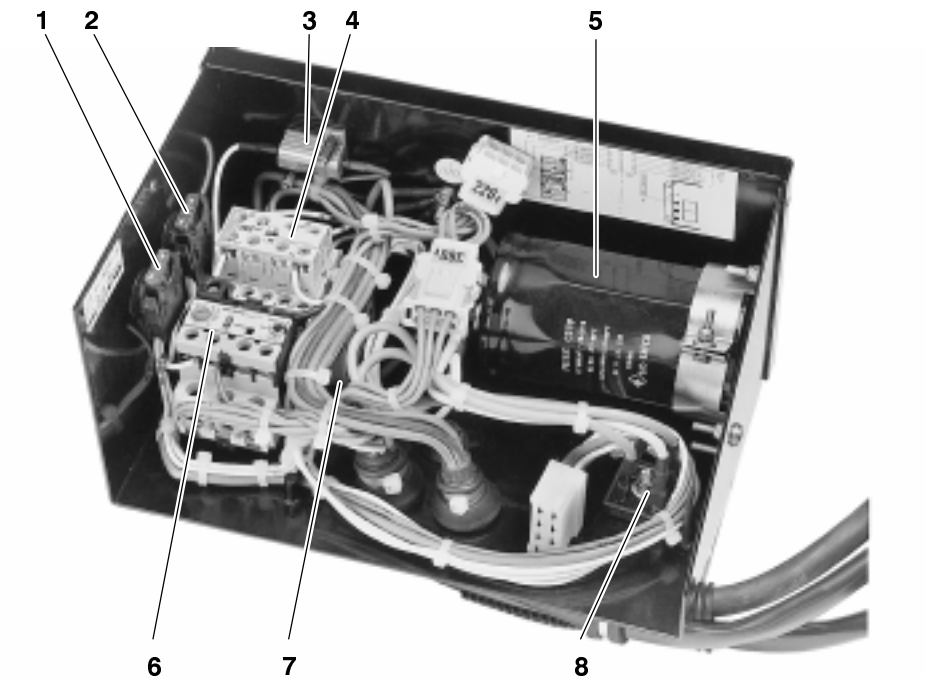


Figure 1-9 - View of Three-phase Road/Standby control box (up to serial number P704190)

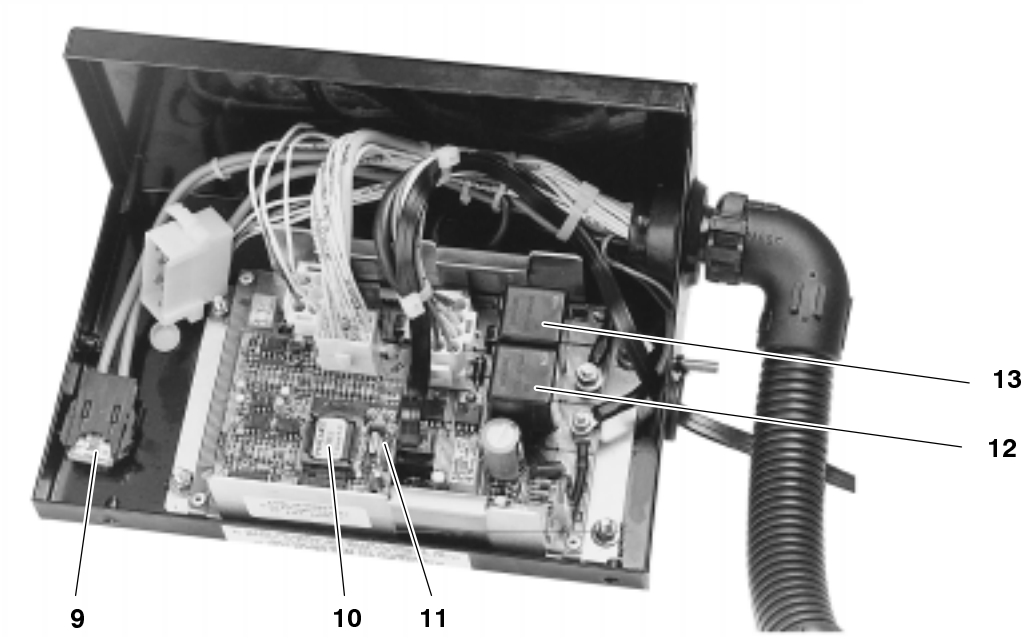


Figure 1-10 - View of Road and Road/Standby relay module

1. Standby clutch fuse
2. Standby fuse
3. Discharge resistor
4. Main + auxiliary contactor
5. Filter capacitor
6. Overload relay
7. Diode
8. Diode bridge
9. Road fuse
10. Microprocessor
11. °C or °F temperature selector switch
12 Standby relay
13 Road relay

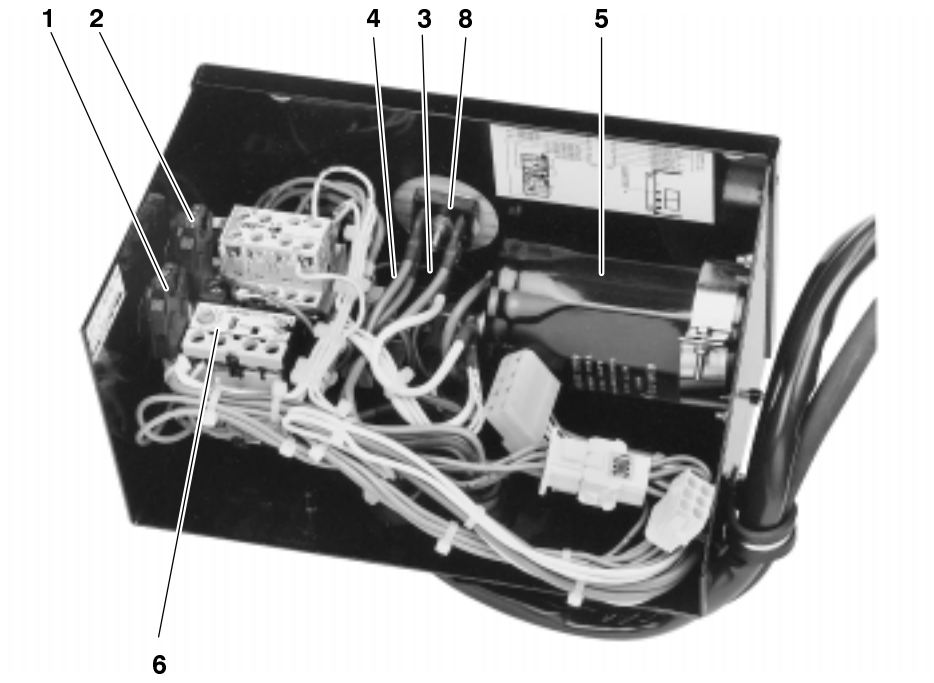


Figure 1-11 - View of three-phase Road/Standby control box (after serial number P704190)

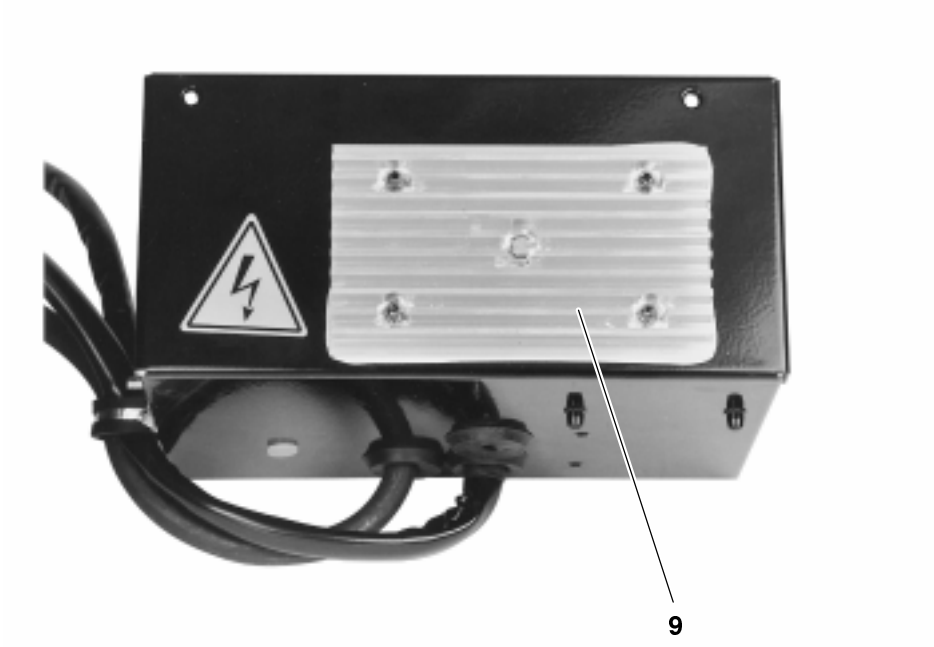


Figure 1-12 - Rear view of three-phase Road/Standby control box (after serial number P704190)

1. Standby clutch fuse
2. Standby fuse
3. Discharge resistor
4. Main + auxiliary contactor
5. Filter capacitor
6. Overload relay
7. Diode
8. Diode bridge
9. Heat sink (diode bridge)

1.2 COMPRESSOR REFERENCE DATA

Model	SD 5H09	TM 15	TM 16	York 209 SC
Displace-ment	87 cm3 (5.82 in3)	147 cm3 (8.99 in3)	162 cm3 (9.9 in3)	142 cm3 (8.69 in3)
N° cylin-ders	5	6	6	2
Weight	5.3 kg	6.7 kg	7 kg	6.6 kg
Oil Charge	200 cm3	250 cm3 road 150 cm3 standby	250 cm3 road 150 cm3 standby	355 cm3
Approved Oil	CARRIER POE #46-6002-02			

1.3 REFRIGERATION SYSTEM DATA

a. Defrost Timer

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

b. Defrost Thermostat

Opens at : 9° ± 3°C (48° ± 5°F)
Closes at : 3° ± 3°C (37° ± 5°F)

c. HP R134a Pressure Switch (HP1)

Cutout at : 24,5 bars (355 psig ± 10 PSI)
Cut-in at : 20 bars (290 psig ± 10 PSI)

HP R404A Pressure Switch (HP1)

Cutout at : 32 bars (465 psig ± 10 PSI)
Cut-in at à : 25 bars (360 psig ± 10 PSI)

R134a High Pressure Cutout Switch (HP2)

Cutout at : 9 bars (130 psig ± 10 PSI)
Cut-in at : 12 bars (175 psig ± 10 PSI)

R404A High Pressure Cutout Switch (HP2)

Cutout at : 17 bars (245 psig ± 10 PSI)
Cut-in at : 22 bars (320 psig ± 10 PSI)

d. Refrigerant charge R134a for Z 20S/Z 30S
R404A pour Z 30S

See Table 1-1.

e. Compressor Pressure Regulating Valve (CPR) R404A only

Model	CPR Settings	
	kg/cm2	psi
Z 30S	1.8	26±1

f. Thermostatic Expansion Valve Superheat

Setting for a box temperature of - 17,8°C (0°F) 4°C (7 ± 1°F)

g. R134a Low Pressure switch

Cutout at : — 0,45 bar (— 6,5 psig ± 3 PSI)
Cut-in at : + 0,45 bar (+ 6,5 psig ± 3 PSI)

R404A low pressure switch

Cutout at : — 0,2 bar (— 2,9 psig ± 3 PSI)
Cut-in at : 1 bar (14,5 psig ± 3 PSI)

h. Quench valve

Opens at : 127°C (260°F)
Closed at : 105°C (212°F)

1.4 ELECTRICAL DATA

a. Evaporator Fan Motors

Bearing Lubrication: Factory lubricated.
Horsepower: 0.14 kW (1/5 hp)
Operating Amps: 5 to 7 amps
Speed: 2500 rpm (rated)
Voltage: 12 vdc

b. Standby Motors

Bearing Lubrication: Factory lubricated additional grease not required.

Speed: 1760 rpm - 60 Hz / 1500 rpm - 50 Hz.

c. Overview motor ratings t

Voltage	Frequency	Phase	Type of Connec-tion	Power		Standby motor ratings			
				kW	HP	Constructor data			Unit
						Full Charge 4/4	Overload 6/4	Blocked Rotor	
				Z 30S					
115 V	60 Hz	1	Δ	1.5	2	6.15	8.66	31.18	5.28
230 V	50 Hz	3	Δ	1.5	2	6.15	8.66	31.18	5.28
400 V	50 Hz	3	Y	1.5	2	3.55	5.00	18	3.05
254 V	60 Hz	3	Δ	1.5	2	5.40	8.16	30.31	
440 V	60 Hz	3	Y	1.5	2	3.12	4.71	17.5	
265 V	60 Hz	3	Δ	1.5	2				4.54
460 V	60 Hz	3	Y	1.5	2				2.62
230 V	50 Hz	1	Δ	1.5	2	8.8	13.4	52	7.86
208 V	60 Hz	1	Δ	1.5	2	9.05	14.8	53	7.63
230 V	60 Hz	1	Δ	1.5	2	18.2	27	132.5	15.97
				Z 20S					
230 V	50 Hz	3	Δ	1.1	1.5	4.50	6.75	30.31	4.26
400 V	50 Hz	3	Y	1.1	1.5	2.60	3.90	17.5	2.46
230 V	50 Hz	1		1.1	1.5	6.8	11.1	47	6.32

1.5 TORQUE VALUES

Assembly	**kg—m**	**ft—lb**
Standby compressor platform	5,5	40
Standby motor platform	5,5	40
Standby compressor platform	5,5	40
Standby motor pulley	4,5	32
Compressor pulley (Z 20S)	3,0	22
Evaporator fan motor	1,8	13
Evaporator fan	1,0	7
Condenser - frame	1,0	7
Condenser fan blade	2,5	18
Mounting Bolts	6 to 8	44 to 60

1.6 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 safety devices listed in Table 1-2.

Table 1-2. Safety Devices - Microprocessor Controller

Unsafe Conditions	Safety Device	Automatic restart with fault cleared	Device Setting
1. Excessive drop in pressure	Automatic reset of Low Pressure switch	YES	Cutout : - 0,45 bar (R134a) - 0,2 bar (R404A)
2. Excessive current draw on all microprocessor outputs	Electronic relay	YES	Self-protected opening
3. Excessive current draw control circuit	Fuse on electronic board	NO	Self-protected opening
4. Excessive current draw Standby motor	Overload relay except 115/1/60 115/1/60 = Overload switch	YES/NO NO	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 (HP)		Cutout : 24,5 bar (R134a) 32 bar (R404A)
7. Excessive current draw standby clutch Z 30S	Fuse F3	NO	Opens at 5 A (12 V)
8. Excessive current draw unit on standby	Fuse F2	NO	Opens at 30 A (12 V)
9. Excessive current draw unit on road	Fuse F1	NO	Opens at 30 A (12 V)
10. Connection error on primary transformer	Fuse F4	NO	Opens at 4 A
11. Excessive temperature on standby motor bearing	PT0	YES	Self-protected opening
12. Clutch malfunction - Road (excessive current draw)	Electronic relay	YES	Self-protected opening
13. Clutch malfunction - Road (insufficient current draw)	Electronic relay	YES	Detection of min. threshold at 750 mA
14. Double power supply (road + standby)	Microprocessor		Display on Cab Command until one of the 2 power supplies has been dis-connected
15. Low battery voltage	Microprocessor	YES	Cutout/cut-in at 10 V

1.7 CAB COMMAND

From his seat, the driver can carry out all the control operations:

- shut-down,
- automatic start-up in road or standby mode,
- adjusting the set-point,
- defrost.

The driver can display the box temperature, and see whether the set-point 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 (see Figure 1-13.) Cab command

Figure 1-13. Cab command

1.7.1 INTRODUCTION

The microprocessor controller card is located in the control box. The controller comprises the microprocessor, the program memory and the input/output circuits required to interface with the unit.

The cab command is mounted remote in the cab. The command comprises the green and red LED readouts, the keypad and keypad interface (see Figure 1-13).

WARNING

The controller card and cab command must never be repaired by the driver! (see section 3.16). In the event of a malfunction with any of their components please contact your nearest Carrier Transicold distributor so that they can be replaced.

The Carrier Transicold microprocessor controls the following functions:

a. Maintains the box temperature at set-point by regulating through cooling, heat, offmode and automatic defrost cycles.

b. Permanently displays the return air temperature and on request the set-point temperature.

c. Digital display and selection of data.

For further details on digital message display, see section 1.7.6.

1.7.2 KEYPAD

The keypad comprises six keys enabling the operator to activate various functions, display operating data and to modify operating parameters.

Display

Readout

Standby operation led

Road operation led

Unit operating data led

- Green = cycling (left-hand side)
- Red = malfunction (right-hand side)

Keys

Manual defrost control key

Unit start-up key
Unit shut-down key in standby or road mode. On road operation, the unit can be shut down with the ignition key.

Unit data and function modification

The SET key, together with the + and - keys, enables display and modification of unit operating data.

The display changes parameter each time the SET key is pressed.

Decrement key for selected data

Increment key for selected data

1.7.3 SET-POINT

Modification of the set-point temperature

Display of the set-point temperature.

Decrements the set-point.

Increments the set-point.

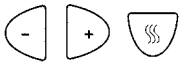
Validates set-point temperature.Returns to display of the box temperature.

It is possible to increase or decrease the set-point by whole numbers until the requisite set-point is displayed. If display stays highlighted, this indicates the set-point displayed has not been validated.

The new setting for the set-point is validated by pressing the SET key.

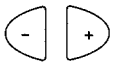
Locking the set-point

Unit start-up.



Access to menu.

The indicators light up or or flash depending on whether you are in STANDBY or ROAD mode.



Displays maximum set-point

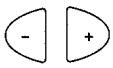
(0°C/- 27°C). Modification of maximum set-point.

Validates set-point.

Display of thermostat differential temperature.

Modification of thermostat differential

After accessing the “Set-point lock” function:



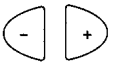
Modification of setting if necessary.

(3 possibilities : 1°/2°/3°C)

Validates modified setting.

Evaporator ventilation permanent or not

After accessing the “Thermostat differential setting” function:



Select ON or OFF.

Validate selection.

• Exit box temperature display menu
Return to normal operation of unit
After 5 seconds without pressing any key
• Exit box temperature display menu

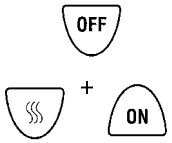
1.7.4 DIGITAL DISPLAY

The digital display comprises three alphanumeric characters. The default value displayed is the set-point. The microprocessor enables selection of the display in degrees Celsius or Fahrenheit (see photo Road control box).

The display also includes settings for defrost operation (dF).

1.7.5 FUNCTIONAL PARAMETERS

Modification of defrost parameters



Display of defrost interval previously selected.

Modification of defrost interval.

0: complete deletion of defrost.
0.5 to 0.9: decreases time interval between 2 auto defrost cycles in relation to calculated time (coefficient 1).
AUT: automatic defrost optimized by the microprocessor according to the type of cargo transported (variable intervals).
1.1 to 1.5: increases the time interval between 2 automatic defrost cycles
in relation to calculated time (coefficient 1).
1 H, 2 H,... 6 H: Forced interval between each defrost expressed in hours.

Validates modified setting.

Returns to display of box temperature.

1.7.6 ALARM DISPLAY

Access to malfunction codes

Malfunction management

SET Press SET for 5 seconds: enables access to malfunction codes.

Malf. codes	
A00	Red LED flashes No malfunction. Unit in operation.
A01	Cut-out: low-pressure switch
A02	Cut-out: high-pressure safety switch.
A03	Cut-out: electric motor overload protection on start-up.
A04	Malfunction: road operation clutch control.
A05	Malfunction: standby clutch and contactor control.
A06	Malfunction: condenser fan control.
A07	Malfunction: evaporator fan 1 control.
A08	Malfunction: heating option command.
A09	Malfunction: defrost valve control
A 10	Malfunction: quench valve control.
A 11	Malfunction: heating valve control.
A 12	High temperature alarm.
A 13	Low temperature alarm.
A 14	Defrost alarm > 45 minutes.

In cases of several simultaneous malfunctions, use the keys + to list them.

SET	Display of program version
SET	Return to box temperature
EE	Malfunction: evaporator temperature probe.
bAt	Low battery voltage low alarm. (< 10V)
- - -	Twin power supply (Diesel and Standby).

These malfunction messages are displayed instead of the temperature.

GREEN LIGHT STATUS

SET POINT

Green Led flashing 0.5 Hz	
	Set-point + 4°C
Green Led flashing 3 Hz	
	Set-point + differential Hysteresis 1, 2, 3°
Steady green Led	
Steady green Led	
	Set-point - differential 1, 2, 3°C
Green Led flashing 3 Hz	
	Set-point - differencial +4°C
Green Led flashing 0.5 Hz	

The red alarm LED flashes at 3 Hz after 15' of high or low alarm.

The red LED goes out when the temperature is within the Set-point range ± differential (steady green LED). Except on versions older than 3.00 (steady red).

In the case of defrost, the time of 15' is extended to 60'.

1.7.7 CHECKING THE EPROM VERSION

ON Start-up unit.

First check for any eventual malfunction codes.

SET Display on-screen the version no. (e.g.: 2.02).

1.7.8 DEFROST CYCLE

Defrost is an independent cycle overriding cooling and heating functions, because it enables the evaporator to be defrosted when necessary. In defrost mode, the microprocessor displays “dF” on the cab command, which no longer displays the set-point.

DEFROST

Defrost is fully automatic but can be manually controlled if authorized by the defrost thermostat.

The defrost cycles are fully managed by the integrated microprocessor.

During the defrost phase, the evaporator fan shuts down. The condenser fan is controlled by the microprocessor.

The end of the cycle is controlled by a “Klixon” thermostat.

During the defrost phase, the readout of the cab command indicates “dF”.

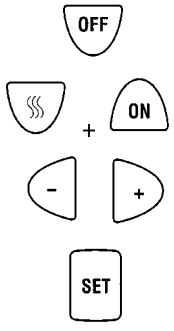
a. Defrost

Defrost mode is activated by the microprocessor automatically or manually by the operator. The cycle stops when the defrost termination thermostat (DTT) is activated. The defrost interval timer is reset to zero when the defrost cycle is terminated, for whatever reason.

b. Defrost termination safety

If the defrost cycle does not terminate after 45 minutes, the cycle terminates automatically and displays alarm code A14.

c. Modifying defrost parameters



Shut-down unit.+

Display parameters

Modify parameters

Validate modified setting.

d. Minimum shut-down only on standby

The minimum shut-down for the standby motor is 5 minutes.

After this minimum shut-down period, the unit restarts when the temperature goes out of the cycling range by ± 1. 2 or 3°C (± 1.8. 3.6 or 5.4°F).

e. Battery voltage

The battery voltage is detected. The correct voltage is 13.4 V at 24°C (75°F).

If the battery voltage drops below 10 V, the unit shuts down and the cab command displays the message “bAt”.

1.8 COMPRESSOR PRESSURE REGULATING VALVE (CPR) ON Z 30S R404A ONLY

This CPR valve is installed on the suction line of the compressor to regulate the amount of suction pressure entering the compressor. The CPR valve is set to limit the maximum suction pressure. For CPR settings refer to section 1.4.

The suction pressure is controlled to avoid overloading the electric motor or engine during high box temperature operation. To adjust the CPR valve, refer to section 4.17

1.9 HOT GAS SOLENOID (TWO-WAY)

The hot gas solenoid is normally closed (NC) and is only powered in defrost or heat modes.

If HP2 is closed, the condenser fan is ON.

If HP2 is opened, the condenser fan is OFF.

1.10 CONDENSER CLOSING SOLENOID (TWO-WAY) (OPTION)

The condenser closing solenoid is normally open (NO). It is powered if the pressure switch for fan cycling is closed.

1.11 REFRIGERANT CIRCUIT DURING COOLING (SEE FIGURE 1.14)

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 condenser air (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 receiver stores the additional charge necessary for low ambient operation and for heating and defrost modes.

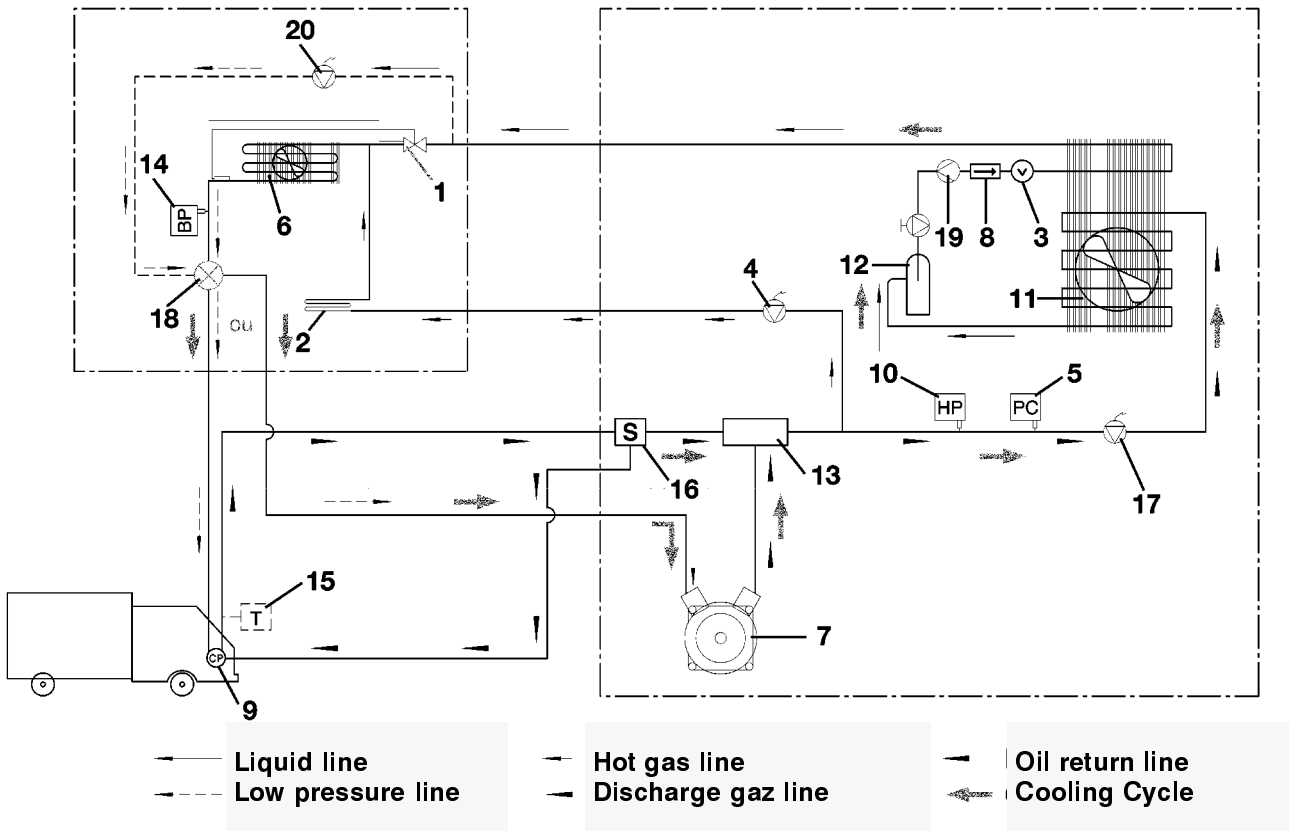
The refrigerant leaves the receiver and flows through a manual receiver shut-off valve (king valve).

The refrigerant then flows through a check valve (optional).

The refrigerant then flows through the filter-drier, where an absorbent keeps it dry and clean. The refrigerant then flows though a sight glass with moisture indication through the subcooler.

The subcooler occupies a portion of the main condensing coil surface and gives off further heat to the passing air and then towards a thermostatic expansion valve (with external pressure equalizer) which regulates the flowrate of refrigerant towards 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 truck to maintain to the cargo at the desired temperature.



1. Thermostatic expansion valve
2. Defrost element
3. Liquid sight glass with humidity indicator
4. Hot gas valve (normally closed)
5. Control pressure switch (HP2)
6. Evaporator
7. Standby compressor
8. Filter-drier
9. Road compressor
10. High pressure switch (HP1)
11. Condenser
12. Receiver
13. Discharge check valve section
14. Low pressure switch
15. Injection klixon
16. Oil separator
17. Condenser closing valve (option) (normally open)
18. CPR (only on Z 30S R404A)
19. Check valve (option)
20. Quench valve
    - Option with R134a
    - Standard with R404A

Figure 1-14. Cooling Cycle

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize. The steam at low temperature and pressure enters the accumulator and is then drawn out by the compressor.

Only on the Z 30S R404A. The refrigerant then enters the compressor pressure regulating valve (CPR) which regulates refrigerant pressure entering the compressor, where the cycle starts over.

The quench valve opens as required to maintain a maximum discharge temperature of 127°C (260°F).

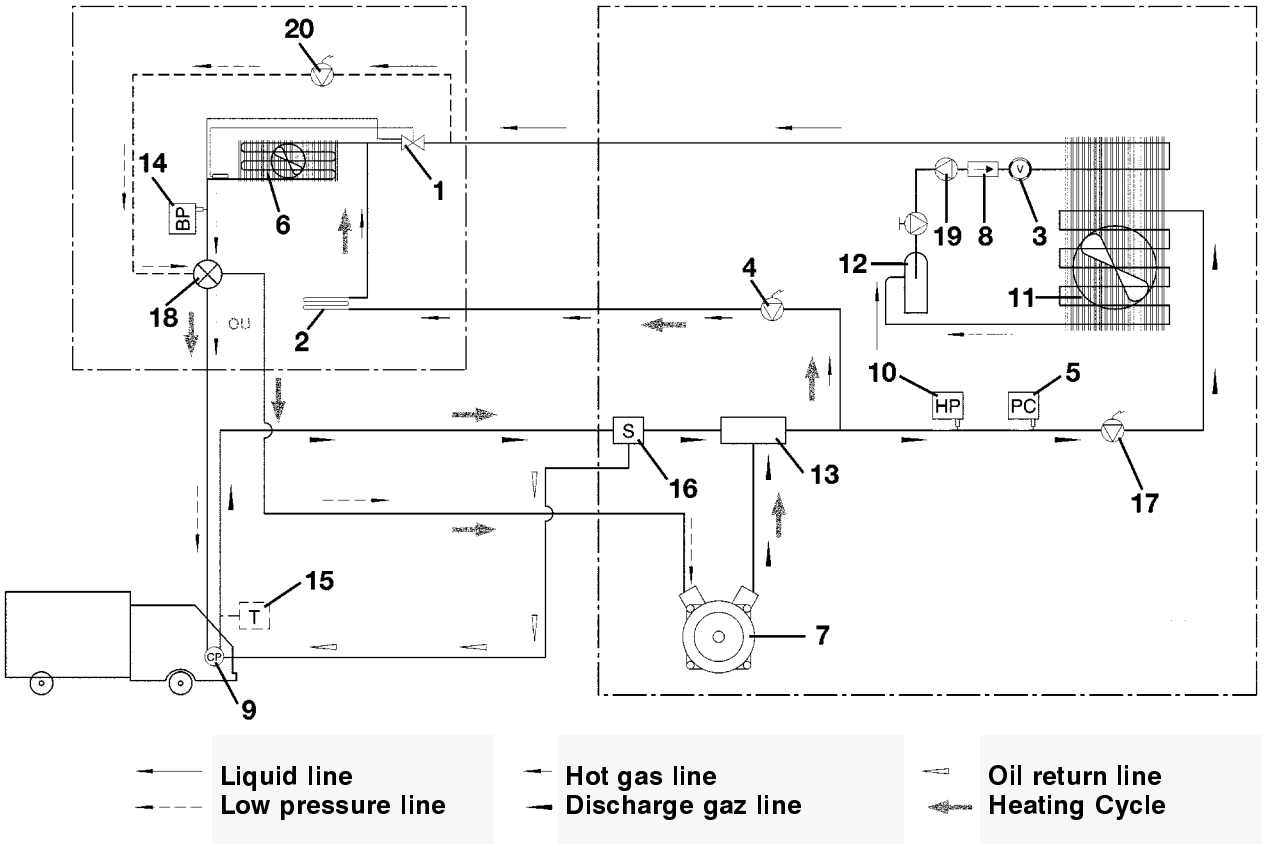
1.12 REFRIGERANT CIRCUIT DURING HEAT AND DEFROST (SEE FIGURE 1.15)

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

Case 1: With condenser closing solenoid option. When the microprocessor activates heating or defrost, the hot gas (two-way) solenoid energizes, and (if HP2 is open) the condenser closing solenoid energizes, closing the port to the condenser and opening a port which allows heated refrigerant vapor to flow directly to the evaporator coil.

Case 2: Without condenser closing solenoid option. When the microprocessor activates heating or defrost, the hot gas solenoid (two-way) energizes, 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 all the evaporator fans continue to run, blowing the air around the heated coils to heat the product. When defrosting, the evaporator fans stop, allowing the heated vapor to defrost any ice build-up there may be.



1. Thermostatic expansion valve
2. Defrost element
3. Liquid sight glass with humidity indicator
4. Hot gas valve (normally closed)
5. Control pressure switch (HP2)
6. Evaporator
7. Standby compressor
8. Filter-drier
9. Road compressor
10. High pressure switch (HP1)
11. Condenser
12. Receiver
13. Discharge check valve section
14. Low pressure switch
15. Klixon injection
16. Oil separator
17. Condenser closing valve (option) (normally open)
18. CPR (only on Z 30S R404A)
19. Check valve (option)
20. Quench valve
    - Option with R134a
    - Standard with R404A

Figure 1-15. Heating Cycle

SECTION 2

OPERATION

2.1 CONTROL AND STARTING UP

2.1.1 ON ROAD

Check the belt tension of the compressor drive belts.

Start-up and control of box temperature

Start the vehicle engine.

ON	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.
SET	Check the temperature set-point is correct by pressing the SET key; the set-point temperature is highlighted on the digital display.

Enter a new set-point if necessary (see temperature set-point adjustment).

In the event of difficulty on start-up, check that:

The control box fuses have not blown.

The temperature selected by the cab command has not been affected.

Unit shut-down

OFF Press the OFF key.

2.1.2 ON STANDBY (ROAD/STANDBY VERSION)

VERY IMPORTANT

The unit must be shut-down to connect or disconnect the standby supply cable.

Before start-up, check:

- On the power network:
  Check that the type of current corresponds to the characteristics of the unit (see section 1.8).
- On the unit :

Connect the unit to the power network.

Start-up and box temperature control

ON Press the ON key.

The digital display of the cab command displays the box temperature.

SET Check the temperature set-point is correct by pressing the SET key; the set-point temperature is highlighted on the digital display.

Enter a new set-point if necessary (see temperature set-point adjustment).

Unit shut-down

OFF Press the key OFF.

If you have difficulty in starting up, check:

The set-point temperature selected on the cab command has not been reached.

The control box fuses have not blown

Cooling

There are two control ranges, Frozen and Perishable. The frozen range is active with set points at or below -12°C (+10°F) and the Perishable range is active at set points above -12°C (+10°F).

The controller automatically selects the mode necessary to maintain box temperature at set point.

Heating

See section 1.12 for a description of the heating cycle.

The unit will only heat when the controller is set above -12°C (+10°F) as the heat relays are electronically locked out with set points at or below -12° (+10°F)

The microprocessor automatically selects the mode necessary to maintain box temperature at set point. In pulldown the heating modes are as follows (Figure 2.1 and 2.2):

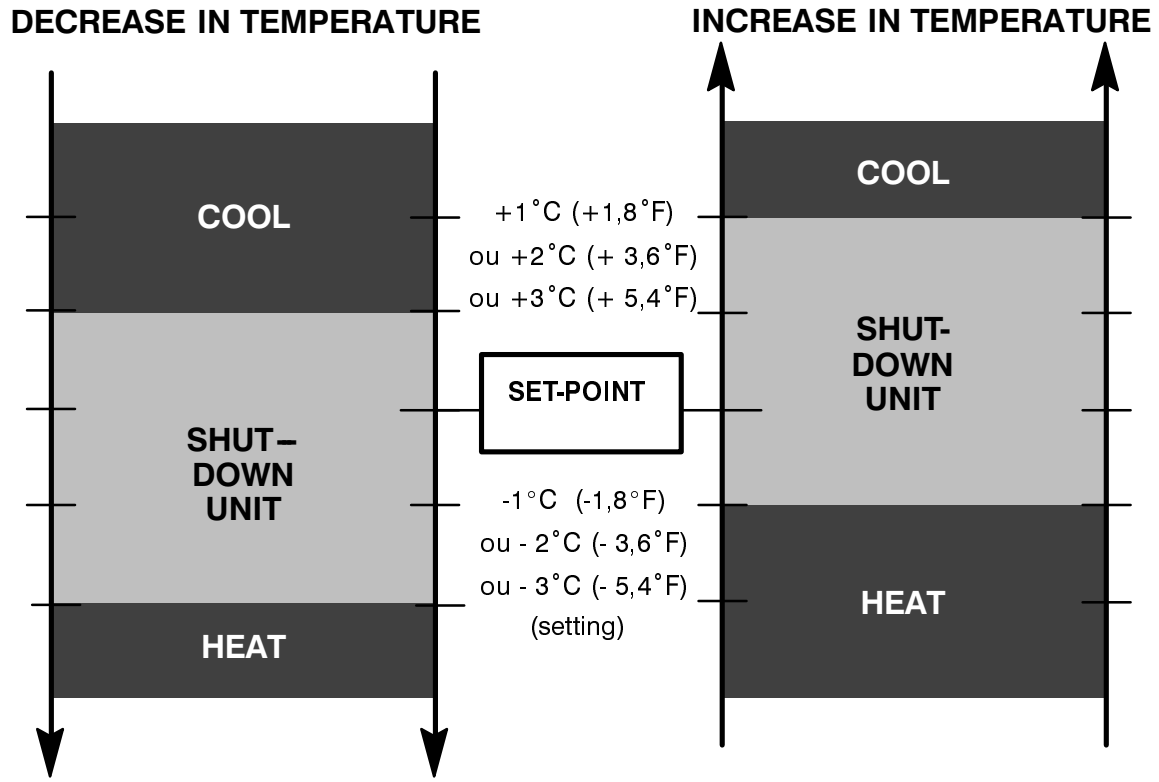
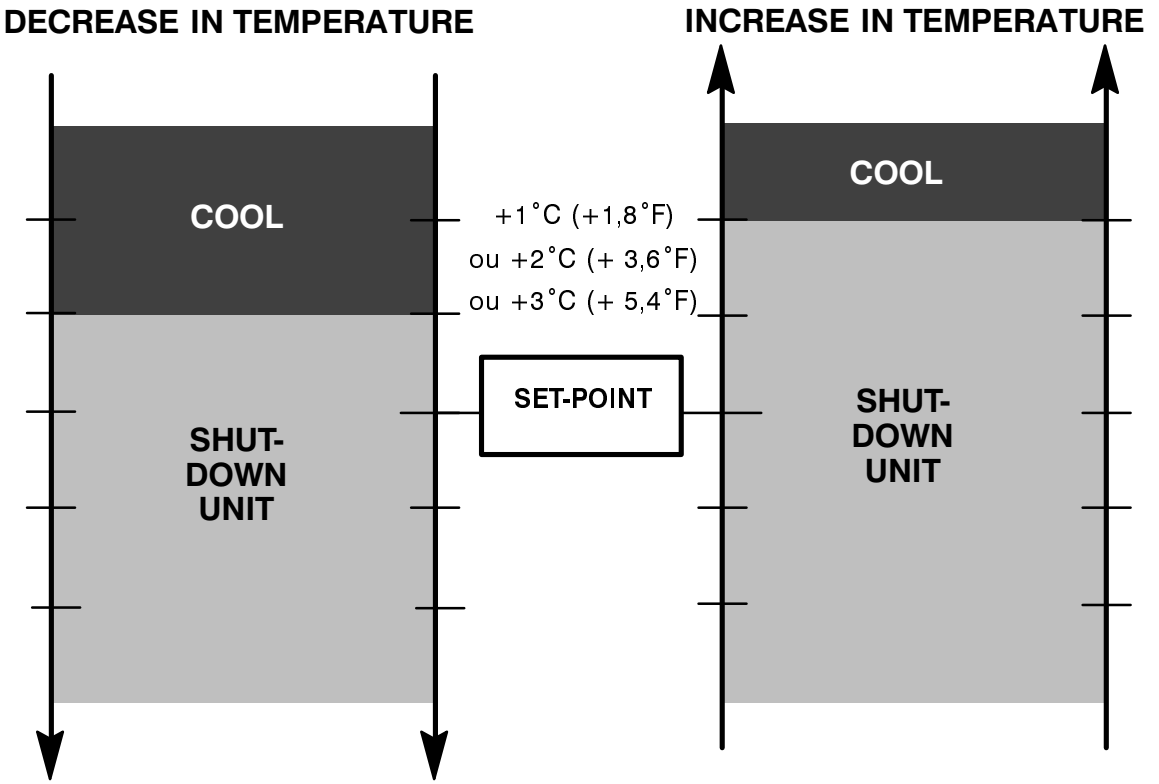


Figure 2-1. Thermostat operating sequence - Standby or road operation
Set-point higher than -12°C (+10°F)



NOTE: The thermostat inhibits heat mode when it is set to a temperature lower than -12°C (+ 10°F).

Figure 2-2. Thermostat operating sequence - Standby or road operation
Set-point lower than -12°C (+ 10°F)

Defrost

See sections 1.11 et 1.12 for a description of heat and defrost cycles.

Chart 2-1. Management of condenser and evaporator fans and heat and defrost valves (from version 3.01)

	EFM evaporator fan		CFM condenser fan	Heat standby	HGS2 heat valve	HGS1 defrost valve	HP2 Pressure switch	Klixon defrost
Cool	ON		OFF	OFF	OFF	OFF	OPEN	XX
	ON		ON 3 mn minimum	OFF	OFF	OFF	CLOSED	XX
Cycling	OFF	ON if forced by config.	OFF	OFF	OFF	OFF	OPEN	XX
	OFF		OFF	OFF	OFF	OFF	CLOSED	XX
Heating if set-point = or > -12°C	ON		OFF	ON	ON	ON	OPEN	XX
	ON		ON IF HGS2 = OFF + 1mn	ON	OFF 1 mn mini	ON	CLOSED	XX
Defrost	OFF		OFF	OFF	ON	ON	OPEN	CLOSED
	OFF		ON IF HGS2 = OFF + 1mn	OFF	OFF 1 mn mini	ON	CLOSED	CLOSED

Chart 2-2. Management of condenser and evaporator fans and heat and defrost valves (until version 3.0)

	EFM evaporator fan		CFM condenser fan	Heat standby	HGS2 heat valve	HGS1 defrost valve	HP2 Pressure switch	Klixon defrost
Cool	ON		OFF	OFF	OFF	OFF	OPEN	XX
	ON		ON 3 mn minimum	OFF	OFF	OFF	CLOSED	XX
Cycling	OFF	ON if forced by config.	OFF	OFF	OFF	OFF	OPEN	XX
	OFF		OFF	OFF	OFF	OFF	CLOSED	XX
Heating if set-point = or > -12°C	ON		OFF	ON	ON	ON	OPEN	OPEN
	OFF							CLOSED
	ON		ON if HGS2 = OFF + 1 mn	ON	OFF 1mn mini	ON	CLOSED	OPEN
	OFF							CLOSED
Defrost	OFF		OFF	OFF	ON	ON	OPEN	CLOSED
	OFF		ON if HGS2 = OFF + 1 mn	OFF	OFF 1 mn mini	ON	CLOSED	CLOSED

Minimum "OFF" time (5 minutes): Once the motor has cycled off, it will remain off for the minimum "off time". This prevents the motor from rapid cycling due to changes in air temperature. Air temperature in the box change rapidly, but it takes time for the product temperature to change.

NOTE

When in Continuous Run, perishable range, the unit cycle between cool and heat to maintain box temperature at setpoint. In frozen range the unit will run in cool only. Continuous Run is normally used for perishable products that require constant air flow.

Defrost on standby

Defrost on standby operates the same way as the defrost on road operation (see section 1.12).

SECTION 3

SERVICE

WARNING

Beware of V-belt and belt-driven components as the unit may start automatically. Before servicing unit, make sure the Run-Stop (ON/OFF) switch is in the OFF position. Also disconnect the negative battery cable.

NOTE

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

3.1 UNIT MAINTENANCE

3.1.1 Unit maintenance schedules

Regular servicing is required in order to optimize the service life and reliability of your unit. Service operations are to be carried out according to the following schedule.

Kilometers	5 000	30 000	60 000	90 000	120 000	150 000	180 000	210 000
Miles	3 000	18 000	36 000	54 000	72 000	90 000	108 000	126 000
Service A	n	n	n	n	n	n	n	n
Service B		n	n	n	n	n	n	n
Service C			n		n		n	
Service D					n			

Table 3-1

Refrigerant : type R134a on Z 20S.
type R134a or R404A on Z 30S.

Road compressor oil type: The road compressors are supplied with CARRIER POLYESTER (POE) oil. The presence of a sticker indicates that the oil-change has been correctly carried out in our CARRIER TRANSICOLD plant. Oils of PAG type are **strictly incompatible** with the operation of our units, **never use an oil other than that approved by CARRIER**.

Oil analysis:

On request we can analyze your compressor oil.

To do this, we send a small drum with a label on which you should indicate:

- the type of compressor,
- the lapse of time or mileage since the last oil change,
- the type of CARRIER equipment,
- the date of initial operation.

IMPORTANT

Before any operation requiring an intervention on the unit, check that:

• that the unit (cab command) is OFF.

• that it is impossible for the unit to automatically start up during maintenance.

3.1.2 Description of maintenance operations

Maintenance operations

Service A
- Check the tension of the compressor belt(s).
- Check that the vehicle engine runs correctly at low speed and that the compressor kit is correctly tightened
- Check the tightness of bolts and screws and that the unit is correctly fastened onto the box.

Service B
- Clean the condenser and the evaporator.
- Replace the Road and Standby compressor belt(s).
- Replace the filter-drier.
- Check the compressor oil level.
- Check the operation of the cab command.
- Check the defrost
  - Cut-in,
  - Fan shut-down,
  - Cut-out,
  - Defrost water drain.

Service C
- Check the bearings of the belt tension pulleys and bearing of the mechanics kit.

Change the spring if there is one.
- Check the operation of the evaporator and condenser fans. Change the motor brushes.
- Change the compressor oil. Only use Ester oil (POE) approved by CARRIER. See the technical information sheets for the recommended quantities and types of oil.

Service D
- Change the removable relays and fuses in the control box.

3.2 BELT MAINTENANCE AND ADJUSTMENT

WARNING

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

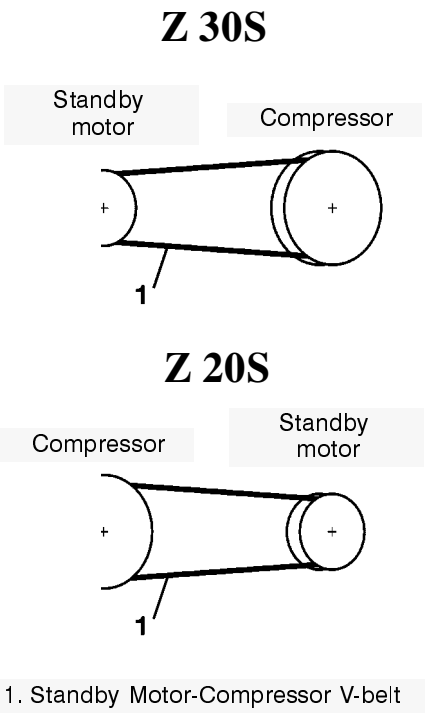
3.2.1 Belt tension gauge

It is recommended to use a belt tension gauge (tester) code 07-00203, as shown in Figure 3.2, whenever V-belts are adjusted or replaced.

A belt tension gauge provides an accurate and easy method of adjusting belts to their proper tension. Properly adjusted belts give long lasting and efficient service. Too much tension shortens belt and bearing life, and too little tension causes slippage and excessive belt wear. It is also important to keep belts and sheaves free of any foreign material which may cause the belts to slip.

The Belt Tension gauge can be used to adjust all belts. The readings which we specify for Carrier Transicold units are applicable only for our belts and application, as the tension is dependent on the size of the belt and distance between sheaves. When using this gauge, it should be placed as close as possible to the midpoint between two sheaves. (See Figure 3.2).

When installing a new V-belt the tension should be somewhat higher than specified and readjusted after allowing the unit to run for some time.



1. Standby Motor-Compressor V-belt

Figure 3-1 Layout of V-belts

Table 3-2
Belt tension (see Figure 3-1)

BELTS	Tension (daN)
Standby motor - compressor	20

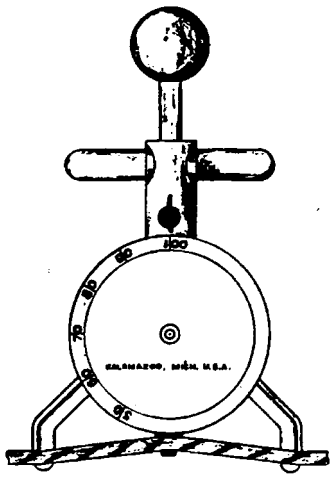


Figure 3-2 Belt Tension Gauge (Code 07-00203)

3.2.2 Standby motor-Compressor V-belt

a. Loosen the retaining bolts of the standby motor support plate.

b. Replace the V-belt. Position the motor to correct belt tension. Tighten the motor retaining bolts.

3.3 REMOVING THE REFRIGERANT CHARGE

NOTE

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

a. Pumping the Unit Down (Z 30S only)

To service the filter-drier, expansion valve, quench valve, CPR valve or evaporator coil, pump most of refrigerant into condenser coil and receiver as follows:

1. Open valves two turns (clockwise). Purge gauge line.
2. Close the receiver outlet (king) valve by turning clockwise. Start unit
3. The refrigerant will be trapped between the compressor discharge valve and the receiver service valve.
4. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge.
5. When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation.
6. Open the receiver service valve.
7. Leak check connections with a leak detector (see section 3.4).
8. Start the unit in cooling mode and check for non-condensibles.
9. Check the refrigerant charge (see section 3.6.3).

NOTE

Store the refrigerant charge in an evacuated container if the system must be opened between the compressor discharge valve and receiver.

Once the system is OPEN, it must be evacuated and dehydrated (see section 3.5.3).

b. Removing the Refrigerant Charge

Connect a refrigerant system to the unit to remove refrigerant charge. Refer to instruction provided by the manufacture of the refrigerant recovery system.

3.4 REFRIGERANT LEAK CHECKING

Once the recovery system is OPEN and repairs completed, leak check the unit by proceeding as follows:

a. The recommended procedure for finding leaks in a system is with a halide torch or electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.

b. If system is without refrigerant, charge system with refrigerant to build up pressure between 2.1 to 3.5 kg/cm2 (30 to 50 psig). Remove refrigerant cylinder and leak check all connections. NOTE Important: only the correct refrigerant cylinder be connected 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.

NOTE

Important: only the correct refrigerant cylinder be connected 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.

c. Remove refrigerant using a refrigerant recovery system and repair any leaks. Evacuate and dehydrate the unit. (Refer to section 3.5) Charge unit with refrigerant. (Refer to section 3.6)

3.5 EVACUATION AND DEHYDRATION

3.5.1 General

Moisture is the deadly enemy of 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.

3.5.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section(see section 3.4).

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5cfm = 8m3H volume displacement, code 07-00176-01) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator).

NOTE

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

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

3.5.3 Evacuation and dehydration procedure

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 3.3 (do not us standard service hoses as they are not suited for evacuation purposes). Also, as shown, connect an evacuation manifold with special evacuation hoses to the vacuum pump, to the electronic vacuum gauge and to the refrigerant recovery system.

c. Shut off the pump and check to see if the vacuum holds. This operation is to test the evacuation setup for leaks, repair if necessary.

e. 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.

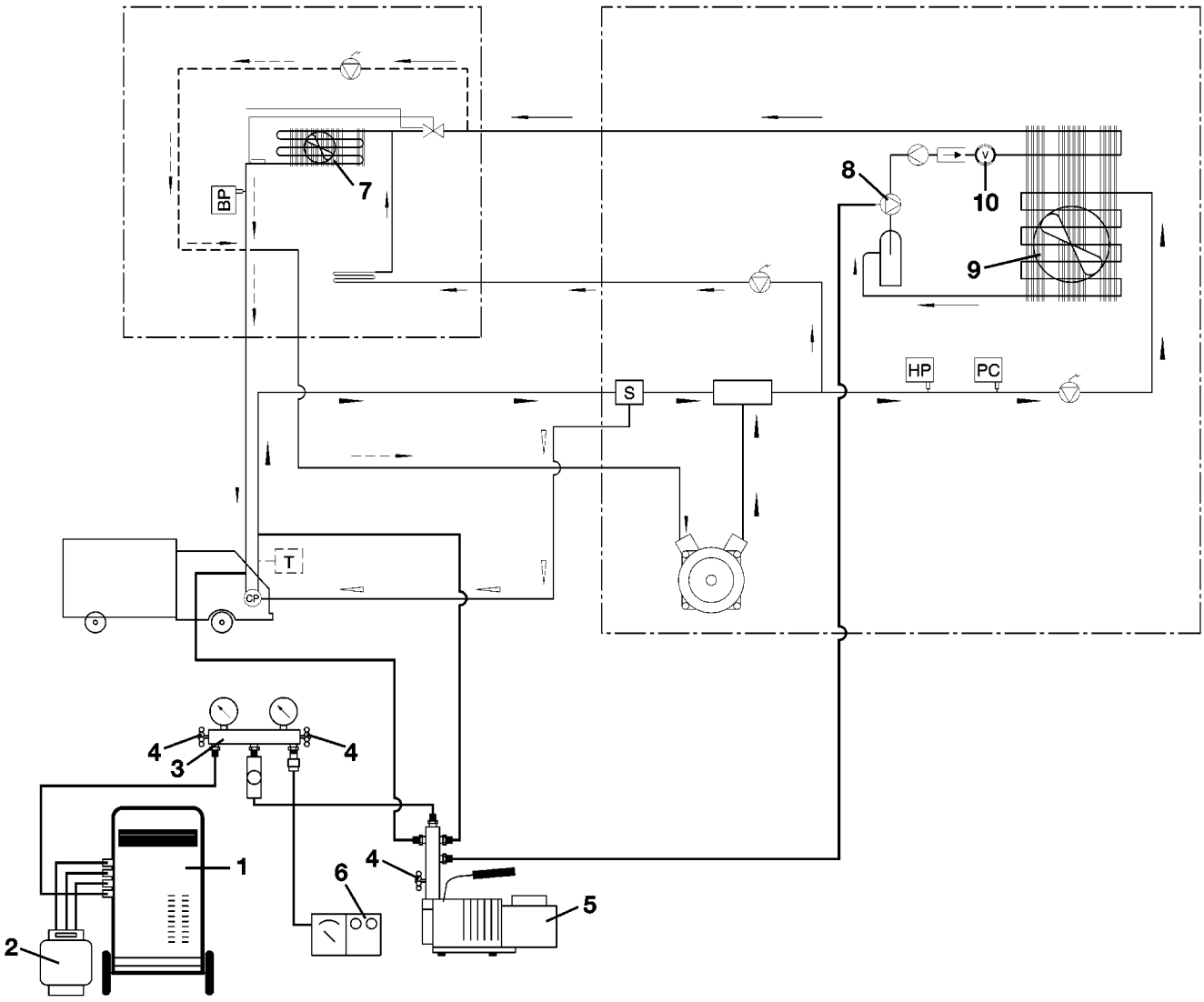
f. Break the vacuum with clean dry refrigerant. Use refrigerant that the unit calls for. Raise system pressure to approximately 2 psig.

g. Remove refrigerant using a refrigerant recovery system.

h. Repeat steps e to g.

i. 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.

j. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales. The correct amount of refrigerant may be added by observing the scales (see section 3.6)



1.	Refrigerant Recovery Unit	6.	Electronic Vacuum Gauge
2.	Refrigerant Cylinder	7.	Evaporator
3.	Evacuation Manifold	8.	Receiver Service Valve
4.	Valve	9.	Condenser
5.	Vacuum Pump	10.	Sight glass

Figure 3-3. Vacuum Pump Connection

3.6 CHARGING THE REFRIGERATION SYSTEM

3.6.1 Installing a complete charge

a. Dry the refrigeration circuit and create a high vacuum (see section 3.5).

b. Place refrigerant cylinder on scale and connect charging line from cylinder to receiver outlet (king) valve. Purge charging line at outlet (king) valve. Purge charging line at outlet valve.

c. Note weight of refrigerant cylinder.

d. Open liquid valve on refrigerant cylinder. Open king valve half way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales. (Correct charge will be found in section 1.2).

NOTE

It is possible that all liquid may not be pulled into the receiver, as outlined in step d above. In this case, vapor charge remaining refrigerant through the suction service valve (see section 3.6.2).

e. When refrigerant cylinder weight (scale) indicates that the correct charge has been added, close liquid line valve on cylinder and open the service valve on the receiver.

3.6.2 Adding a partial charge

a. Place refrigerant cylinder on scale and note weight Backseat suction service valve and connect charging line between suction valve port and refrigerant cylinder.

b. Run the unit in high speed cool and open suction service valve.

c. If necessary partially block the condenser coil to raise the head pressure to 12 bars (R134a) or 22 bars (R404A).

NOTE

*** When charging the refrigeration system with R134a, install a vapor charge.**

*** When charging the refrigeration system with R404A, install a liquid charge.**

d. Open suction service valve. Close VAPOR valve on refrigerant cylinder, noting weight.

e. Start unit and check for non-condensibles.

3.6.3 Checking the refrigerant charge

a. Start unit in cooling mode. Run approximately ten minutes. Partially block off air flow to condenser coil so discharge pressure rise to 12 bars (R134a) or 22 bars (R404A).

The charge is correct if there are no bubbles at the coolant light level (10).

3.7 REPLACING THE COMPRESSOR

a. Evacuate the unit. Repeat the steps in section 3.3.

b. Installation

1. To install the compressor, reverse the procedure outlined when removing the compressor. Refer to section 1.5 for torque values.

NOTE

The replacement compressor is sold without flanges.

Pump down the unit, see section 3.5 then charge system, see section 3.6.

3.8 CHECKING AND REPLACING FILTER-DRIER

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 discharge connection seems lower than that of the suction connection, replace the filter-drier.

Replacing the filter-drier

a. Pump unit down according to section 3.3. Remove the drier mounting clip, then replace the filter-drier.

3.9 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCH

3.9.1 Replacing high pressure cutout switch

a. Remove defective switch.

b. Install the new switch.

3.9.2 Checking high pressure cutout switch

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 165 kg/cm2 (2350 psi). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 3.4).

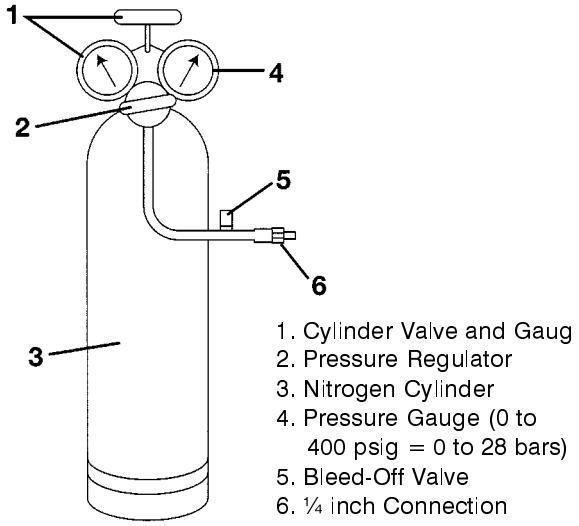


Figure 3-4. Typical setup for Testing High Pressure Switch 1 and HP2

a. Remove switch as outlined in section 3.9.1.

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

c. Connect switch to a cylinder of dry nitrogen (see Figure 3.4).

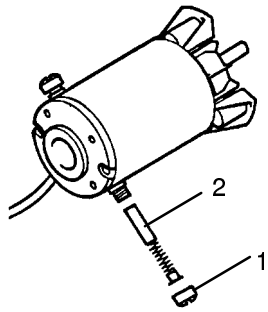
d. Set nitrogen pressure regulator higher than cut-out point on switch being tested. Pressure switch cut-in points are shown in sections 1.3.

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

f. Open cylinder valve. Slowly close bleed-off valve and increase pressure until the switch opens. If light is used, light will go out and if an ohmmeter is used, the meter will indicate open. Open pressure on gauge. Slowly open bleed-off valve (to decrease pressure) until switch closes (light will light or ohmmeter will move).

3.10 CHECKING AND REPLACING EVAPORATOR FAN MOTOR BRUSHES AND COMMUTATOR

The fan motor commutator and brushes should be checked periodically for cleanliness and wear to maintain proper operation of the fan motors.



1. Brush Cap
2. Brush

Figure 3-5. Fan Motor Brushes

To check brushes proceed as follows:

a. With unit off and battery disconnected, remove brush cap (item 1; 2 per motor). See Figure 3.5.

b. Remove brushes (item 2; 2 per motor) and check the length of the brush. If the length is less than inch (6 mm) the brushes should be replaced (after checking collector).

c. Blow out the brush holder with low pressure air to remove any carbon dust in the holder. This dust could prevent a good contact between the brushes and collector.

d. Remove the back cover of the motor and inspect the collector. If the collector is heavily grooved, polish it using fine sandpaper; do not use emery cloth. Wipe out any accumulation of greasy material using a clean rag dampened with solvent. Reassemble the motor; install new brushes and replace cap.

3.11 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 a 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.

3.12 CONDENSER COIL-CLEANING

Remove all foreign material from the condenser coil by reversing the normal air flow. (Air is pulled in through the front and discharges over the engine.) 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.

3.13 HOT GAS (TWO-WAY) SOLENOID AND CONDENSER CLOSING SOLENOID (TWO-WAY)

3.13.1 Replacing solenoid coil

It is not necessary to pump the unit down to replace the coil (see Figure 3.6).

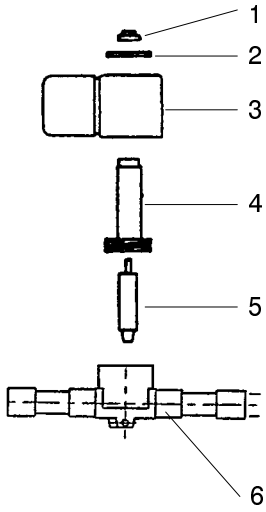
a. Remove coil snap cap, voltage plate and coil assembly. Disconnect leads and remove coil junction box if necessary.

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.

CAUTION

Do not damage or over tighten the enclosing tube assembly. Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burn-out.



1. Snap Cap
2. Voltage Plate
3. Coil Assembly
4. Enclosing Tube
5. Plunger Assembly
6. Valve Body Assembly

Figure 3-6. Hot gas (two-way) solenoid or Condenser closing solenoid (Two-Way)

3.13.2 Replacing solenoid valve internal parts

If the hot gas solenoid is to be replaced, or if a service operation is scheduled on the internal components of the valve, the refrigerant must be evacuated.

a. Remove and store the refrigerant charge in an evacuated container (see section 3.3).

b. Remove coil snap cap, voltage cover and coil assembly. Remove the valve body head.

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.

e. Tighten enclosing tube. If the valve has been removed from the circuit, check for eventual leaks.

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

g. Evacuate and dehydrate the circuit.

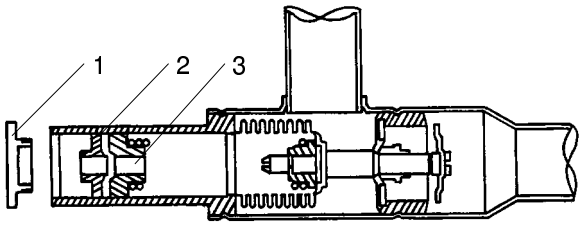
h. Install a complete refrigerant charge.

i. Start unit and check operation.

3.14 ADJUSTING THE COMPRESSOR PRESSURE REGULATING VALVE (CPR)
(ONLY ON Z 30S R404A)

The CPR valve is factory pre-set and should not need adjustment. If it is necessary to adjust the valve for any reason, proceed with the following outline:

When adjusting the CPR valve, the unit must be running in the high speed heat or defrost. This will ensure a suction pressure above the proper CPR setting.



1. Cap 2. Jam Nut 3. Setting Screw

Figure 3-7. Compressor Pressure Regulating Valve

To adjust the CPR valve, proceed as follows:

a. Install a low-pressure.

b. Remove cap (item 1) from CPR valve.

c. With an 8 mm Allen wrench, loosen the jam nut (Figure 3.7, item 2).

d. Using the 8 mm Allen wrench, adjust the setting screw. To raise the suction pressure turn the setting screw (item 3) clockwise; to lower the suction pressure, turn the setting screw counterclockwise. Refer to section 1.3 for CPR valve setting.

e. When the setting has been adjusted, tighten the jam nut securely against the setting screw (item 3). This will prevent any movement of the setting screw due to vibrations in the unit. Replace the cap.

3.15 THERMOSTATIC EXPANSION VALVE

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 requires no maintenance.

a. Replacing expansion valve

1. Pump down the unit by closing the receiver service valve (see section 3.3.a).

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

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

4. The thermal bulb is located below the center of the suction line (See 3.8). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line and insulate both.

5. Braze the equalizer tubes to expansion valve.

6. Evacuate by placing vacuum pump on suction service valve.

7. Open receiver service valve and then check refrigerant level (see section 3.6.3).

8. Check superheat (see section 1.3).

b. Measuring Superheat

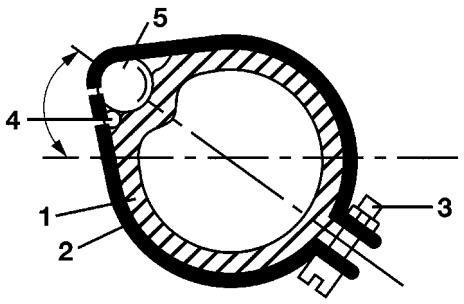
NOTE

The expansion valve and bulb location are shown in Figure 1.4.

1. Remove insulation from expansion valve bulb and suction line.

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

3. Place thermocouple above (parallel) TXV bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 3.8.



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

Figure 3-8. Thermostatic Expansion Valve Bulb and Thermocouple

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

5. Run unit until stabilized at -17,8°C (box temperature).

6. From the temperature/pressure chart, determine the saturation temperature corresponding to the evaporator outlet pressure.

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

8. Subtract the saturation temperature determined in Step 7 from the average temperature measured in Step 6. The difference is the superheat of the suction gas. (**see section 1.3.f**)

3.16 MICROPROCESSOR

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 always 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 trailer, ALL wiring to the microprocessor MUST be disconnected. When welding is performed on other areas of the trailer, 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 wedding on either the unit frame or the truck to prevent possible damage to other components such as the alternator and voltage regulator.

Table 3-3 Pressure - temperature

Temperature (°C)	Vapor pressure (bar abs.)	
	R134a	R404A
-60		0.50
-58		0.57
-56		0.63
-54		0.70
-52		0.78
-50		0.86
-48		0.95
-46		1.04
-44		1.14
-42		1.25
-40	0.51	1.37
-38	0.57	1.50
-36	0.63	1.63
-34	0.59	1.78
-32	0.77	1.93
-30	0.84	2.11
-28	0.93	2.27
-26	1.02	2.48
-24	1.11	2.65
-22	1.22	2.85
-20	1.33	3.09
-18	1.45	3.32
-16	1.57	3.57
-14	1.71	3.83
-12	1.85	4.11
-10	2.01	4.40
-8	2.17	4.71
-6	2.34	5.03
-4	2.53	5.38
-2	2.72	5.73

Temperature (˚C)	Vapor pressure (bar abs.)	
	R134a	R404A
0	2.93	6.11
2	3.15	6.50
4	3.38	6.92
6	3.62	7.35
8	3.88	7.80
10	4.15	8.28
12	4.43	8.77
14	4.73	9.29
16	5.05	9.83
18	5.38	10.39
20	5.72	10.98
22	6.08	11.59
24	6.46	12.22
26	6.86	12.89
28	7.28	13.57
30	7.71	14.29
32	8.16	15.03
34	8.64	15.80
36	9.13	16.61
38	9.64	17.44
40	10.18	18.30
42	10.73	19.19
44	11.31	20.12
46	11.91	21.08
48	12.54	22.07
50	13.19	23.10
52	13.87	24.16
54	14.57	25.26
56	15.29	26.40
58	16.05	27.57
60	16.83	28.79

SECTION 4

TROUBLESHOOTING

CAUTION

Under no circumstances should anyone attempt to service the microprocessor (see section 3.16). Should a problem develop with the microprocessor, contact your nearest Carrier Transicold dealer for replacement.

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
4.1 REFRIGERATION		
4.1.1 UNIT WILL NOT COOL		
Compressor malfunction	Compressor drive defective Compressor defective	3.2.1 3.7
Refrigeration system	Defrost cycle has not terminated Abnormal pressure Hot gas (two-way) solenoid malfunction	1.7.8 3.3 3.13
4.1.2 UNIT RUNS BUT HAS INSUFFICIENT COOLING		
Compressor	Compressor valves defective	
Refrigeration system	Abnormal pressure Expansion valve malfunction No or restricted evaporator airflow	3.6.3 3.15 3.10
4.1.3 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	3.6.3
Compressor	Defective	
4.1.4 UNIT WILL NOT HEAT OR HEATING INSUFFICIENT		
Refrigeration	Abnormal pressure Temperature controller malfunction Hot gas (two-way) solenoid malfunction	3.6.3 3.13
Compressor	Compressor drive defective Compressor defective	3.2.1 3.7
4.1.5 DEFROST MALFUNCTION		
Automatic defrost will not initiate	Defrost thermostats (DTT) open or defective Hog gas valve Electronic card malfunction	Replace Check operation Check defrost parameters
Manual defrost will not initiate	Microprocessor defective Defrost thermostats (DTT) open or defective	Replace Replace
Defrost cycle initiates but does not defrost	Hot gas (two-way) solenoid malfunction	3.13
Frequent defrost	Wet load	Check defrost parameters
Does not terminate or cycles on defrost	Defrost thermostats (DTT) shorted closed	Replace

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
4.1.6 ABNORMAL PRESSURE **4.1.6.1 Cooling**		
High discharge pressure	Condenser coil dirty Non-condensibles or refrigerant overcharge	Check
Low discharge pressure	Compressor valves(s) worn or broken Hot gas (two-way) solenoid malfunction	
High suction pressure	Compressor valves(s) worn or broken Hot gas (two-way) solenoid malfunction	
Low suction pressure	Suction service valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction No evaporator air flow or restricted air flow Excessive frost on coil	Open Check
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective Hot gas (two-way) solenoid malfunction	
4.1.6.2 Heating		
High discharge pressure	Overcharged system Condenser fan of HP2 pressure switch defective Non-condensibles in system Condenser fan defective	 Check Check
Low discharge pressure	Compressor valve(s) worn or broken Hot Gas -two-way valve malfunction	
Low suction pressure	Refrigerant shortage Compressor pressure regulating valve malfunction	
4.1.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	
Condenser or evaporator fan	Loose shroud Bearings defective Bent shaft	Check Check Check
4.1.8 Cab Command Malfunction		
Cab Command non-operational	Sensor defective Microprocessor malfunction Microprocessor/Cab command cable	 Change
4.1.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil or dirty Fan motor(s) malfunction	Check
No or partial evaporator air flow	Evaporator fan loose or defective Evaporator fan rotating backwards Evaporator air flow blocked in trailer (box) Fan motor(s) malfunction	Check Check

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
4.1.10 Expansion valve malfunction		
Low suction pressure with high superheat	Low refrigerant charge External equalizer line plugged Ice formation at valve seat Wax, oil or dirt plugging valve or orifice Broken capillary Power assembly failure or partial Loss of element/bulb charge Superheat setting too high	 Clean Replace Replace
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	 Open
Fluctuating suction pressure	Improper bulb location or installation Low superheat setting	
High superheat	Expansion valve setting	Adjust
4.1.11 Malfunction Hot gas (two-way) solenoid / expansion closure 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
Valve shifts but refrigerant continues to flow	Foreign material lodged under seat Defective seat	
4.2 STANDBY MOTOR MALFUNCTION		
Standby motor fails to start	Motor contactor defective Motor Overload open Improper power supply Malfunction displayed on Cab Command 5-minute timer on standby	Replace Check/ replace motor Check
Standby motor starts, then stops	Motor Overload open High amperage draw	 Check

SECTION 5

ELECTRICAL SCHEMATIC WIRING DIAGRAMS

5.1 INTRODUCTION

This section contains Electrical Schematic Wiring Diagrams 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 fans and V-belts caused by the thermostat and the start/stop cycling of the unit.

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (see section 3.16)
Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

CAUTION

Observe proper polarity when installing battery, negative terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

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 case, 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 truck/trailer microprocessor.

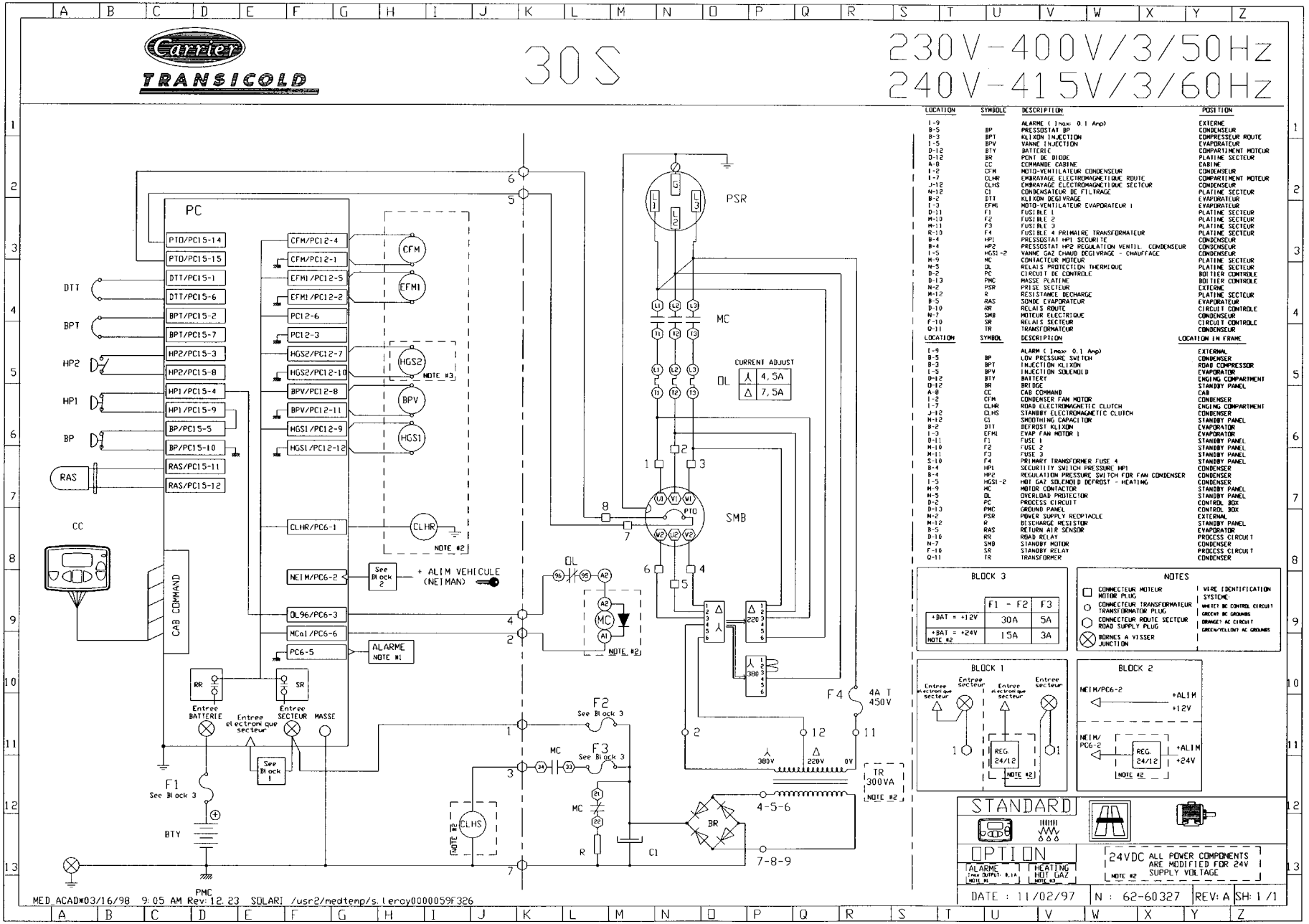


Figure 5-1. Electrical wiring diagram Z 30S drawing n° 62-60327

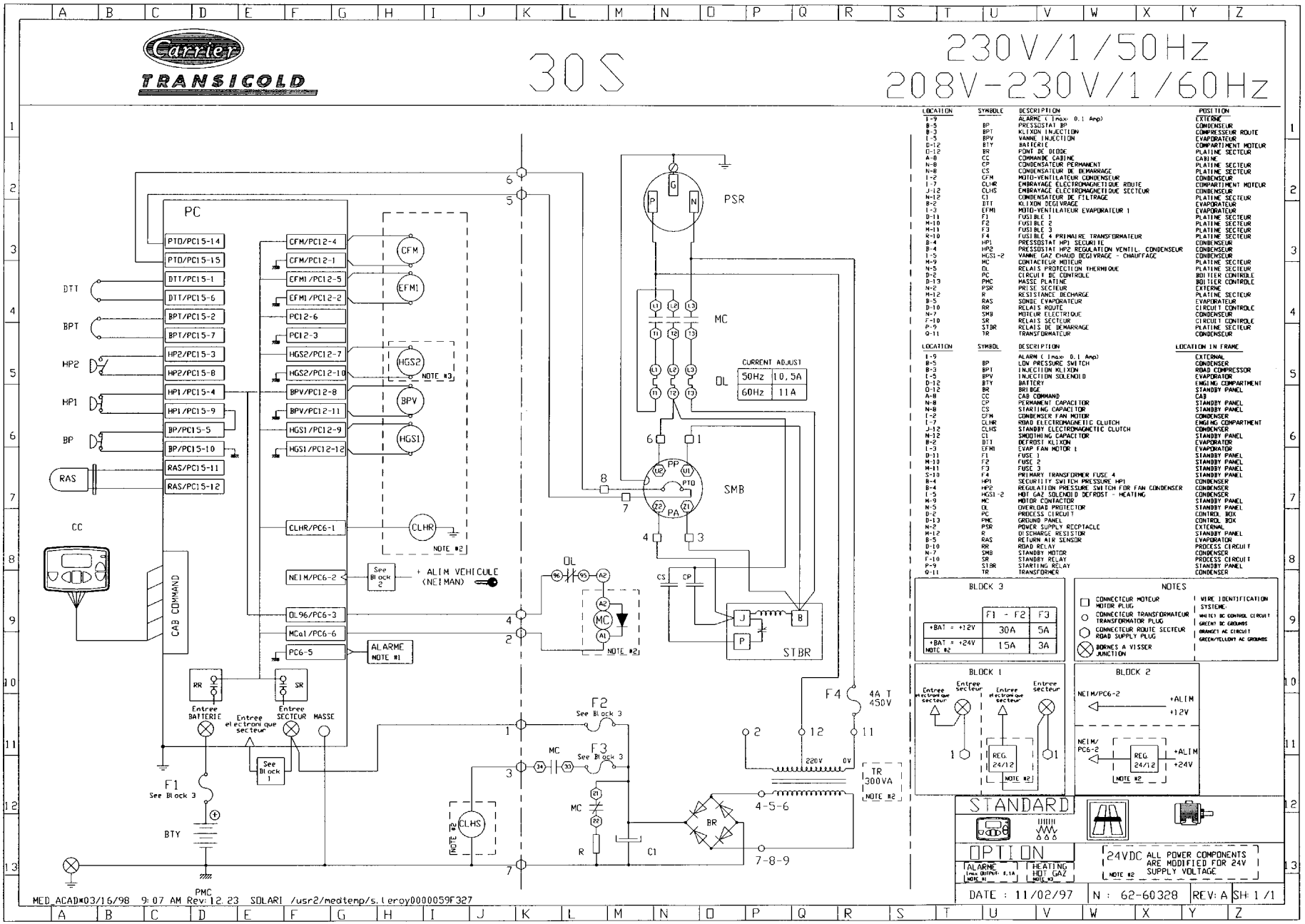


Figure 5-2. Electrical wiring diagram Z 30S drawing n° 62-60328

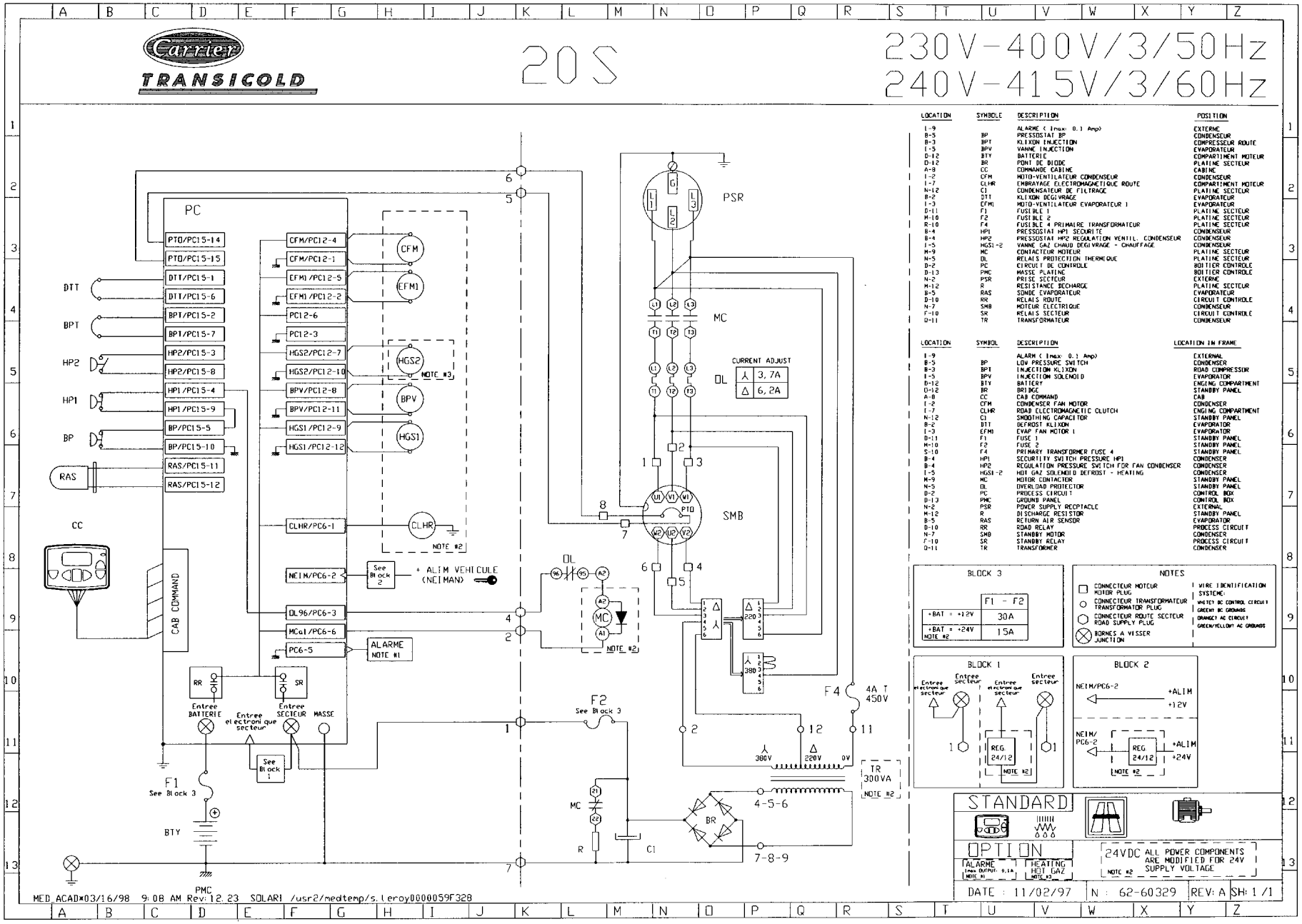


Figure 5-3. Electrical wiring diagram Z 20S drawing n° 62-60329

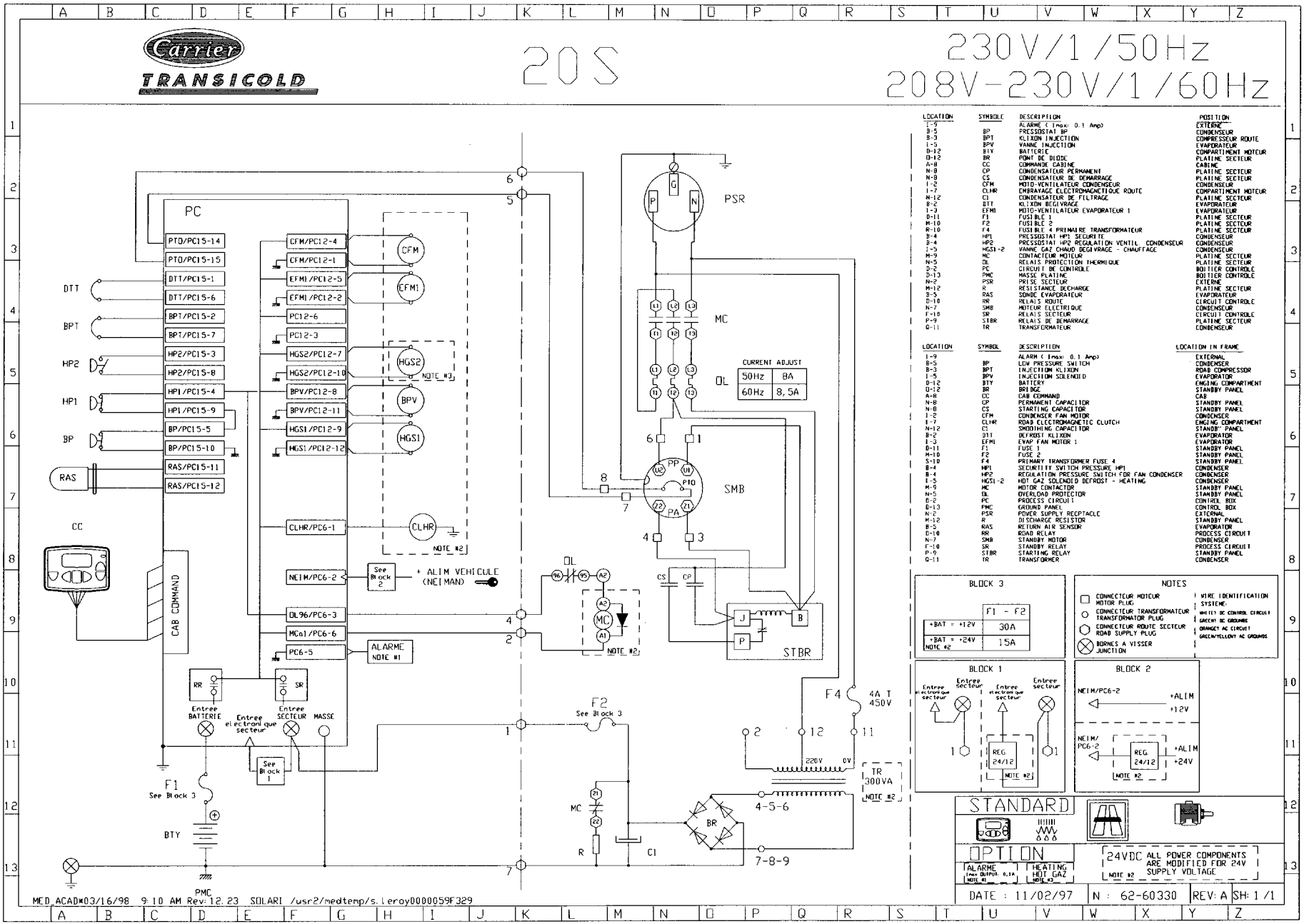


Figure 5-4. Electrical wiring diagram Z 20S drawing n° 62-60330

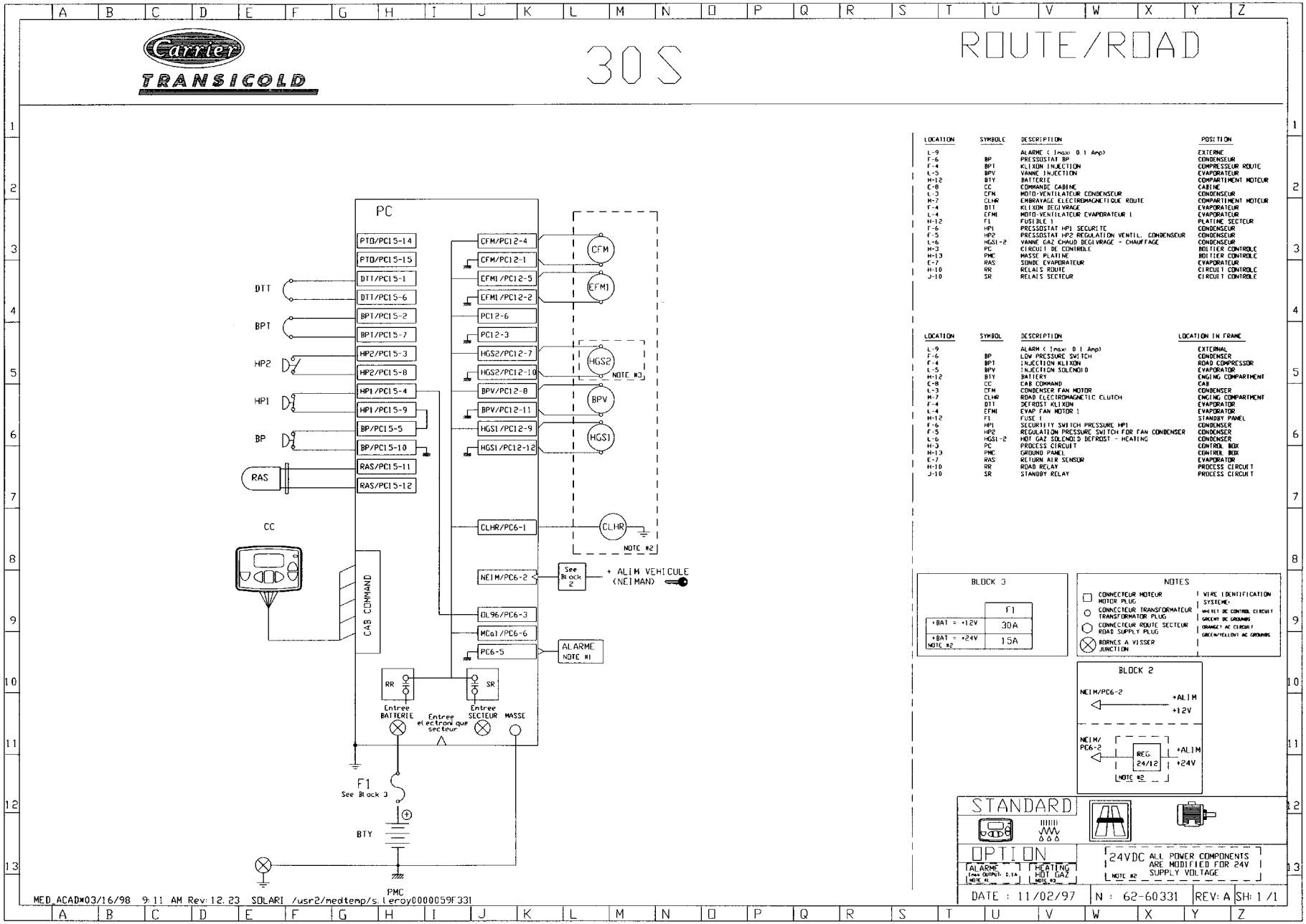


Figure 5-5. Electrical wiring diagram Z 20S/30S Road drawing n° 62-60331