Carrier
TRANSICOLD

Truck/Trailer Refrigeration Unit

Genesis R70
Genesis R90
Genesis TR1000
Multi-Temp

OPERATION AND SERVICE

62-02884 Change 05/10

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

TRUCK/TRAILER REFRIGERATION UNITS

Genesis R70, R90 and Genesis TR1000 Multi-Temp

Carrier
A United Technologies Company

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DESCRIPTION

1.1 INTRODUCTION

a. System

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

The Genesis Multi-Temp, multiple compartment refrigeration systems offer the versatility of two or three compartment temperature control in truck or trailer. The Multi-Temp allows the shipper to ship frozen and perishable commodities in the same load under separate refrigeration control.

WARNING

Beware of unannounced starting of the fans, V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run - Stop switch is in the STOP position. Also disconnect the negative battery cable.

b. Truck Condensing Units

The Genesis R70/R90 models are one piece condensing units designed for truck applications. They are equipped with an electric standby motor.

The model/serial number plate is located inside of the unit on the frame as shown in Figure 1-2.

The control system is a microprocessor controller (Refer to section 1.8). Once the controller (remote Cab Command within the cab of the truck) is set at the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects high and low speed cooling or high and low speed heating as necessary to maintain the desired temperature.

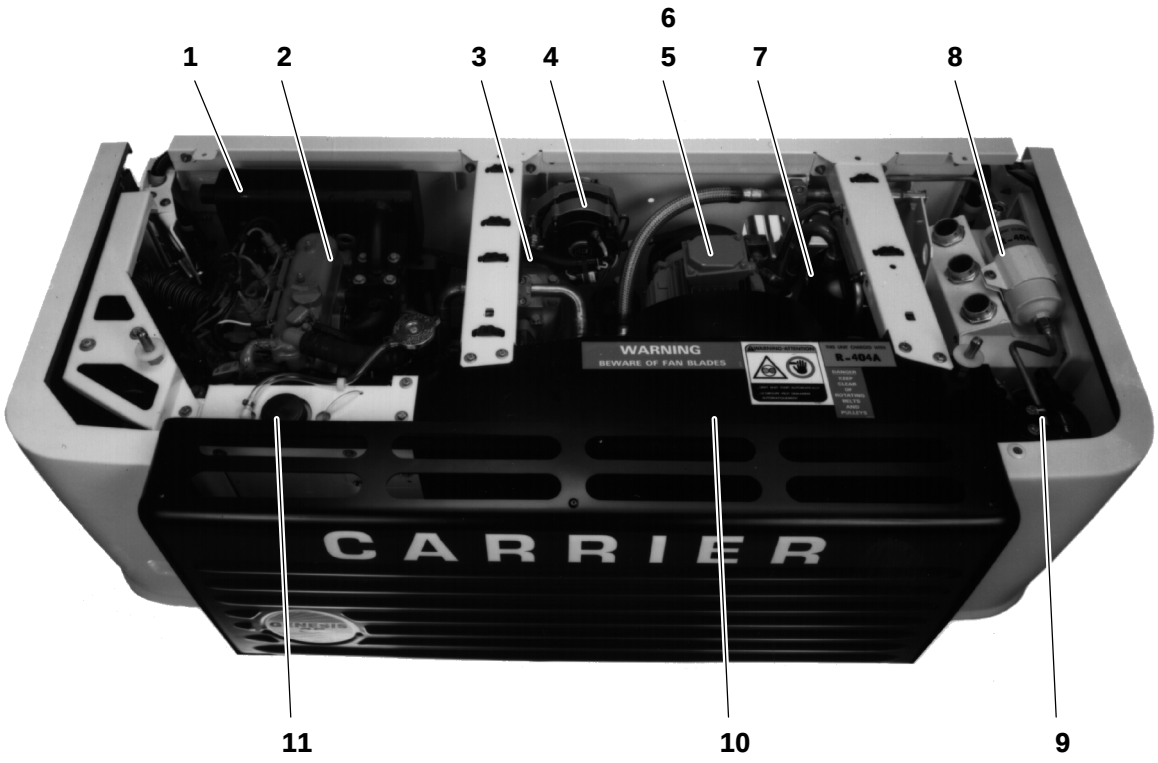
The microprocessor controller has an auto start/stop feature. The auto start/stop operation provides automatic cycling of the diesel engine, which in turn offers an energy efficient alternative to continuous operation of the engine with control of temperature by alternate cooling and heating of the supply air (evaporator outlet air).

A remote standby receptacle is standard with all units except trailer model NDC.

Table 1-1. Model Chart

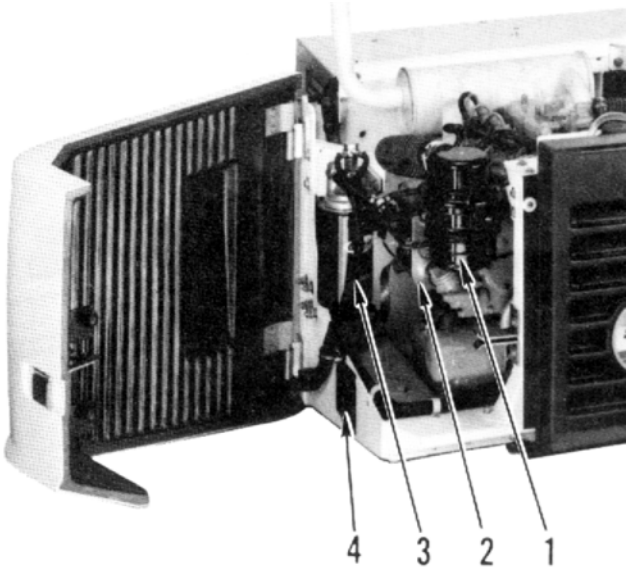
Models	Refrigerant R-404A		Engine	Compressor	Standby Motor	
	LB	KG			3ph, 50hz	3ph, 60hz
TRUCK UNITS						
Genesis R70	13.5	6.1	CT3-44TV	05K 2Cylinder	6.4 hp	7.6 hp
Genesis R90	12	5.4	CT3-69TV	05G 6Cylinder	12 hp	14.7 hp
TRAILER UNIT						
Genesis TR1000 (NDD) 50hz	26	11.8	CT4-134-TV	05G 6Cylinder	14 hp	–
Genesis TR1000 (NDC) 60hz	26	11.8	CT4-134-TV	05G 6Cylinder	–	Heat Only

Evaporator Models	Lane Size	Discharge	Number of Fans
MTD 700-1	1/3	Double	1
MTD 700-2	1/3	Double	2
MTD 1100-2	1/2	Double	2
MTD 1450-2	2/3	Double	2
MTD 1450-3	2/3	Double	3
MTD 2200-3	1	Double	3
MTD 2200-4	1	Double	4
MTS 700-1	1/3	Single	1
MTS 700-2	1/3	Single	2
MTS 1100-2	1/2	Single	2
MTS 1450-2	2/3	Single	2
MTS 1450-3	2/3	Single	3
MTS 2200-3	1	Single	3
MTS 2200-4	1	Single	4



1. Muffler
2. Engine (Refer toTable 1-1)
3. Compressor (Refer toTable 1-1)
4. Alternator
5. Electric Standby Motor
6. 1 ph Alternator (Under Standby Motor)
7. Accumulator/Heat Exchanger
8. Filter-Drier
9. Receiver
10. Condenser
11. Radiator Overflow Reservoir

Figure 1-1. Truck Unit -- Top View

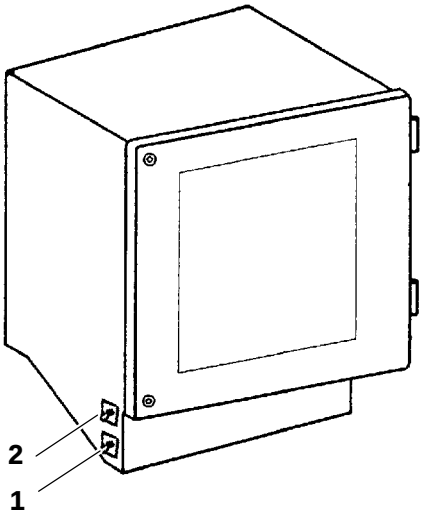


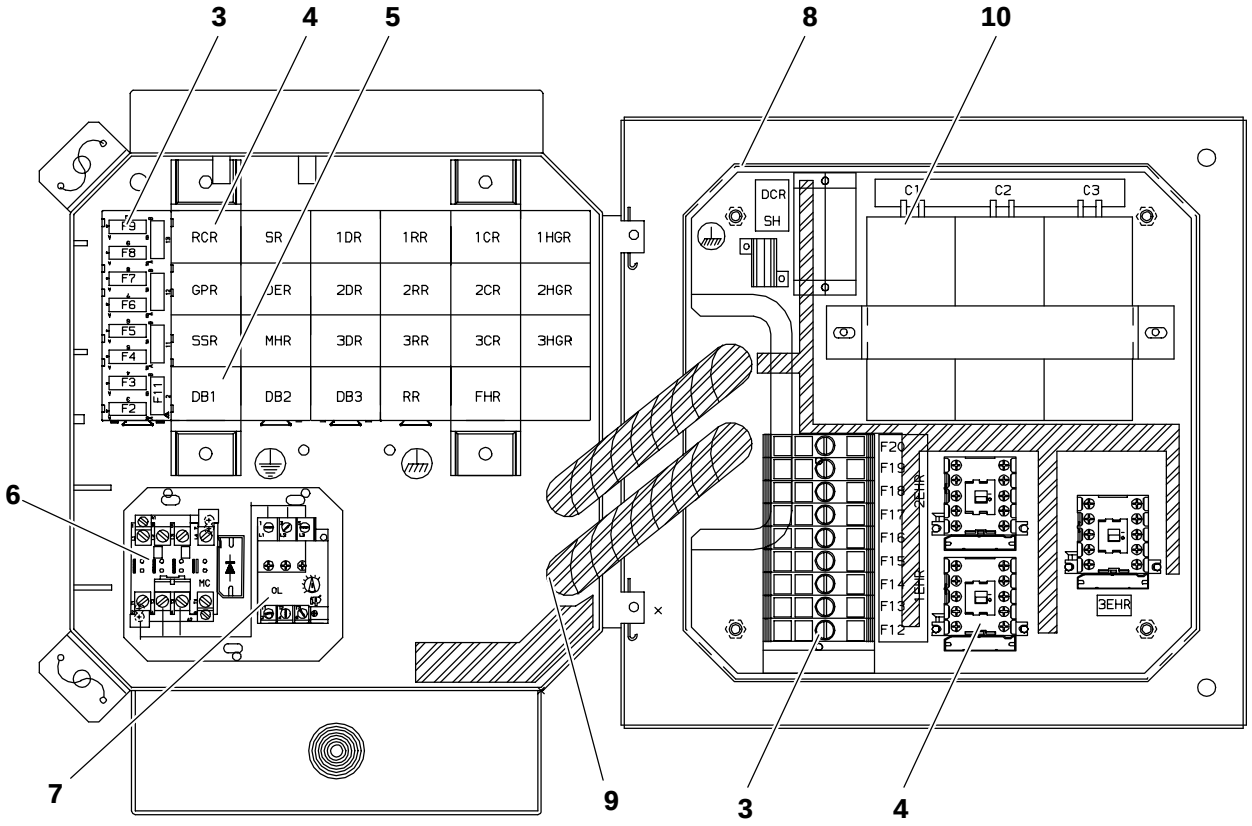
1. Air Cleaner
2. Speed & Run Solenoid
3. Fuel Filter
4. Serial/Model Plate

Figure 1-2. Truck Unit -- Curbside View

1. Electrical Box (See Figure 1-4)

Figure 1-3. Truck Unit -- Roadside View





1. Run-Stop Switch (RS)
2. Manual Glow/Crank Switch (MGC)
3. Fuses
4. Relays
5. Diode, Block
6. Standby Motor Contactor (MC)
7. Motor Overload Relay (MOL)
8. Microprocessor Module
9. Fuse (F1 80 amp)
10. Capacitor

Note: See Figure 1-12 for Cab Command

Figure 1-4. Truck Unit – Electrical Box

c. Trailer Condensing Unit (NDC/NDD)

The Genesis TR1000 (NDC/NDD) is a fully charged, pre-wired, refrigeration/heating "nosemount" diesel powered condensing unit for use on insulated trailers to maintain cargo temperatures within very close limits. The model/serial number plate is located inside of the unit as shown in Figure 1-5.

The condensing unit consists of an engine—compressor drive package, condenser fan, condenser/radiator coil, control panels, relay module, refrigerant controls, piping, wiring, and associated components.

Heating is accomplished either by circulating hot gas directly from the compressor to the evaporator coil or by electric heaters run by a 5-kilowatt induction generator. Two electric solenoid valves in each evaporator control the refrigerant circuit to operate the heating/cooling system.

Evaporator coil defrosting is initiated by the defrost timer in the microprocessor or by the manual defrost keys.

The control door and relay module include manual switches, microprocessor, ammeter, fuses, and associated wiring.

The temperature controller is a microprocessor solid state controller (Refer to section 1.8). Once the controller is set at the desired temperatures, the unit will operate automatically to maintain the desired temperatures within very close limits. The control system automatically selects cooling, null or heating as necessary to maintain the desired temperatures within the trailer.

The 05G compressor is equipped with Varipowr as standard equipment. Varipowr is used as a compressor capacity control to unload the compressor during periods of reduced loads. This provides closer temperature control, reduces potential for top freezing, and reduces power required to operate the compressor, thus reducing fuel consumption.

The engine (refer to Table 1-1) gives excellent fuel economy and has easy starting characteristics. The engine is equipped with spin-on lube oil and fuel oil filters for easier filter changes.

NOTE

Throughout this manual, whenever the "left" or "right" hand side of the engine is referred to, it is the side as viewed from the flywheel end of the engine.

Electrical power for the control system and for charging the batteries is provided by the 12 vdc alternator.

The auto start/stop feature is standard equipment.

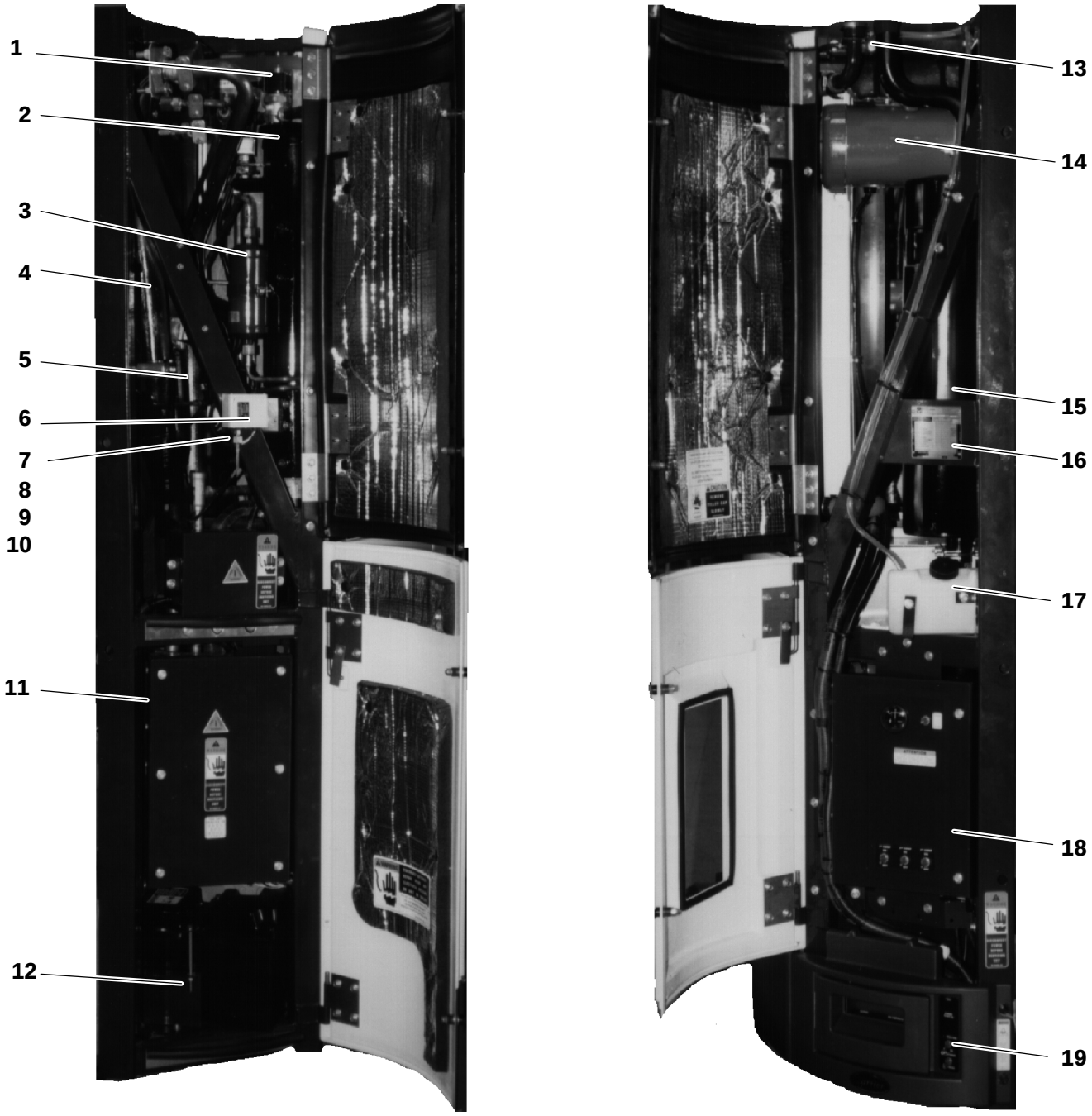
The auto start/stop operation provides automatic cycling of the diesel engine, which in turn offers an energy efficient alternative to continuous operation of the engine with control of temperature by alternate cooling and heating of the supply air (evaporator outlet air).

The diesel engine drives the compressor directly through a centrifugal clutch, except during standby operation. During standby operation, the centrifugal clutch is disengaged from the compressor sheave. The compressor is then belt-driven by the standby motor.

d. Model with Phase Sequence Module

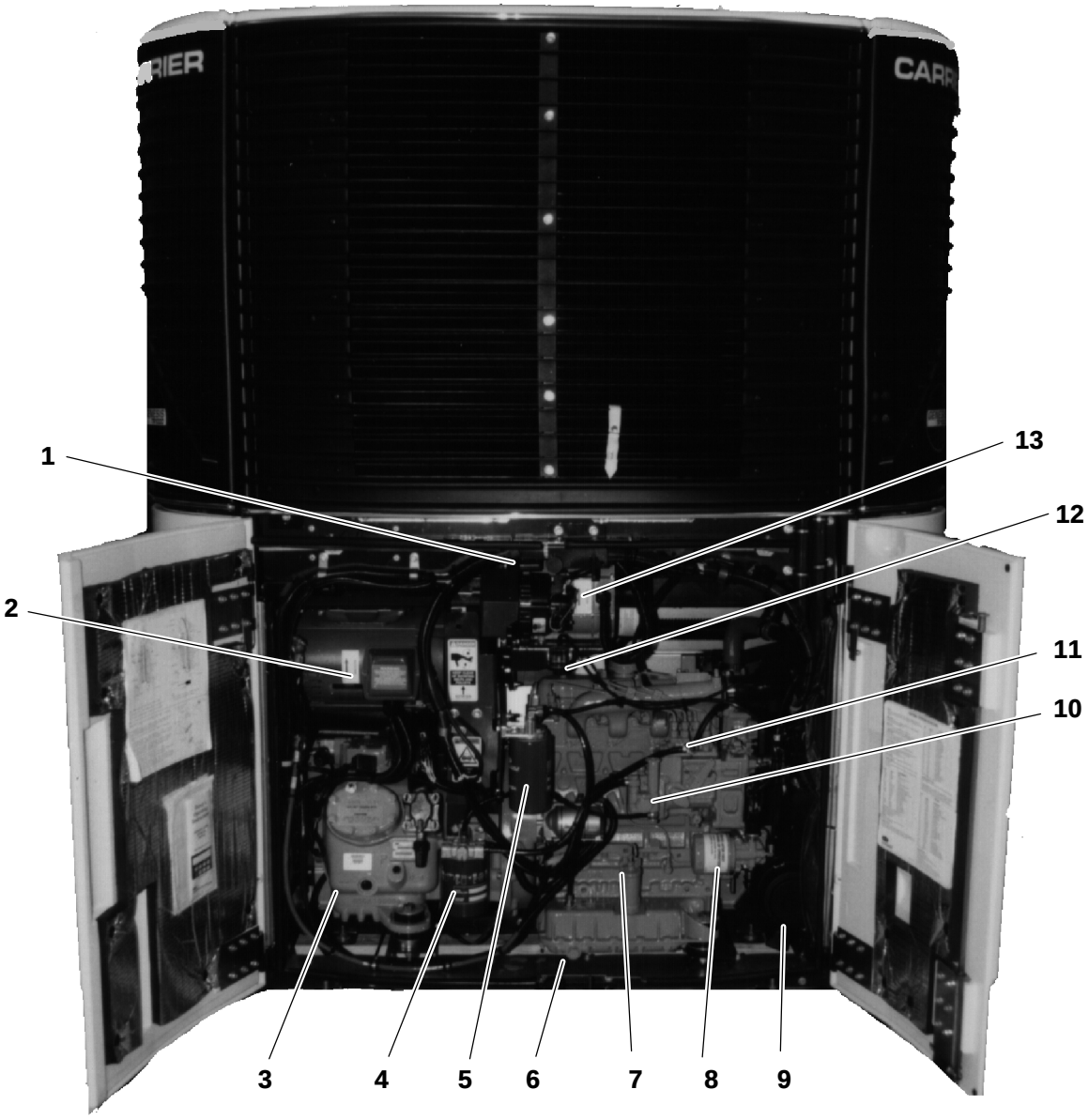
Some units have a Phase Sequence Module (see Figure 1-8 & Figure 4-22). This phase sequence sensing system provides a safe method of automatically providing correctly phased three-phase power to the unit. This feature allows the user to connect the unit to any three phase power source of correct voltage and frequency without regard to the phase sequence of the power source.

This module contains two electrically identical sections of circuitry, each connected to a different pair of phases. Depending on the phase sequence occurring at the module inputs (X1, X2, H4 and 46), relay PR-1 or PR-2 will be energized as required to effect correct phasing of power to unit.



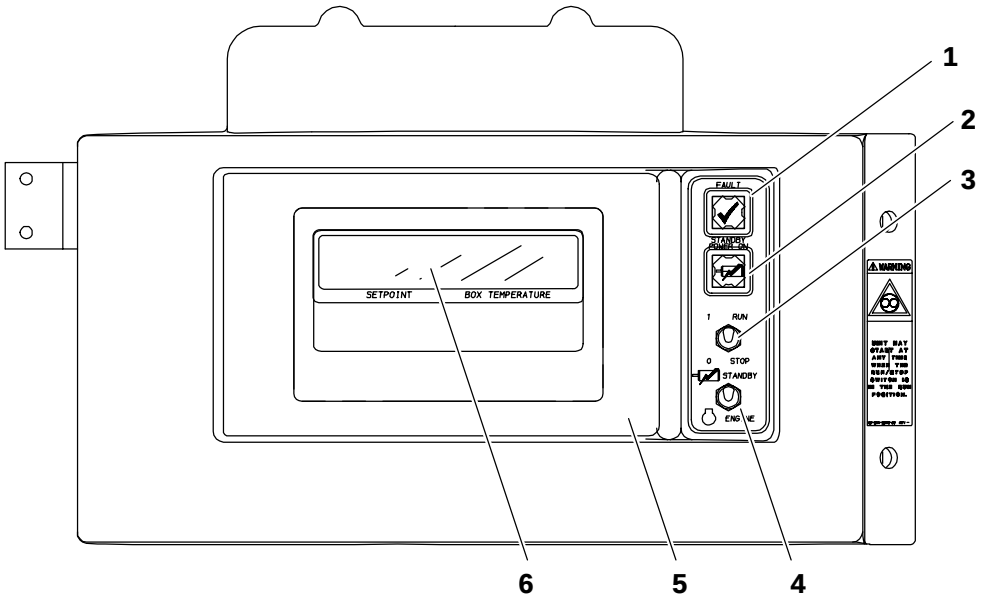
1. Main Heat Valve (MHV)
2. Receiver
3. Filter-Drier
4. Compressor Pressure Regulating Valve (CPR)
5. Accumulator/Heat Exchanger
6. Pressure Switch – If Used (for BPV)
7. King Valve
8. Receiver Pressure Valve (RPV)
9. Quench Valve
10. By-Pass Valve (BPV)
11. High Voltage Box (See Figure 1-8)
12. Battery
13. Radiator Fill Neck
14. Condenser Motor
15. Muffler
16. Model/Serial No. Location
17. Radiator Overflow Reservoir
18. Relay Box (See Figure 1-9)
19. Control Box Door (See Figure 1-7)

Figure 1-5. Trailer Unit – Side Views



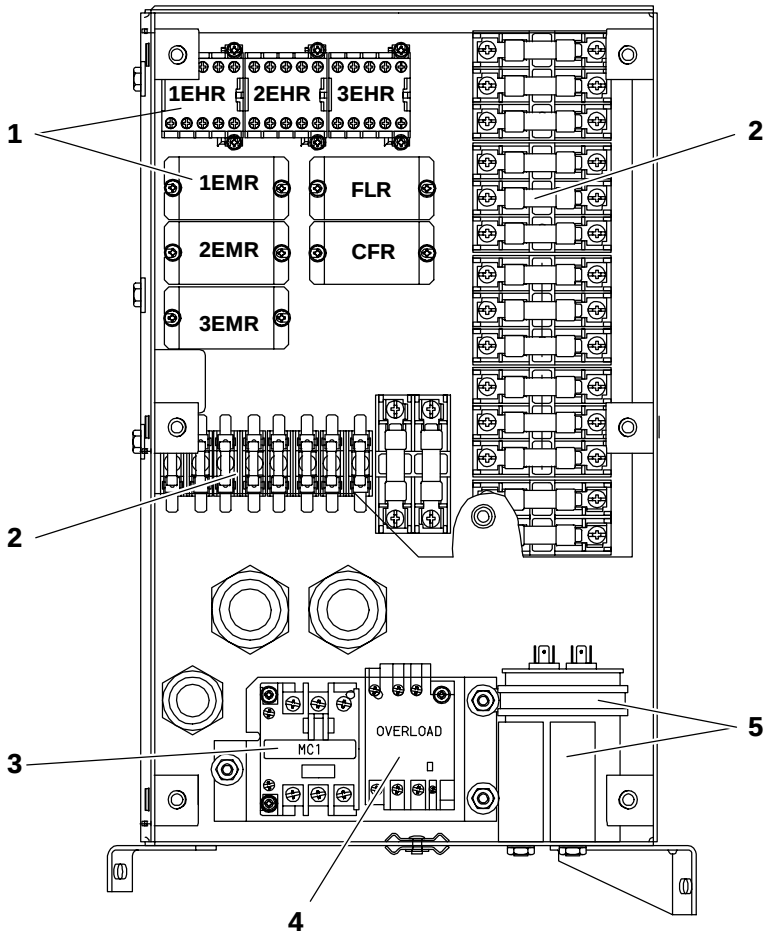
1. Alternator and Regulator
2. Standby Motor
3. Compressor – 05G
4. Fuel Filter
5. Bypass Oil Filter
6. Oil Drain
7. Lube Oil Fill
8. Lube Oil Filter
9. Engine Air Cleaner
10. Mechanical Fuel Pump
11. Fuel Bleed Valve
12. Air Cleaner Service Indicator
13. Generator 5 kw

Figure 1-6. Trailer Unit – Front View



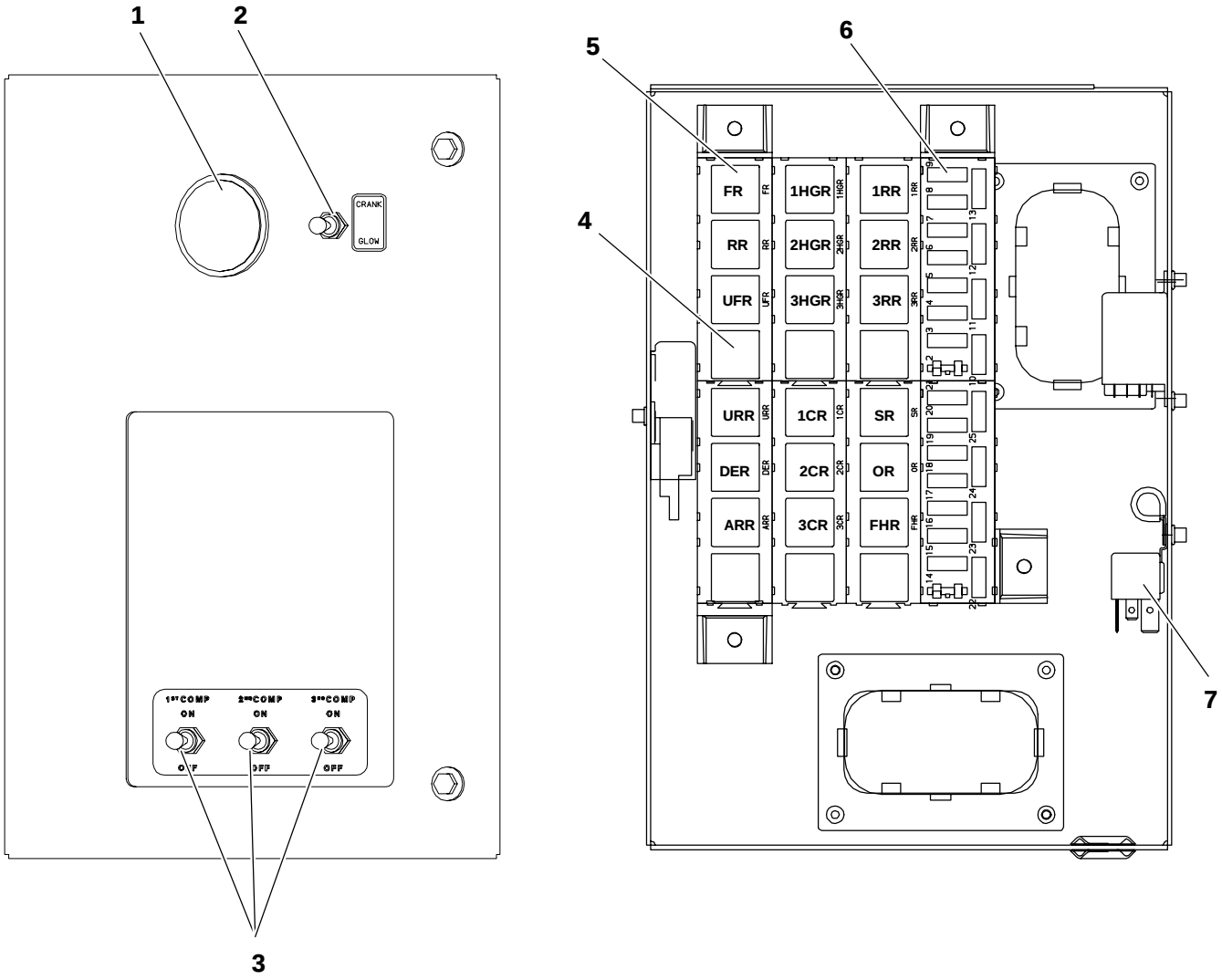
1. Fault Light
2. Standby Power Light (PL)
3. Run-Stop Switch
4. Selector Switch (SSW)
5. Keypad Door
6. Microprocessor Control Panel (See Figure 1-12)

Figure 1-7. Control Box Door – Trailer Unit



1. Relays
2. Fuses
3. Motor Contactor (MC) – Model NDD
4. Motor Overload (MOL) – Model NDD
5. Capacitor

Figure 1-8. High Voltage Box – Trailer Unit



1. Ammeter
2. Manual Glow/Crank Switch
3. Compartment On/Off Switches
4. Diode, Block
5. Relays
6. Fuses
7. Starter Solenoid Relay (SSR) and Glow Plug Relay (GPR)

Figure 1-9. Relay Box – Trailer Unit

e. Evaporators

The compartments of the Multi-Temp system are equipped with separate evaporators.

For Multi-Temp applications, single discharge and double discharge evaporators are available. The evaporators are different in size, capacity and number of fans, but all work on the same principle and use the same single-phase 50Hz/60Hz fan assembly. The electrical heaters vary according to the type of condensing unit used and number of compartments. (see Figure 1-11)

The evaporator is constructed with aluminium profiles designed to meet the specific requirements of the transport industry. The bottom section of the evaporator is hinged to allow easy access to both the electrical and refrigeration hardware. The air outlet profiles are designed to adjust to allow different airspeeds and velocity.

Inside the evaporator housing are one or more of the following :

240 Volt Single phase backward curved impeller which supplies high air volumes at low noise levels; expansion valve; check valve; 12V hot gas solenoid; 12V liquid line solenoid; 12V water drain heater; electrical heater element; sensor (defrost termination sensor); safety heating thermostat.

f. Compartment Control Box (Optional)

The compartments of the Multi-Temp system maybe equipped with remote mounted control box (see Figure 1-10). This control box has a system on/off button, compartment on/off buttons and a manual defrost button. The remote mounted control box displays current compartment temperature and setpoint.

Set setpoint by pressing the up or down arrows as required. The control box can be locked (no buttons active) by pushing the Carrier oval once. This will activate the LED next to the lock picture. To unlock the control box press the Carrier oval for 10 seconds. When the compartment control box is locked the temperature setting and manual defrost can still be altered with microprocessor panel.

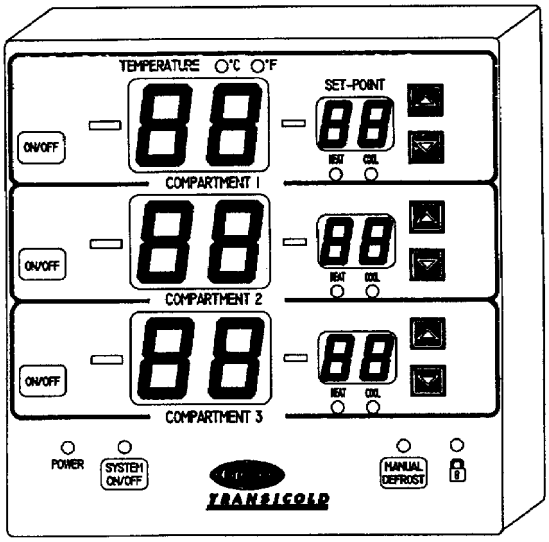
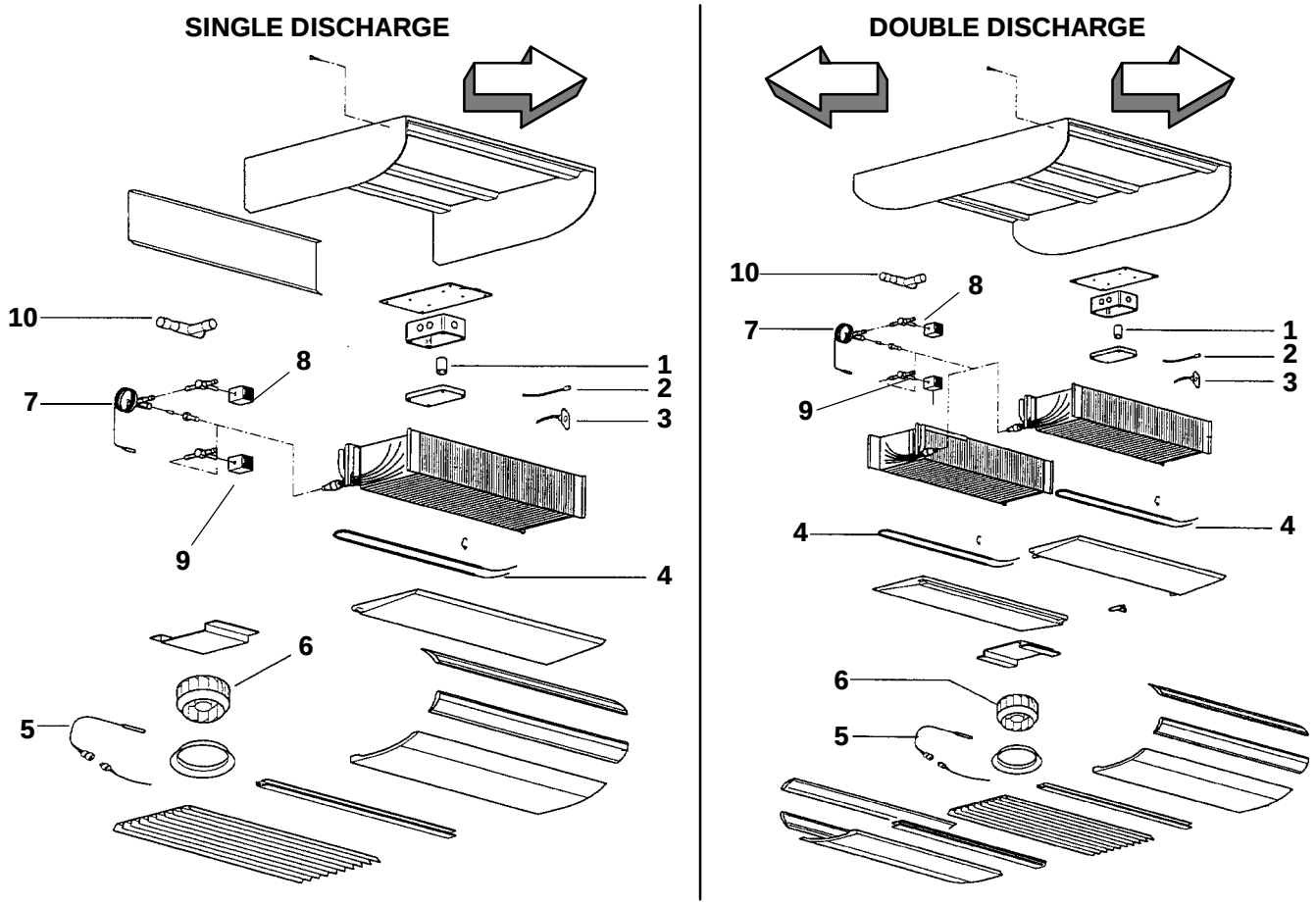


Figure 1-10. Compartment Control Box



1. Capacitor
2. Defrost Terminal Sensor
3. High Temperature Klixon
4. Heaters
5. Thermostat Sensor
6. Evaporator Fan & Motor
7. Expansion Valve
8. Liquid Solenoid Valve (LSV)
9. Hot Gas Solenoid Valve (HGV)
10. Check Valve

Figure 1-11. Evaporator

1.2 ENGINE DATA

Engine Model		CT4-134TV (V2203TV)	CT3-69TV (1105)	CT3-44TV (D722)
Used on		Genesis TR1000	Genesis R90	Genesis R70
Displacement		2.2 liters (134 in^3)	1105 cc (68.5 in^3)	719 cc (43.9 in^3)
No. Cylinders		4	3	3
Horsepower		20.8 kw (28 hp) @ 1500 rpm	13.8 kw (18.5 hp) @2300rpm	10.3 kw (13.4 hp) @2200rpm
Weight		189.5 kg (417.8 lbs)	89 kg (196 lbs)	63 kg (139 lbs)
Coolant Capacity		7.6 liters (2 gallons)	3 liters (3.2 U.S. quarts)	3.7 liters (3.9 U.S. quarts)
Oil Capacity		14 liters (15 quarts)	9.8 liters (11 U.S. quarts)	8.1 liters (8.5 U.S. quarts)
Operating Speeds	High	60hz Units: 1700 rpm 50hz Units: 1500 rpm	2300 rpm	Genesis R70: 2200 rpm
	Low	–	1800 rpm	1800 rpm
Injection Setting		140 to 150 kg/cm^2 (1991 to 2133 psi)		

a. Water Temperature Sensor (WTS)

Closes at: 110 ¦ 3_C (230_ ¦ 5_F)

b. Lubrication System

Lube Oil Viscosity: (API Classification CD)

Outdoor Temperature		SAE
Fahrenheit	Centigrade	
Below 32_	0_C	10W or 15W40
32_ to 77_F	0_ to 25_C	20W or 15W40
Over 77_F	Over +25_C	30W or 15W40

c. Oil Pressure Safety Switch

Closes at: 1.05 ¦ 0.2 kg/cm@ (15 ¦ 3 psig)

1.3 ENGINE AIR CLEANER

The air cleaner is designed to prolong engine life and performance by preventing dirt and grit from getting into the engine causing excessive wear on all operating parts. However, it is the responsibility of the operator to give the air cleaner equipment regular and constant attention in accordance with the instructions. (Refer to section 4.4.4)

Clean air is supplied to the engine through the air cleaner (see Figure 1-5). This air supply is necessary for complete combustion and scavenging of the exhaust gases. As the engine piston goes through the intake stroke, the piston draws clean, fresh air down into the cylinder for the compression and power strokes. As the engine goes through its exhaust stroke, the upward movement of the piston forces the hot exhaust gases out of the cylinders through the exhaust valves and the exhaust manifold. If the air filter is allowed to become dirty, operation of the engine will be impaired.

1.4 COMPRESSOR REFERENCE DATA

Model	05G	05K 012
Displacement	41 CFM	200 cc (12.2 in^3)
No. Cylinders	6	2
No. Unloaders	2	0
Weight	62 kg (137 lbs)	38 kg (84 lbs)
Oil Charge	3.8 L (8 pints)	1.9 L (4 pints)

APPROVED COMPRESSOR OIL		
Refrigerant	**05G**	**05K**
R-404A	Mobil Arctic EAL 68	

1.5 REFRIGERATION SYSTEM DATA

a. Defrost Timer

1-1/2, 3, 6, or 12 hours

b. Defrost Temperature Sensor

Opens at: 10_ ¦ 3_C (50_ ¦ 5_F)

Closes at: 7_ ¦ 3_C (45_ ¦ 5_F)

c. High Pressure Cutout Switch (HP)

Cutout at: 32.7 ¦ 0.7 kg/cm@ (469 ¦ 10 psig)
Cut-in at: 24.6 ¦ 0.7 kg/cm@ (350 ¦ 10 psig)

d. Refrigerant R-404A Charge

Refer to Table 1-1

e. Compressor Pressure Regulating Valve (CPR)

MODEL	CPR Setting	
	kg/cm@	psig
Genesis R70/R90	1.8	26 ¦ 1
Genesis TR1000	1.7	29 ¦ 1

f. Thermostatic Expansion Valve Superheat

Setting at −17.8_C (0_F) box temperature:

MODEL	SETTING
All Units	8 to 10_F (4.4 to 5.6_C)

g. Compressor Discharge Temperature Sensor

Unit shut down at:

154_C (310_F) for 3 minutes or 177_C (350_F)

h. Bypass Pressure Switch (If Used)

Opens at: 1.4 kg/cm@ (20 psig)

Closes at: 1.9 kg/cm@ (28 psig)

1.6 ELECTRICAL DATA

a. Evaporator Fan Motors

Bearing Lubrication: Factory lubricated, additional grease not required
Horsepower: .15 kw (1/5 hp)
Operating Amps: 1.5 amps
Speed: 2250 rpm
Voltage: 230 vdc

b. Generator (1 phase alternator)

Generator (1 phase alternator)		
	TRUCK	**TRAILER**
Wattage	1.5 kva −R70 2 kva − R90	5 kw
Volts	240 vac	240 vac
Speed (rpm)	1800/2200	3600

c. Standby Motors

Bearing Lubrication: Factory lubricated additional grease not required

STANDBY MOTOR (TRUCK)					
Voltage		**Type of Connection**	**Power**		**FULL LOAD AMPS**
3ph, 50 hz	**3ph, 60 hz**		**KW**	**HP**	
Genesis R70					
200		Δ	4.8	6.4	17.3
240		Δ			14.4
350		Y			9.8
415		Y			8.3
	208	Δ	5.7	7.6	19.8
	230	Δ			17.9
	380	Y			10.8
	460	Y			8.9
Genesis R90					
400		Y	9	12	25.1
	208	Δ	11	14.7	38.6
	460	Y	11	14.7	22.9
Rotation Speed: 1760 rpm @ 60hz / 1500 rpm @ 50hz					

STANDBY MOTOR (TRAILER)	
	50HZ
Horsepower	14hp
Voltage	380
Full Load Amps	20.2
Lock Rotor Amps	165
RPMS	2917

d. Alternator: 65 amps – North & South America
70 amps – Europe

e. Standby Motor Overload

STANDBY MOTOR OVERLOAD	
MODEL	**SETTING**
Genesis R70/R90	13 amps

f. Evaporator Heaters

Evaporator Heaters			
Part No.	**Wattage**	**Voltage**	**OHM**
24-60008-00	200W	240V	288Ω
24-60008-01	400W	240V	144Ω
24-60008-02	800W	260V	72Ω

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 safety devices listed in Table 1-2.

Table 1-2. Safety Devices

Unsafe Conditions	Safety Device	Device Setting
1. Low engine lubricating oil pressure	Oil pressure safety switch (OP) automatic reset	Opens below 1 ¦ 0.2 kg/cm@ (15 ¦ 3 psig)
2. High engine cooling water temperature	Water temperature sensor (microprocessor)	Opens above 110 ¦ 3_C (230 ¦ 5_F)
3. Excessive current draw by glow plug circuit , control circuit or starter solenoid (SS)	Fuse (F1)	Opens at 80 amps
4. Excessive current draw by microprocessor	Fuse (F2)	Opens at 5 amps
5. Excessive current draw by control circuit	Fuse (F3)	Opens at 25 amps
6. Excessive current draw by speed control solenoid	Fuse (F4)	Opens at 15 amps
7. Excessive current draw by auto restart	Fuse (F5)	Opens at 7 1/2 amps
8. Excessive compressor discharge pressure	High pressure cutout switch (HP) automatic reset	Cutout 32.7 ¦ 0.7 kg/cm@ (469 ¦ 10 psig)
9. Excessive compressor discharge temperature	Compressor discharge temperature sensor (CDT)	Shuts unit down above 154_C (310_F) for 3 minutes or 177_C (350_F)
10. Excessive current draw by compartment	Fuse	Opens at 10 amps
11. Excessive current draw by evaporator fan motors	Fuse	Opens at 2 amps (TRUCK) Opens at 8 amps (TRAILER)
12. Heater over temperature	High Temperature Klixon	Opens at 120 ¦ 5_F
13. Excessive current draw by heaters	Fuse	Opens at 2 amps (TRUCK) Opens at 8 amps (2 Comp. Trailer) Opens at 4 amps (3 Comp. Trailer)

1.8 MICROPROCESSOR CONTROLLER

1.8.1 INTRODUCTION

The microprocessor controller is housed in the control box. This controller consists of two control boards and a relay module:

1. The Processor Board includes the microprocessor, program memory, and necessary input/output circuitry to interface with the unit.

2. The Relay Module contains replaceable relays, diodes and fuses along with the wiring harness.

On Genesis truck units, the Cab Command is remote mounted in the truck. The Cab Command includes the LCD display, keypad and keypad interface. (See Figure 1-12.)

On Genesis trailer units the Display Board is mounted in the same control box as the processor board. The display board includes the LCD display, keypad and keypad interface. (See Figure 1-13.)

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (See Section 4.21.) Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

The Carrier Transicold microprocessor controller incorporates the following features:

a. Controls return air temperature to tight limits by providing refrigeration control, heat and defrost to ensure conditioned air delivery to the load.

b. Dual independent readouts of set point and return air temperature.

c. Digital readout and ability to select data. Refer to Table 1-3 for Function Codes and Table 1-5 for Unit Data.

d. Alarm digital display identification. Refer to Table 1-6.

e. A self-test check on program memory and data memory. The self-test is executed each time the system is switched from "Stop" to "Start." Errors, if any, shall be indicated on the display as a ERR.X, where X is a number corresponding to the number of the test. The unit shall display this error for five seconds and then reset the microprocessor.

ERROR	CAUSE
ERR.1 ERR.2 ERR.3	Processor failure Check chip installation or Replace microprocessor.
ERR.4	Display board to logic board communication failure. This can be caused by a defective ribbon cable or ribbon cable not plugged in properly.

1.8.2 SETPOINT

Setpoints of −30_C to +30_C (−22_F to +86_F) may be entered via keypad. The controller always retains the last entered setpoint in memory. If no setpoint is in memory (i.e., on initial startup), the controller shall lock out the run relay and flash "SP" on the left hand display until a valid setpoint is entered.

The setpoint may be changed up or down in whole numbers until the desired setpoint is displayed. The display will flash to indicate that the setpoint reading currently being displayed is a non-entered value. Each time the *up/down arrow key* is pressed, the five second display timer will be reset.

Depressing the *enter key* will cause the new displayed setpoint value to become active. If the display is flashing, and the new value is not entered after five seconds of no keypad activity, the display will revert back to the active setpoint.

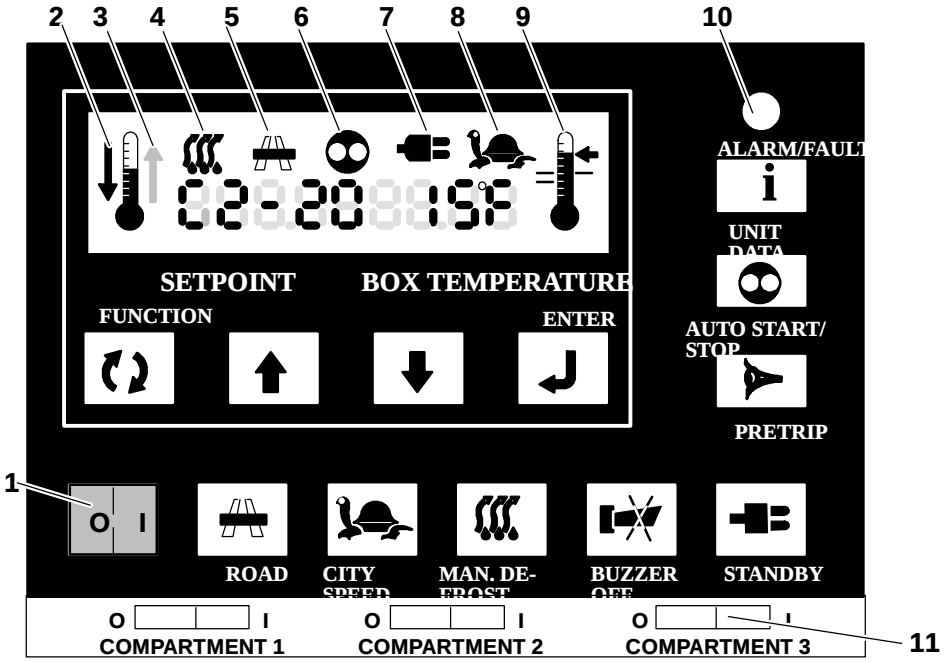
1.8.3 DIGITAL DISPLAY

The digital display has 9 digits. The default display is compartment number (C1, C2 or C3) on the left, setpoint in the middle and controlled air temperature on the right. The readout is keypad selectable for Degrees C or Degrees F.

For Truck Units, the display also has symbol indicators for the following modes: COOL, HEAT, DEFROST, OUT-OF-RANGE, CITY SPEED, AUTOSTART/STOP, STAND-BY, and ROAD (diesel operation). (See Figure 1-12.)

For Trailer Units, digital displays are provided to indicate the following modes: COOL, HEAT, DEFROST, IN-RANGE, HI AIR, START/STOP. (See Figure 1-13.)

On each power-up, the unit will display a Display Test for five seconds, then display the default reading.



1. Main ON–OFF Switch
2. Cool Mode
3. Heat Mode
4. Defrost Mode
5 Road Mode
6. Autostart/Stop Mode
7. Stand-by Mode
8. City Speed Mode
9. Out-of-range
10. Fault Light
11. Compartment On/Off Switches

Figure 1-12. Cab Command (Truck Unit)

1.8.4 KEYPAD (Cab Command -- Truck Unit)

The keypad has 12 keys which will allow the operator to initiate various functions, display operating data and change operating parameters.

Arrow Keys

The keypad has *up* and *down arrow keys* which are used to modify (increment or decrement) the displayed data. If the unit is in the default display then these keys will modify the setpoint selection.

Enter Key

The *enter key* is used to accept a change in unit parameters or a change in setpoint.

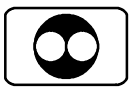
Manual Defrost Key

The *manual defrost key* is used to initiate a defrost cycle, given that the proper conditions are met.

Pretrip Check Key

This key is inactive and not applicable for this application.

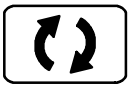
Auto Start/Stop Continuous Key



The *autostart/stop continuous key* is used to change the operating mode from "auto start/continuous run" to "auto start/stop." Each push of the key will alternate the operating modes. The operating status will be stored in memory and is retained through power outages. The digital display will indicate when stop/start is enabled (refer to Section 1.8.9).

To start the unit in manual start mode, the *autostart/stop continuous* selection must be in continuous run mode.

Function Change Key



The *function change key* is used to display the operating parameters. Each time this key is pressed the display will advance to the next parameter. This key, in conjunction with the *up/down arrow* and *enter keys*, will allow the user to change the parameters. (Refer to Section 1.8.6).

Unit Data Key

The *unit data key* is used to display the unit operating data. This key, in conjunction with the *up/down arrow* keys, will allow the user to display the unit's operating data values (i.e, coolant temperature, battery voltage, etc.). (Refer to Section 1.8.7).

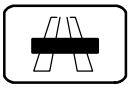
City Speed Key

The *city speed key* enables the city speed (low speed). Each push of the key toggles the operating mode. The operating status will be stored in memory. The display will indicate when city speed is activated.

Buzzer Off Key

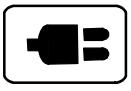
The *buzzer off key* will turn off the cab command buzzer. The buzzer is turned on when the fault light is energized and off when the fault light is de-energized.

Road Key



The *road key* selects the diesel engine operating mode. The operating status will be stored in memory.

Stand-by Key



The *stand-by key* selects the electric motor operating mode. The operating status will be stored in memory. "NO POWER" will be displayed if unit is switched to standby and power plug is not plugged in.

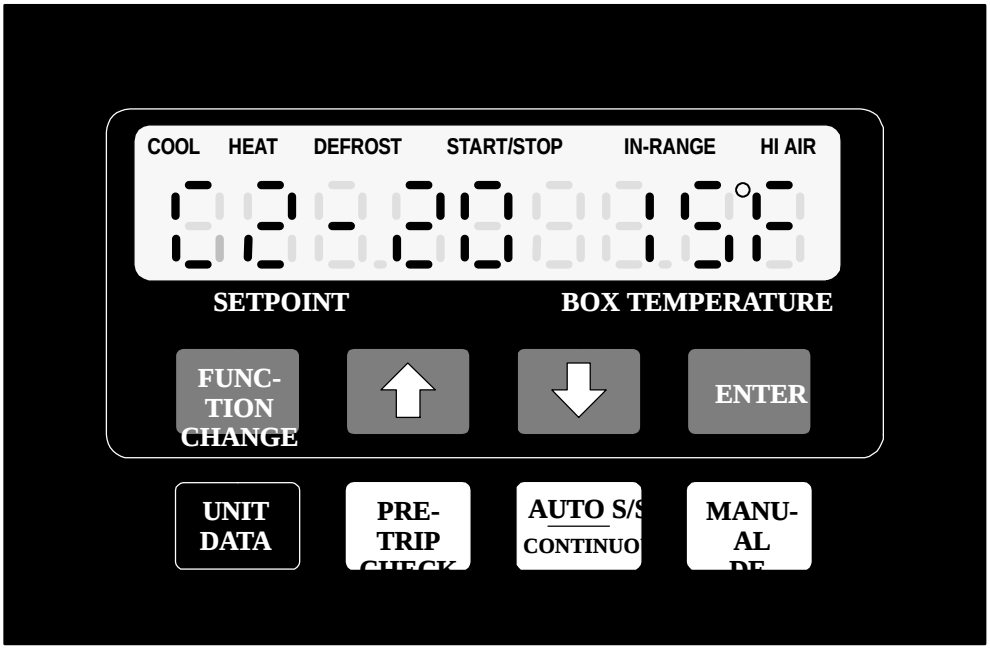


Figure 1-13. Microprocessor Control Panel (Trailer Unit)

1.8.5 KEYPAD (Trailer Unit See Figure 1-13)

The keypad has eight keys which will allow the operator to initiate various functions, display operating data and change operating parameters.

Arrow Keys

The keypad has *up* and *down arrow keys* which are used to modify (increment or decrement) the setpoint selection or modify the displayed data.

Enter Key

The *enter key* is used to accept a change in unit parameters or a change in setpoint.

Manual Defrost Key

The *manual defrost key* is used to initiate a defrost cycle, given that the proper conditions are met.

Pretrip Check Key

This key is inactive and not applicable for this application.

Auto Start/Stop Continuous Key

The *start/stop continuous key* is used to change the operating mode from "auto start/continuous run" to "auto start/stop." Each push of the key will alternate the operating modes. The operating status will be stored in memory and will be retained through power outages. The digital display will indicate when stop/start is enabled (also see Section 1.8.9).

To start the unit in manual start mode, the *Start/Stop Continuou*s selection must be in continuous run mode.

Function Change Key

The *function change key* is used to display the operating parameters. Each time this key is pressed the display will advance to the next parameter. This key, in conjunction with the *up/down arrow* and *enter keys*, will allow the user to change the parameters (see Section 1.8.6).

Unit Data Key

The *unit data key* is used to display the unit operating data. This key, in conjunction with the *up/down arrow keys*, will allow the user to display the unit's operating data values (i.e, coolant temperature, battery voltage, etc.). (See Section 1.8.7).

1.8.6 FUNCTIONAL PARAMETERS

The functional parameters will control selected operating features of the unit. These parameters can be displayed by pressing the *function change key*. All functional parameters are retained in memory. The following sections describe the list of functions which can be modified via the keypad. A description of the function is displayed on the left side with the corresponding data on the right side. The function parameter list can be scrolled through by pressing the *function change key* or by using the *up/down arrow keys*. With each *function change key* push, the list is advanced one item. If the function key is pressed and held for one second, the list will advance one item at a time. This list is circular, meaning once the end of the list is reached the list will go to the first entry. While the functional parameter is displayed, the data can be changed by pressing *enter,* then pressing either the *up or down arrow keys*. If the value is changed, the displayed data will then flash to indicate that the value has not been entered. If the new value is not entered in five seconds, the display will revert back to the last entered value. If the *enter key* is pressed, the display will stop flashing to indicate that the value has been entered. The new value will continue to be display for five seconds before reverting back to the default display. Each time a key is pressed, the five second delay will reset. To select a different functional parameter the *function change key* must be pressed first.

Table 1-3. Function Codes

CODE	ENGLISH	DATA
FN0	DEFR	Defrost Interval
*FN1 ON	CITY SPD	Low Speed
*FN1 OFF	HIGH SPD	High Speed
FN2	OFF T	Minimum Off-time
FN3	ON T	On-time
FN4	Degrees F or C	Temperature Unit _C or _F
FN5 ON	TIME STRT	Maximum Off-time 30 Min.
FN5 OFF	TEMP STRT	Temperature Based Restarting
FN6	MOP	By-Pass Valve
FN7 ON	AUTO OP	Auto Start Operation
FN7 OFF	MAN OP	Manual Start Operation
FN8	T RANGE	Out-of-Range Tolerance
Code vs English = Code or English display format		
Manual Glow Override = Normal or Add 30sec		
Alarm RST = Alarm Reset Required Alarm CLR = No Alarm Active		
* FN1 is NOT APPLICABLE for Genesis TR1000		

Code Vs English Messages

The description messages of the functional parameters, unit status and alarms can be displayed in English or Codes using this function selection. The two choices are displayed as ENGLISH or CODES. With this parameter set to CODES, all display descriptions are set to their code display. This parameter will not change due to this selection. Refer to each section for the alternate display description.

Manual Glow Override

The auto start glow time can be manually overridden through this function. The messages are displayed as NORM GLOW or ADD GLOW. If the ADD GLOW selection is entered, the control will add 30 seconds of glow to the glow times listed in Section 1.8.9. This feature must be selected before the three start attempts have been completed. At higher ambients, this override will only affect the second or third start attempt. The ADD GLOW time is deselected when the engine starts or fails to start. This parameter will not change due to the Code vs English selection.

Alarm Reset

Alarms can be reset through this function. The messages are displayed as ALARM RST or ALARM CLR. If the ALARM RST is displayed then there is at least one alarm present. Pressing the *enter key* will clear all the alarms present. If the ALARM CLR is displayed then there are no alarms present. (See Section 1.8.8.) This parameter will not change due to the code vs English selection.

Defrost Interval

The defrost interval is displayed with the description DEFR or FN0. The data for the interval is displayed with one decimal place, then the letter "H" for hours (i.e., DEFR 12.0H). The defrost intervals are $1\ ^{1}/_{2}$, 3, 6 or 12 hours.

Airflow

For Genesis TR1000, this function is not applicable because Genesis TR1000 is a single speed unit.

For Truck Units, the status of the speed control solenoid override is displayed as CITY SPD or HIGH SPD. The code display is FN1. The city speed setting is "ON" and the high speed setting is "OFF." If the display shows CITY SPD, the unit is locked into low speed.

Minimum Off-Time

The off-time selection for the auto start mode is displayed with the description OFF T or FN2. The off-times are 10, 20, 30, 45 or 90 minutes. The data for the off-time is displayed with two digits and then the letter "M" for minutes (i.e. OFF T 20M).

On-Time

The on-time selection for the auto start mode is displayed with the description ON T or FN3. The on-times are four or seven minutes. The data for the on-time is displayed with two digits and then the letter "M" for minutes (i.e. ON T4 M).

Standard Units Select

The standard units select will control how all parameters are displayed. The two choices are DEGREES F and DEGREES C. This parameter also controls units that data is displayed in psig or bars (i.e. Degrees F or Degrees C). The code display is FN4. The selections are "F" or "C."

Maximum Off Time

The description for the maximum off time is TEMP STRT or TIME STRT. The code display is FN5 and the selections are "ON" or "OFF." "ON" corresponds to TIME STRT. With the unit in time start, the control will force the engine to restart 30 minutes after shutoff.

MOP By-Pass Valve

The description for By-Pass Valve setup is MOP. The code display is FN6. Once By-Pass Valve is de-energized it will be held off for a minimum of 2 minutes.

Table 1-4. By-Pass Valve Setup (PSIG)

FN6 setting	TRUCK		TRAILER	
	Energized (Open)	De-Energized (Close)	Energized (Open)	De-Energized (Close)
STD	17	25	20	29
MOP–	15	27	18	27
MOP+	19	29	21.5	30.5

Auto/Manual Start Operation

The selection for starting the unit is displayed AUTO OP (code FN7 ON) for auto start operation or MAN OP (code FN7 OFF) for manual start operation.

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in "Continuous Run" mode.

Out-of-Range Tolerance

The out-of-range temperature tolerance selection is displayed with the description T RANGE or code FN8. The selection are A, B and C. A=2_C(3.6_F), B=3_C(5.4_F) and C=4_C (7.2_F).

The controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 15 minutes.

For set points at or below –12.2_C (+10_F) *frozen range* the unit is only considered out-of-range for temperatures above set point.

1.8.7 UNIT DATA

The *unit data key* can be used to display the unit operating data values. The data values are displayed for five seconds, then the display will revert back to the default display if no further action is taken. The following sections describe the list of data which can be displayed via the keypad. The description of the data is displayed on the left side with the actual data on the right side. The unit data list can be scrolled through by pressing the *unit data key*. With each successive key push, the list is advanced one item. If the *unit data*, *up* or *down arrow key* is held for one second, the list will change at a rate of one item every 0.5 seconds. This list is circular, meaning once the end of the list is reached the list will go to the first entry. Each time the *unit data key* or the *up/down arrow key* is pressed, the display time will be reset to five seconds. If the *enter key* is pressed, the display time will be set to 30 seconds. The position in the unit data list will remain at the last selected value except if power is removed. If the display were to time out and revert to the default display, the operator would only have to press the *unit data key* to display the same data again.

Table 1-5. Unit Data Codes

CODE	ENGLISH	DATA
CD1	SUCT	Suction Pressure
CD2	ENG	Engine Hours
CD3	WT	Engine Temperature
CD4	1RA	Return Air Temperature C1
CD6	2DT	Compartment 2 Defrost Thermistor Sensor
CD7	3DT	Compartment 3 Defrost Thermistor Sensor
CD8	1DTS	Compartment 1 Defrost Thermistor Sensor
CD9	CDT	Discharge Temperature
CD10	BATT	Battery Voltage
CD11	SBY	Standby Hours
CD12	MOD V	Future Expansion
CD13	REV	Software Revision
CD14	SERL	Serial Number Low
CD15	SERU	Serial Number Upper
CD16	2RA	Compartment 2 Air Temperature
CD17	3RA	Compartment 3 Air Temperature
CD18	MHR1	Maintenance Hour Meter 1
CD19	MHR2	Maintenance Hour Meter 2
CD20	SON	Switch On Hour Meter

Suction Pressure

The suction pressure is displayed with the description SUCT or CD1. The data is displayed with the proper unit designator P (psig) or B (Bars) (i.e. SUCT 25P) . The display is in inches of mercury for readings below 0 psig. The display range is –0.7 Bars to 29.4 Bars (–20 HG to 420 psig).

Engine Hours

The number of diesel engine hours are displayed with the description ENG or CD2. The data is displayed with units designator H (i.e. ENG 5040H OR CD2 5040H). The display range is 0 to 99999.

Engine Temperature

The coolant temperature is displayed with the description WT or CD3. The data is displayed with the proper unit designator: Degree C or Degree F (i.e, WT 185F or CD3 185F). The display range is −12_C to 130_C (10_F to 266_F).

Compartment 1 Return Air Temperature

Compartment 1 Return Air Temperature is displayed with the description 1RA or CD4. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. RAS 85.0F). The display range is −38_C to 70_C (−36_F to 158_F).

Compartment 2 Defrost Thermistor Sensor

Compartment 2 Defrost Thermistor Sensor is displayed with the description 2DT or CD6. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 2DT 85.0F). The display range is −38_C to 70_C (−36_F to 158_F).

Compartment 3 Defrost Thermistor Sensor

Compartment 3 Defrost Thermistor Sensor is displayed with the description 3DT or CD7. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F, (i.e. 3DT 85.0F) . The display range is −38_C to 70_C (−36_F to 158_F).

Compartment 1 Defrost Thermistor Sensor

Compartment 1 Defrost Thermistor Sensor is displayed with the description 1DT or CD8. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F, (i.e. 1DT 85.0F) . The display range is −38_C to 70_C (−36_F to 158_F).

Compressor Discharge Temperature

Compressor Discharge Temperature is displayed with the description CDT or CD9. The data is displayed with the proper unit designator, Degree C or Degree F, (i.e. CDT 85F) . The display range is −40_C to 200_C (−40_F to 392_F). If the sensor is absent, then the display will read "−−−" for the data.

Battery Voltage

The battery voltage is displayed with the description BATT or CD10. The data is displayed with one decimal place and then the letter "V" for volts (i.e. BATT 12.2V or CD10 12.2V). The voltage reading is displayed with a "+" (plus) sign if the battery status is good.

Standby Hours

The number of electric motor hours are displayed with the description SBY or CD11. The data is displayed in hours and units designator "H" (i.e. SBY 5040H or CD11 5040H). The display range is 0 to 99999.

Mod V – Future Expansion

This unit data is not used at this time. The Code display is CD12.

Software Revision

The Eprom software revision number is displayed with the description REV or CD13 on the left and Eprom software revision number on the right side. Pressing the ENTER key for 3 seconds will display CD13 U2 on the left and the board mounted software revision number on the right side.

Serial Number Low

The low serial number of the unit is displayed with the description SERL or CD14. The data is the lower three digits of the serial number burned in to the Eprom (i.e. SERL 504 or CD14 504).

Serial Number Upper

The upper serial number of the unit is displayed with the description SERU or CD15. The data is the upper three digits of the serial number burned in to the Eprom (i.e. SERH 001 or CD15 001).

Compartment 2 Return Air Temperature

The return air temperature for Compartment 2 will be displayed with the abbreviated description 2RA on the left side of display. The code display is CD16. The data will be displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 2RA85.0F).

Compartment 3 Return Air Temperature

The return air temperature for Compartment 3 will be displayed with the abbreviated description 3RA on the left side of display. The code display is CD17. The data will be displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 3RA85.0F).

Maintenance Hour Meter 1

The Maintenance Hour Meter 1 setting is displayed with the description MHR1 or CD18. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated.

Maintenance Hour Meter 2

The Maintenance Hour Meter 2 setting is displayed with the description MHR2 on the left side or CD19. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated.

Switch On Hour Meter

The number of Switch On Hours is displayed with the description SON or CD20 (i.e. SON 2347H or CD20 2347H). The display range is 0 to 99999.

1.8.8 ALARM DISPLAY

The fault light (FL) is turned on only for alarms that specify it. The default display will be overridden if an alarm is generated. When an alarm is generated, the display will alternate the default display (setpoint/air temperature) and the active alarm(s). Each item will be displayed for 3 to 10 seconds, and will continue to scroll through the list. See Section 1.8.6 for the procedure on resetting alarms.

Table 1-6. Alarm Display

CODE	ENGLISH	ALARM DESCRIPTION
AL0	ENG OIL	✔Low Oil Pressure
AL1	ENG HOT	✔High Coolant Temperature
AL2	HI PRESS	✔High Pressure
AL3	STARTFAIL	✔Start Failure
AL4	LOW BATT	✔Low Battery Voltage
AL5	HI BATT	✔High Battery Voltage
AL6	DEFRFAIL	✔Defrost Override
AL7	ALT AUX	✔Alternator Auxiliary
AL8	STARTER	✔Starter Motor
AL9	1RA SENSOR	✔Return Air Sensor Compartment 1
AL10	2RA SENSOR	✔Return Air Sensor Compartment 2
AL11	WT SENSOR	Coolant Temperature Sensor
AL12	HIGH CDT	✔High Discharge Temperature
AL13	CD SENSOR	Discharge Temperature Sensor
AL14	SBY MOTOR	✔Standby Motor Overload
AL15	FUSE BAD	✔Fuse Open
AL16	3RA SENSOR	✔Return Air Sensor Compartment 3
AL17	DISPLAY	Display
AL18	SERVICE 1	Maintenance Hour Meter 1
AL19	SERVICE 2	Maintenance Hour Meter 2
AL20	1RA OUT	✔Compartment 1 Out-of-range
AL21	2RA OUT	✔Compartment 2 Out-of-range
AL22	3RA OUT	✔Compartment 3 Out-of-range
NO POWER		No Power for Standby
✔ = FAULT LIGHT ON		

Low Oil Pressure Alarm

The low oil pressure alarm is displayed with the description ENG OIL or AL0. This alarm is generated if the control senses low oil pressure under the proper conditions. The fault light (FL) is turned on. Engine will shut down.

High Coolant Temperature Alarm

The high coolant temperature alarm is displayed with the description ENG HOT or AL1. This alarm is generated if the control senses a high coolant temperature over 110_C (230_F). The fault light (FL) is turned on and the engine will shut down.

High Pressure Alarm

The high pressure alarm is displayed with the description HI PRESS or AL2. This alarm is generated if the high pressure switch opens. The fault light (FL) is turned on and the engine will shut down.

Start Failure Alarm

The start failure alarm is displayed with the description STARTFAIL or AL3. This alarm is generated if the engine fails to start. The fault light (FL) is turned on.

If function MAN OP (manual start mode) is selected the start failure alarm will be generated if the engine fails to start in 5 minutes.

Low Battery Voltage Alarm

The low battery voltage alarm is displayed with the description LOW BATT or AL4. This alarm is generated if the battery voltage falls below 10 vdc. The fault light (FL) is turned on.

High Battery Voltage Alarm

The high battery voltage alarm is displayed with the description HI BATT or AL5. This alarm is generated if the battery voltage is above 17 vdc. The fault light (FL) is turned on and the engine will shut down.

Defrost Override Alarm

The defrost override alarm is displayed with the description DEFR FAIL or AL6. This alarm is generated if the unit is in a defrost override mode. The fault light (FL) is turned on.

Alternator Auxiliary Alarm

The alternator auxiliary alarm is displayed with the description ALT AUX or AL7. This alarm is generated if the alternator auxiliary signal is not present with the engine running. (See Section 1.8.9). The fault light (FL) is turned on.

Starter Motor Alarm

The starter motor alarm is displayed with the description STARTER or AL8. This alarm is generated if the starter motor input signal is not present with starter solenoid energized. The fault light (FL) is turned on.

Compartment 1 Return Air Sensor Alarm

The Compartment 1 return air sensor alarm is displayed with the description 1RA SENSOR or AL9. This alarm is generated if the return air sensor is open or shorted. The fault light (FL) is turned on because there is no controlling probe.

Compartment 2 Return Air Sensor Alarm

The Compartment 2 return air sensor alarm is displayed with the description 2RA SENSOR or AL10. This alarm is generated if the return air sensor is open or shorted. The fault light (FL) is turned on because there is no controlling probe.

Coolant Temperature Sensor Alarm

The coolant temperature sensor alarm is displayed with the description WT SENSOR or AL11. This alarm is generated if the coolant temperature sensor is open or shorted.

Compressor Discharge Temperature Alarm

The compressor discharge temperature alarm is displayed with the description HIGH CDT or AL12. This alarm is generated if the temperature is sensed above 155_C (310_F) for three minutes. If the discharge temperature exceeds 177_C (350_ F), the three minute timer is overridden and the unit shut down immediately. The fault light (FL) is turned on.

Compressor Discharge Temperature Sensor Alarm

The compressor discharge temperature sensor alarm is displayed with the description CD SENSOR or AL13. This alarm is generated if the sensor is open or shorted.

Standby Motor Overload Alarm

The standby motor overload alarm is displayed with the description SBY MOTOR or AL14. This alarm is generated when the MOL input is sensed open with the Run Relay energized in electric mode (Diesel/Electric Relay energized).

Fuse Alarm

The fuse alarm is displayed with the description FUSE BAD or AL15. This alarm is generated when the FUSE input is sensed low. The fault light (FL) is turned on.

Compartment 3 Return Air Sensor Alarm

The Compartment 3 return air sensor alarm is displayed with the description 3RA SENSOR or AL16. This alarm is generated if the return air sensor is open or shorted. The fault light (FL) is turned on because there is no controlling probe.

Display Alarm

When no communications exist between the main board and the display board for eight seconds, the display alarm description is DISPLAY or AL17

Maintenance Hour Meter 1 Alarm

The Maintenance Hour Meter Alarm 1 is displayed with the description SERVICE 1 or AL18. This alarm is generated when the designated hour meter is greater than maintenance hour meter 1.

Maintenance Hour Meter 2 Alarm

The Maintenance Hour Meter Alarm 2 is displayed with the description SERVICE 2 or AL19. This alarm is generated when the designated hour meter is greater than maintenance hour meter 2.

Compartment 1 Out-of-Range Alarm

The out-of-range alarm is displayed with the description 1RA OUT or AL20. This alarm is generated when compartment 1 is out-of-range (refer to section 1.8.6). The fault light (FL) is turned on.

Compartment 2 Out-of-range Alarm

The out-of-range alarm is displayed with the description 2RA OUT or AL21. This alarm is generated when Compartment 2 is out-of-range (refer to section 1.8.6). The fault light (FL) is turned on.

Compartment 3 Out-of-range Alarm

The out-of-range alarm is displayed with the description 3RA OUT or AL22. This alarm is generated when Compartment 3 is out-of-range (refer to section 1.8.6). The fault light (FL) is turned on.

No Power for Standby Alarm (Truck Unit)

"NO POWER" will be displayed if truck unit is switched to standby and power plug is not plugged in.

1.8.9 AUTO START/STOP OPERATION

Automatic start/stop is provided to permit starting/restarting of the diesel-driven compressor as required. This feature fully enables automatic control of the diesel engine starting and stopping. The main function of automatic engine cycling is to turn off the refrigeration system near setpoint to provide a fuel efficient temperature control system and to initiate a restart sequence after conditions are met. System shut-off is allowed only if the battery condition signal is good. The engine coolant temperature shall override the minimum off time and out-of-range condition to force engine restart when the engine coolant temperature drops below 1_C (34_F). A restart will also be initiated if the battery voltage falls below 11.0 Vdc.

a. Autostart/Stop -- Continuous

A key is provided to select between continuous run and auto start/stop operating mode. In the continuous run mode, the diesel engine will not shut down except for safeties or if the engine stalls. This function also apply to the operation of the electric motor.

b. Auto Mode Indicator

The "Auto start/stop" indicator is lit and will be on to indicate the autostart/stop mode has been selected.

c. Auto Start Failure

If the unit, for three consecutive times: fails to start, shuts down on a safety, or fails to run for the minimum run time, the "Start/Fail" alarm is activated.

d. Continuous Run Mode

In continuous run mode, the engine is started but not allowed to shut off except for safeties or if the engine stalls.

e. Auto Start Sequence

When the starting conditions are met, the start sequence will begin by energizing the run relay, and after five seconds energize the glow plug relay (GPR) to supply power to the glow plugs, and five seconds later the starter is energized. On initial power-up, the control will delay five seconds before the starting sequence begins. If the required glow time is zero, the control will energize the starter after a five second delay. After a period of time , the starter solenoid (SS) is energized to crank the engine. The engine will crank for 10 seconds or until engine operation is sensed by the alternator signal. The glow relay is de-energized after the auxiliary input is sensed on. A 15 second null cycle will elapse before subsequent start attempts. The run relay will remain energized until the next starting sequence.

Before the next starting sequence, the oil pressure alternator auxiliary output is checked to insure that the engine is not running. For the second and third start attempts, the glow time is increased by five seconds over the glow time of the first attempt listed below. The control allows three consecutive start attempts before the starting is locked out and the start failure alarm is activated.

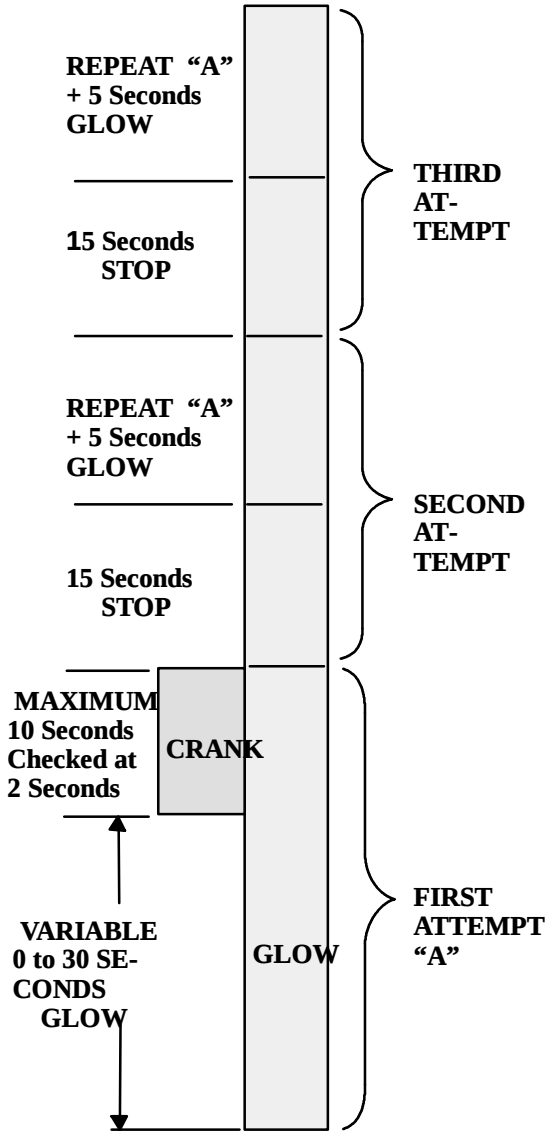


Figure 1-14. Auto Start Sequence

f. Variable Glow Time

The glow time for the first start attempt will vary in duration based on engine coolant temperature and the unit type as follows:

Ambient Temperature	Glow Time in Seconds	
	Truck	Trailer
Less than 0_C (32_F)	55	15
1_C to 10_C (33_F to 50_F)	40	10
11_C to 25_C (51_F to 77_F)	25	5
Greater than 26_C (78_F)	10	0

The second and third start attempts have a glow time that is five seconds greater than the table amount. The glow time can be manually overridden through the function parameters. If the coolant temperature sensor is defective the control assumes a temperature of less than 0_C (32_F) for the glow timing.

g. Minimum On-Time

The engine is allowed to turn off only after a minimum of four or seven minutes of run time.

After the minimum on-time, the unit will go to fully loaded for setpoints greater than −12_C (10_F) and high speed loaded for setpoints of −12_C (10_F) or less.

The unit will not cycle off if the engine coolant temperature is less than 50_C (122_F) or the battery is less than 13.4 volts. If the unit can not cycle off, it will operate normally in continuous mode. If all temperature probes fail and the setpoint is −12_C (10_F) or less, the unit will not shut down.

The unit will shut down when the box temperature is within ±0.5_C of setpoint.

h. Minimum Off-Time

The unit is designed to select the minimum off-time of 10, 20, 30, 45 or 90 minutes.

After the minimum off-time, the unit will restart for temperatures beyond ±2.0_C (±3.6_F) of setpoint for the Perishable range or above +2.0_C (+3.6_F) of setpoint for the Frozen range.

i. Battery Voltage

Provision is made to sense when the battery is good. A good battery is defined as having 13.4v at 24C_ (75_F). This condition is used to allow shut-off of the diesel engine.

If battery voltage falls below 10v during glow cycle, the starter will not engage, and the start sequence will continue, it is considered a failed start. The start sequence is repeated until the unit starts or three consecutive start attempts have failed.

Table 1-7. Battery Voltages

Message Display	Voltage Level	Description
LOW BATT AL4	10 or Less	Unit will shut down except during cranking.
	11 to 13.4	If the unit has cycled off in auto start/stop mode and battery voltage drops below 11.0 volts, the unit is automatically started to charge battery. Unit will operate until a battery voltage of 13.4 volts is obtained at which level unit will stop if temperatures are satisfied.
HI BATT AL5	17 or more	Unit will shut down.

j. Oil Pressure Signal

When the oil pressure switch is closed, it shows that the engine is running and prevents engagement of the starter motor when operating in auto mode.

k. Maximum Off-Time

A keypad selectable feature is provided which will cause the engine to be started 30 minutes after the engine has stopped regardless of the box temperature.

1.9 SWITCHES AND CONTROLS MICROPROCESSOR CONTROLLER

1.9.1 Introduction

Components required for monitoring and controlling the diesel engine−refrigeration system are located in the electrical box. The water temperature sensor is located on top of the engine.

1.9.2 Electrical Box Door (See Figure 1-4)

a. Gauges

1. Ammeter Gauge (A) − Trailer Unit

The DC ammeter indicates the rate of charge or discharge of the battery charging system (including batteries), battery charging alternator and the voltage regulator.

b. Switches

1. Run-Stop Switch (RS)

When placed in the RUN position, this switch provides power to the microprocessor.

To stop the unit or remove power from the microprocessor, move the Run-Stop switch to the STOP position.

2. Manual Glow/Crank Switch (MGC)

The manual glow/crank switch, when held in the GLOW position, energizes (approximately 7.5 amps per plug at 12 vdc) the glow plugs in the engine to pre-heat the combustion chamber. The CRANK position of the switch is used to manually engage the engine starter.

3. Selector Switch (SSW) − Trailer Unit

This switch is used to select mode of operation, either engine drive or standby electric motor drive. When this switch is placed in standby position, the electric motor will not start until the oil pressure safety switch (OP) opens.

1.9.3 Location of Engine Safety Devices

a. Oil Pressure Safety Switch (OP)

This switch, set to open below 1.0 ± 0.2 kg/cm@ (15 ± 3 psig), will automatically stop the engine upon loss of oil pressure. See Figure 1-1 for location.

b. Water Temperature Sensor (WTS)

This sensor senses engine water temperature. The microprocessor will stop the unit when this temperature exceeds 110 ± 3_C (230 ± 5_F). The sensor is located near the thermostat housing in the cylinder head.

1.10 COMPRESSOR PRESSURE REGULATING VALVE (CPR)

This adjustable regulating valve is installed on the suction line of the compressor to regulate the amount of suction pressure entering the compressor. The CPR valve is adjusted to maintain a maximum suction pressure. For CPR settings, refer to Section 1.5.

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 4.20.

1.11 ACCUMULATOR

The accumulator is a refrigerant holding tank located in the suction line between the evaporator and compressor. The purpose of the accumulator is to prevent or minimize entry of any liquid refrigerant (that may be entrained in the suction line) into the compressor, causing internal damage.

This is accomplished by the compressor drawing the refrigerant vapor through the outlet pipe of the accumulator, which is equipped with an orifice. This orifice controls the oil return to the compressor and prevents the accumulation of oil within the accumulator tank.

1.12 COMPRESSOR UNLOADERS

1.12.1 Unloading in Temperature Mode

The compressor is equipped with unloaders (electronically controlled by the microprocessor) for capacity control.

The capacity controlled cylinders are easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid is energized the cylinders unload. The unloaded cylinders operate with little or no pressure differential, consuming very little power. A de-energized solenoid reloads the cylinders.

NOTES

1. The unloader relay is locked in for a minimum of five minutes once it is energized due to suction pressure.

2. There is a delay of 30 seconds between de-energizing one set of unloaders to de-energizing the other set of unloaders.

There are two modes of unloader operation; temperature control and suction pressure control.

a. Temperature Control

1. Cool light (CL) or heat light (HL) illuminated (depending on mode of operation).

2. In low speed cooling or heating, unloader relays (UFR, or UFR & URR) may energize to unload compressor banks. Refer to Table 2-2 or Table 2-3

1.12.2 Suction Pressure Operation

Suction pressure is used for controlling the compressor unloaders to reduce capacity in the compressor at low suction pressures.

If suction pressure falls to 0 psig or below and no unloaders are energized, then UFR will energize.

If suction pressure falls to 0 psig or below, and UFR is energized, URR shall also be energized.

If suction pressure rises to 6 psig when URR and UFR are energized, then URR is de-energized.

If suction pressure rises to 6 psig when UFR is energized, then UFR shall be de-energized.

There is a five minute time delay set between any of the load/unload steps due to suction pressure that are listed above.

This algorithm is turned off during defrost.

1.12.3 Hot Gas Bypass Unloader

a. Major Working Parts

1. Solenoid and valve system
2. Spring loaded piston type bypass control valve
3. Spring loaded discharge check valve

b. Unloaded Operation

Pressure from the discharge manifold (Figure 1-15, item 15) passes through the strainer (9) and bleed orifice (8) to the back of the piston bypass valve (7). Unless bled away, this pressure would tend to close the piston (6) against the piston spring (5) pressure.

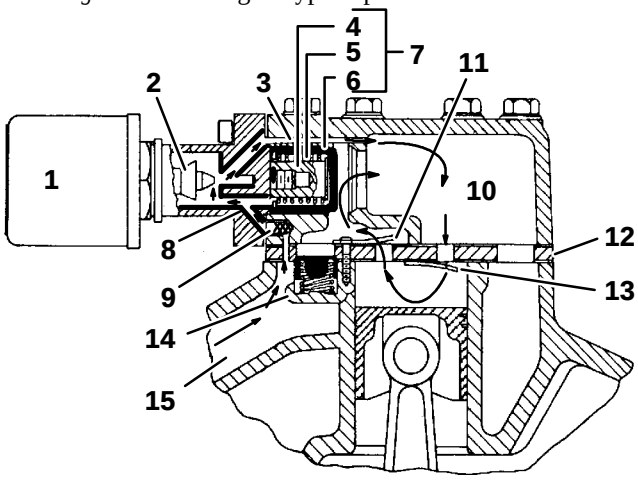
With the solenoid valve (1) *energized* the solenoid valve stem (2) will *open* the gas bypass port (3).

Refrigerant pressure will be bled to the suction manifold (10) through the opened gas bypass port. A reduction in pressure on the piston bypass valve will take place because the rate of bleed through the gas bypass port is greater than the rate of bleed through the bleed orifice (8)**.**

When the pressure behind the piston has been reduced sufficiently, the valve spring will force the piston bypass valve *back*, *opening* the gas bypass from the discharge manifold to the suction manifold.

Discharge pressure in the discharge manifold will close the discharge piston check valve assembly (14) isolating the compressor discharge manifold from the individual cylinder bank manifold.

The *unloaded* cylinder bank will continue to operate *fully unloaded* until the solenoid valve control device is *de-energized* and the gas bypass port is closed.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 1-15. Compressor Cylinder Head UNLOADED

c. Loaded Operation

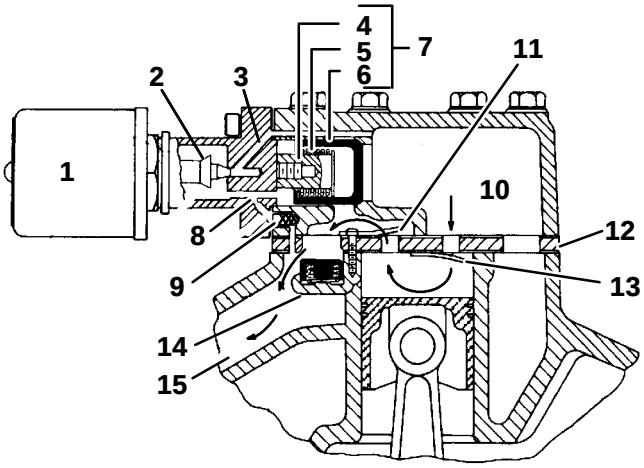
Discharge pressure bleeds from the discharge manifold (Figure 1-16, item 15) through the strainer (9) and bleed orifice (8) to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

With the solenoid valve (1) *de-energized* the solenoid valve stem will *close* the gas bypass port (3).

Refrigerant pressure will overcome the bypass valve spring (5) tension and force the piston (6) *forward closing* the gas bypass from the discharge manifold to the suction manifold (10).

Cylinder discharge pressure will force open the discharge piston check valve assembly (14). Refrigerant gas will pass into the compressor discharge manifold.

The loaded cylinder bank will continue to operate fully loaded until the solenoid valve control device is energized and the gas bypass port is opened.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 1-16. Compressor Cylinder Head LOADED

1.13 BATTERY CHARGING ALTERNATOR

1.13.1 Alternator Operation

CAUTION

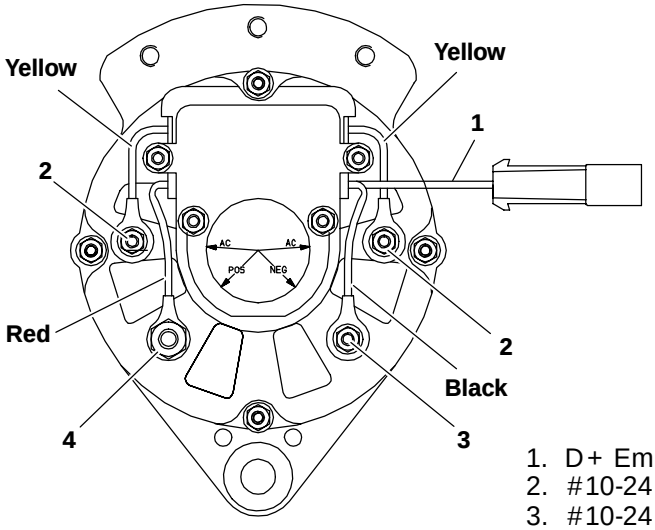
Observe proper polarity when installing battery. Negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the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

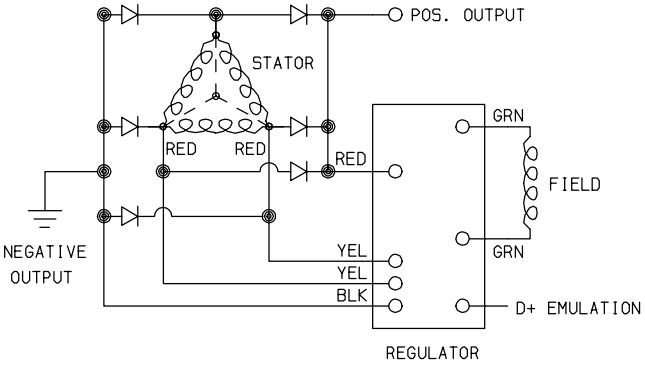
The alternator converts mechanical and magnetic energy to alternating current (AC) and voltage by the rotation of an electromagnetic field (rotor) inside a three phase stator assembly. The alternating current and voltage is changed to direct current and voltage, by passing AC energy through a three phase, full-wave rectifier system. Six silicon rectifier diodes are used. (See Figure 1-17 or Figure 1-18.)

1.13.2 Integral Voltage Regulator Operation (12 volts DC)

The regulator is an all-electronic, transistorized device. No mechanical contacts or relays are used to perform the voltage regulation of the alternator system. The electronic circuitry should never require adjustment and the solid state active elements used have proved reliable enough to warrant a sealed unit. The system is temperature compensated to permit the ideal charging rate at all temperatures.

The regulator is an electronic switching device. It senses the voltage appearing at the auxiliary terminal of the alternator and supplies the necessary field current for maintaining the system voltage at the output terminal. The output current is determined by the load.

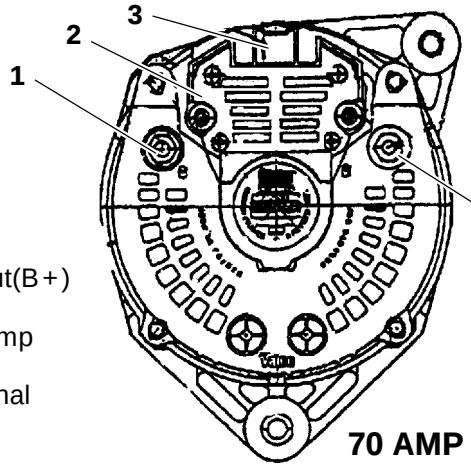


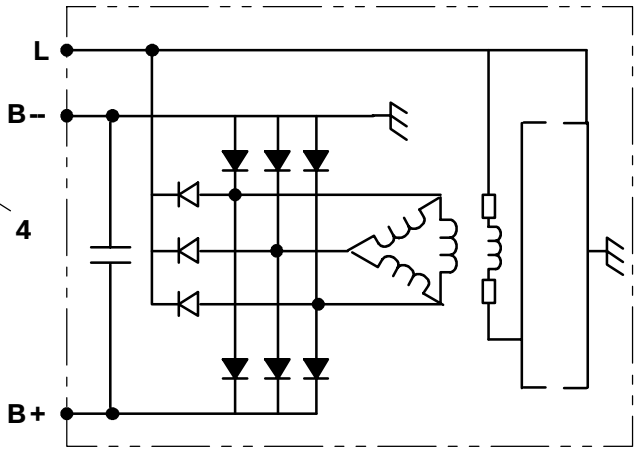


1. D+ Emulation (Orange)
2. #10-24 AC Terminal
3. #10-24 Ground Screw
4. 1/4-20 Positive Output Cable

65 AMP

Figure 1-17. 65 Amp Alternator and Regulator P/N 30-00409-02 (Trailer Unit)





1. Positive Output(B+)
2. Regulator
3. 12vdc Test Lamp Terminal (L)
4. Ground Terminal

70 AMP

Figure 1-18. 70 Amp Alternator and Regulator for Units Built In Europe

1.14 REFRIGERANT CIRCUIT DURING COOLING (See Figure 1-19)

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 liquid line solenoid valve.

The compressor raises the temperature and pressure of the refrigerant and it passes through a normally open Main Heat Valve (MHV), through a check valve into the condenser. The condenser fan circulates surrounding air over the outside of the condenser tubes. Heat transfer is then 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 and through a check valve 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 shutoff valve (king valve).

The refrigerant then flows through the subcooler. The subcooler occupies a portion of the main condensing coil surface and gives off further heat to the passing air.

The refrigerant then flows through a filter-drier where an absorbent keeps the refrigerant clean and dry.

The refrigerant then flows through the accumulator / heat exchanger and then to the liquid solenoid valves (LSV). These solenoids are electrically energized when in cooling mode and allow the liquid refrigerant to flow through the externally equalized thermostatic expansion valve (TXV), which reduces the pressure of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

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

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize. This low temperature, low pressure vapor passes into the accumulator tank. The compressor draws the vapor out of the accumulator through a pick-up tube which is equipped with a metering orifice. This orifice prevents the accumulation of oil in the accumulator tank. The metering orifice is calibrated to control the rate of oil flowing back to the compressor.

The vapor 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 116_C (240_F) maximum discharge temperature.

1.15 REFRIGERANT CIRCUIT DURING HEAT AND DEFROST (See Figure 1-20)

In heat mode, two technologies can be used: Hot gas heating through the hot gas solenoid valves (HGV1, HGV2 & HGV3) or heating by electric heaters in the evaporator.

Heating by hot gas is allowed only if no evaporator is in cooling mode.

If two or three evaporators are in heat mode, one evaporator only will be in hot gas heating. The other evaporators will be given inductive heating using the electric heaters in the evaporator.

Both hot gas and electric heat are used for defrost.

a. Hot Gas Heating

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 as it is being compressed. This energy is referred to as the “heat of compression” and can be used as the source of heat during the heating cycle.

When in the heat mode, with no evaporators calling for cooling, the hot gas solenoid valves HGSV1, HGSV2, and HGSV3 could be energized. The main heat valve (MHV) will close, diverting the refrigerant to HGSV1, HGSV2, and HGSV3. The normally closed liquid solenoid valves LSV1, LSV2, LSV3 will energize and open. The normally closed receiver pressure valve (RPV), situated in the hot gas line to the receiver will open. This allows the receiver to be pressurized and liquid refrigerant to flow through the drier and sight glass and pass through any liquid line solenoid valves which would be energized. The refrigerant passes through the expansion valve into the evaporator. At the same time high temperature, high pressure gas enters the evaporator via the solenoid valves HGSV (1,2 and 3) to give the required heating. The extra liquid purged from the receiver ensures maximum heating capacity in low ambient conditions. The evaporator fan passes the air over the hot refrigerant pipes and distributes heated air into the cargo space.

The hot gas travels through the suction line check valve into the accumulator where it is drawn back through the compressor pressure regulating valve (CPR) to begin the process again.

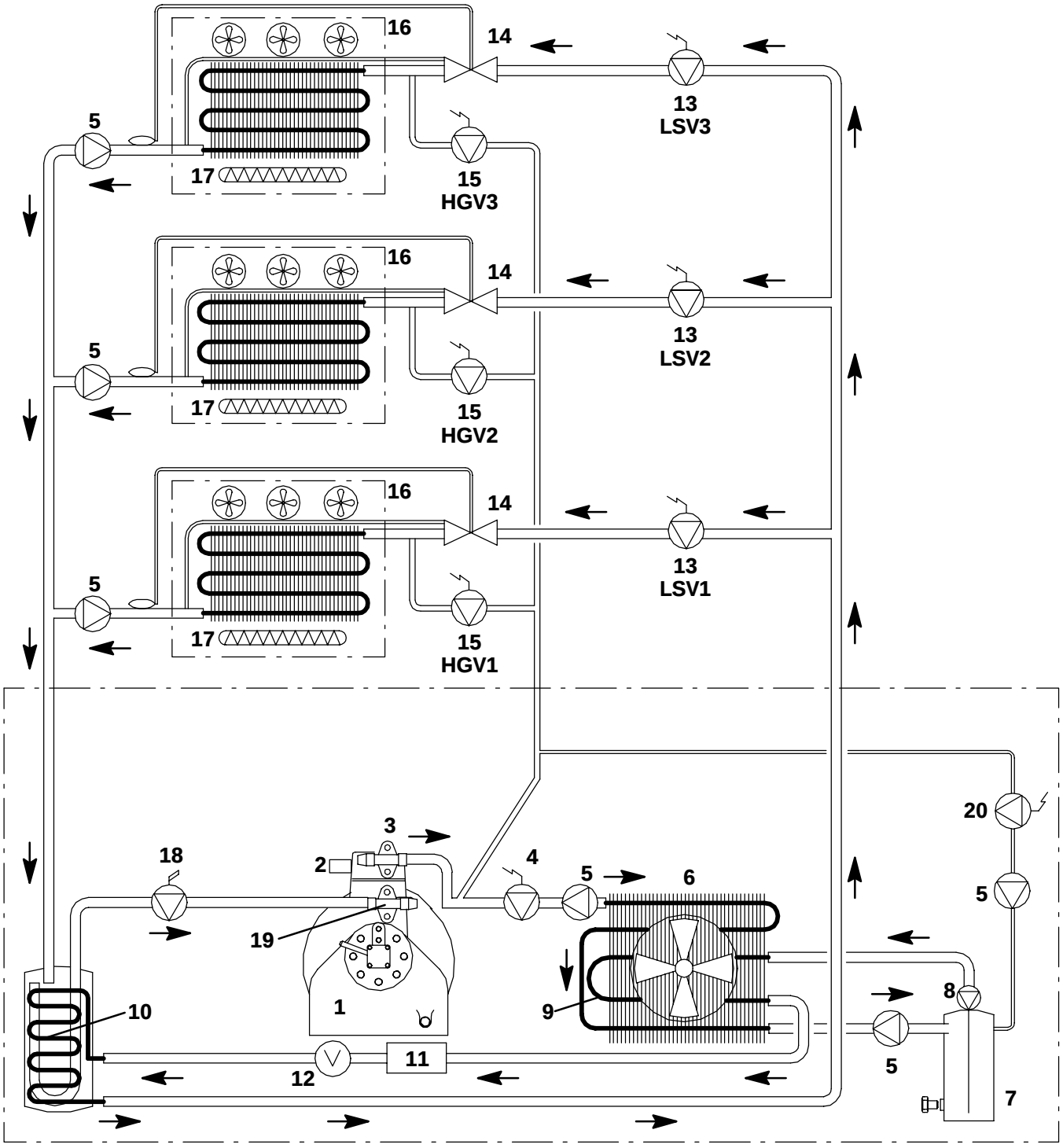
When temperature is achieved in all evaporators, they will go into null mode. The compartment with the highest set point will then take the lead and revert back to cool/heat cycles.

b. Principle Of Induction Heating (Electric Heat)

A control box recuperates the self indicated current from the electric motor when the unit is driven by the diesel engine. This current energizes electrical heaters mounted inside the evaporator.

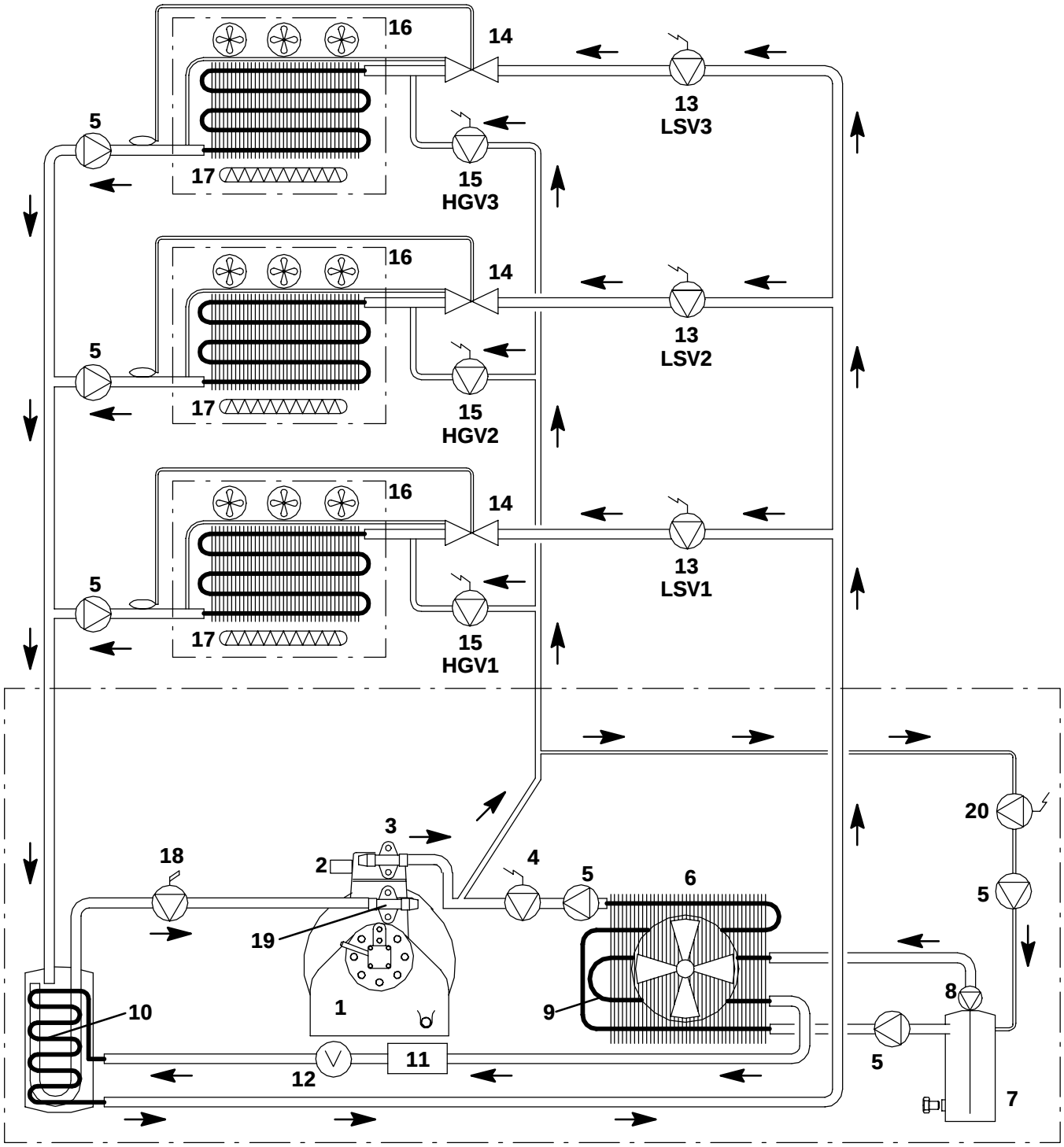
On standby operation the heaters are directly energized by the main electrical supply.

The system includes a control box, connected with electrical cables to the refrigeration unit and to the heaters inside the evaporator .



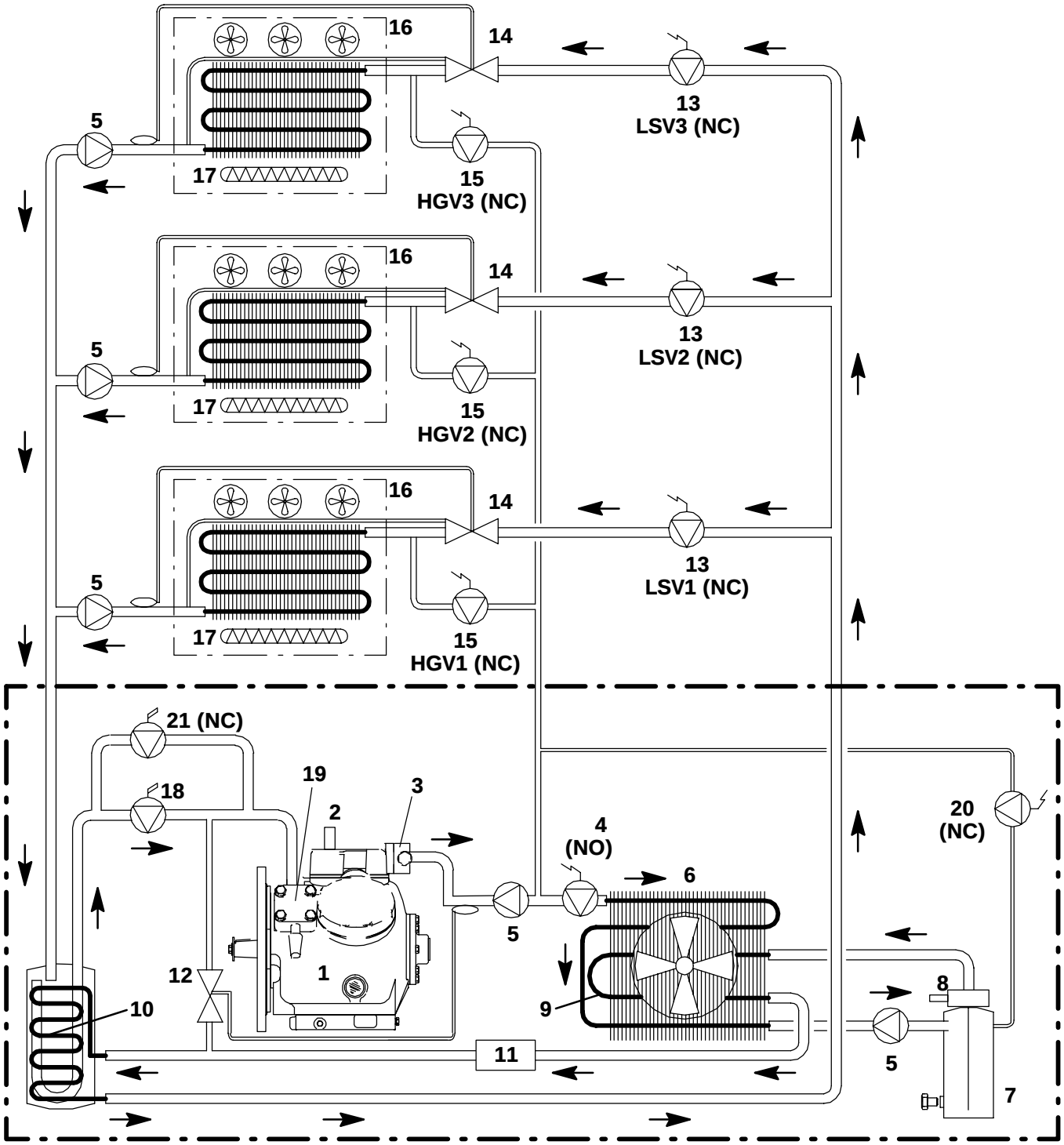
1. Compressor
2. High Pressure Switch (HP)
3. Discharge Service Valve
4. Main Heat Valve (MHV)
5. Check Valve
6. Condenser
7. Receiver
8. Receiver (King) Valve
9. Subcooler
10. Accumulator/Heat Exchanger
11. Filter-Drier
12. Sight Glass
13. Liquid Solenoid Valve (LSV)
14. Expansion Valve
15. Hot Gas Valve (HGV)
16. Evaporator
17. Electric Heater
18. Compressor Pressure Regulating Valve (CPR)
19. Suction Service Valve
20. Receiver Pressure Valve (RPV)

Figure 1-19. Truck Units Refrigeration Circuit -- Cooling



1. Compressor
2. High Pressure Switch (HP)
3. Discharge Service Valve
4. Main Heat Valve (MHV)
5. Check Valve
6. Condenser
7. Receiver
8. Receiver (King) Valve
9. Subcooler
10. Accumulator/Heat Exchanger
11. Filter-Drier
12. Sight Glass
13. Liquid Solenoid Valve (LSV)
14. Expansion Valve
15. Hot Gas Valve (HGV)
16. Evaporator
17. Electric Heater
18. Compressor Pressure Regulating Valve (CPR)
19. Suction Service Valve
20. Receiver Pressure Valve (RPV)

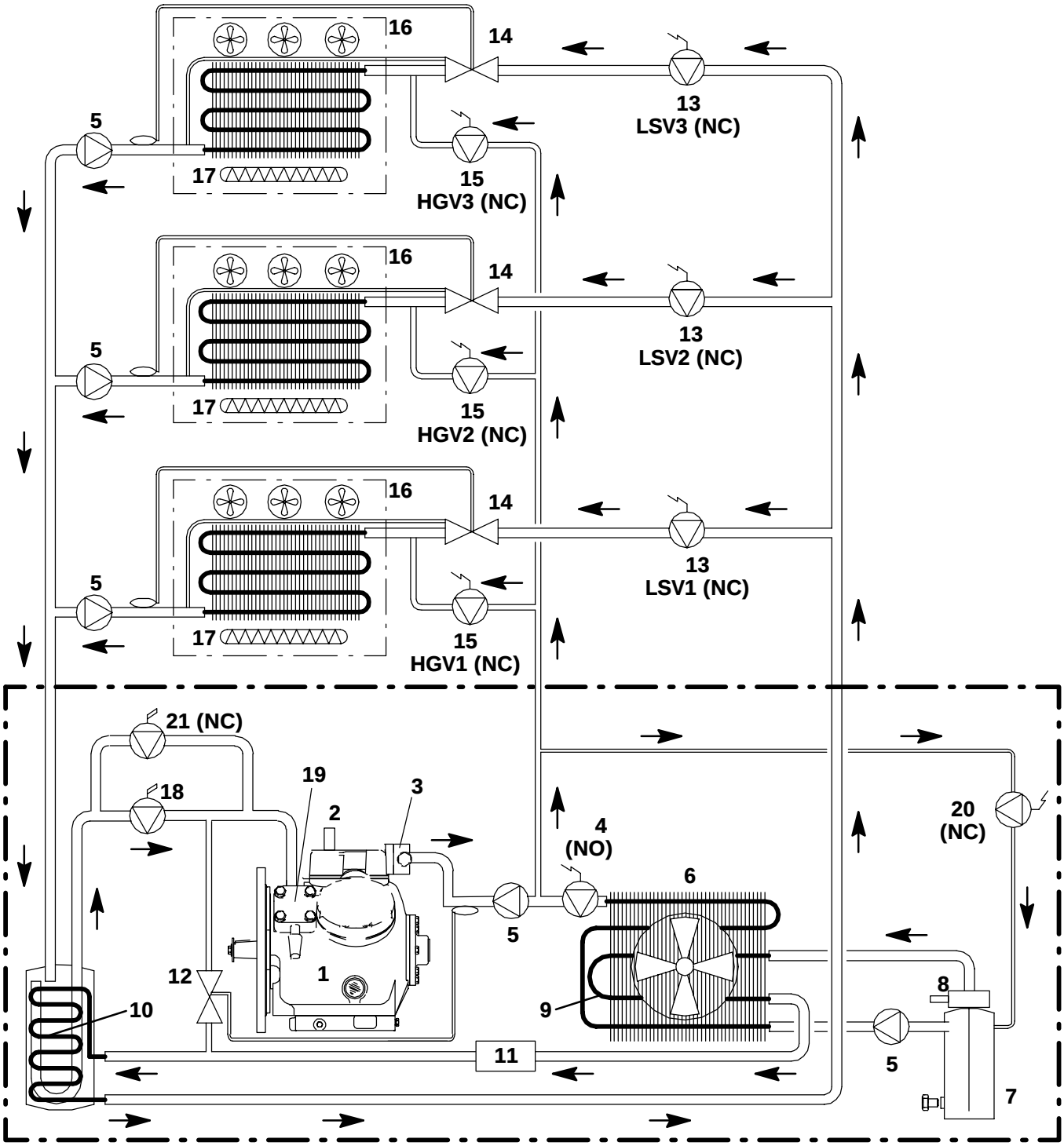
Figure 1-20. Truck Units Refrigeration Circuit -- Heating



TRAILER

1. Compressor
2. High Pressure Switch (HP)
3. Discharge Service Valve
4. Main Heat Valve (MHV)
5. Check Valve
6. Condenser
7. Receiver
8. Receiver (King) Valve
9. Subcooler
10. Accumulator/Heat Exchanger
11. Filter-Drier
12. Quench Valve
13. Liquid Solenoid Valve (LSV)
14. Expansion Valve
15. Hot Gas Valve (HGV)
16. Evaporator
17. Electric Heater
18. Compressor Pressure Regulating Valve (CPR)
19. Suction Service Valve
20. Receiver Pressure Valve (RPV)
21. By-Pass Valve (BPV)

Figure 1-21. Trailer Unit Refrigeration Circuit -- Cooling



TRAILER

1. Compressor
2. High Pressure Switch (HP)
3. Discharge Service Valve
4. Main Heat Valve (MHV)
5. Check Valve
6. Condenser
7. Receiver
8. Receiver (King) Valve
9. Subcooler
10. Accumulator/Heat Exchanger
11. Filter-Drier
12. Quench Valve
13. Liquid Solenoid Valve (LSV)
14. Expansion Valve
15. Hot Gas Valve (HGV)
16. Evaporator
17. Electric Heater
18. Compressor Pressure Regulating Valve (CPR)
19. Suction Service Valve
20. Receiver Pressure Valve (RPV)
21. By-Pass Valve (BPV)

Figure 1-22. Trailer Unit Refrigeration Circuit -- Heating

SECTION 2
OPERATION

2.1 PRE-TRIP INSPECTION

a. Before Starting Engine

1. Drain water and sediment from fuel tank sump. Fill tank with diesel fuel.

2. Check radiator coolant level. (Add pre-mixed 50/50 permanent antifreeze-water as required.) USE ETHYLENE GLYCOL ONLY. (Refer to Section 1.2)

3. Check evaporator and condenser coil for cleanliness.

4. Check engine lubrication and fuel filter, oil lines, and connections for leaks. (Tighten connections and/or replace gaskets.)

5. Check engine oil level. (Refer to Section 1.2)

6. Check V-belts for proper tension, fraying or cracks. Adjust belts or replace.

WARNING

Inspect battery cables for signs of wear, abrasion or damage at every Pre–Trip inspection and replace if necessary. Also check battery cable routing to ensure that clamps are secure and that cables are not pinched or chafing against any components.

7. Check battery terminals for cleanliness and tightness. Clean and coat with a mineral type grease (such as Vaseline).

8. Check engine air cleaner for cleanliness and condition of air cleaner hose.

9. Check defrost drain pan hoses. (Should be clear of debris.)

b. After Starting Refrigeration Unit

1. Check water temperature. (Should be 65 to 82°C = 150 to 180°F.)

2. Check engine speed. (Refer to Section 4.4.3.)

3. Listen for abnormal noises. (Refer to Section 3.3.7)

4. Check compressor oil level. (Refer to Section 4.13)

5. Observe any signs of lube or fuel oil leaks.

6. Check radiator hoses for leaks.

7. Check refrigerant level. (Refer to section 4.10)

8. Feel filter-drier. Excessive temperature drop across drier indicates restriction. (Refer to section 4.15)

2.2 STARTING AND STOPPING INSTRUCTIONS – ENGINE DRIVE

WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

WARNING

Beware of unannounced starting of fans and V-belts caused by thermostatic cycling.

NOTE

Whenever starting the truck unit engine, in order to reduce starter cranking and engine loads, the microprocessor always starts and operates in low speed, unloaded cool for the first 15 seconds. After first 15 seconds the microprocessor will allow the unit to operate normally, providing the coolant temperature is above 26°C (79°F). In order to prolong engine life, the microprocessor will prevent operation in high speed until coolant temperature reaches this temperature.

2.2.1 AUTOMATIC START

a. Starting Instructions

1. Place the *Run-Stop Switch* in the RUN position.

2. For truck units, place the *On-Off Switch* (Cab Command) to ON position and press the *Road Key*.

3. The microprocessor will perform a self-test (all display messages will appear in display window). Next, setpoint and box temperature will be displayed. The microprocessor will energize glow cycle (length of time depends on engine temperature) and start the engine.

4. To change the setpoint, press the *Up Or Down Arrow Key* and then the *Enter Key*.

5. Pressing the *Auto S/S–Continuous Key* changes the operation of the unit between automatic start/stop (unit will automatically start and stop in response to changing box temperature) or automatic start continuous run (unit will operate continuously after starting).

b. Stopping Instructions

Place the *On-Off Switch* (Cab Command if used) to OFF position or place *Run-Stop Switch* in the STOP position to stop unit.

2.2.2 MANUAL STARTING

a. Starting Instructions (Manual Starting)

1. To start the unit manually, place *Run-Stop Switch* to RUN position and the *On-Off Switch* (Cab Command if used) to ON position.

2. Press the *Auto S/S–Continuous Key* (if necessary) to erase AUTOSTART/STOP Symbol from the display.

3. Press the *Function Change Key* until AUTO OP or MAN OP appears on the display.

a. **If AUTO OP appears:**

(1) Press the *Enter Key*.

(2) Press the *Up Or Down Arrow Key* to make MAN OP appear on the display.

(3) Press the *Enter Key*. The unit is in MANUAL START mode.

b. **If MAN OP appears:** the unit is in MANUAL START mode.

4. Use the *Manual Glow/Crank Switch* to start the unit refer to Table 2-1.

NOTE

Once the unit is programmed for Man OP, the *Auto S/S – Continuous Key* can be used to toggle between Auto Start/Stop and Manual Start Continuous Run.

Table 2-1. Manual Glow Time

Ambient Temperature	Glow Time in Seconds	
	Truck	Trailer
Less than 0_C (32_F)	55	15
1_C to 10_C (33_F to 50_F)	40	10
11_C to 25_C (51_F to 77_F)	25	5
Greater than 26_C (78_F)	10	0

b. Stopping Instructions

Place the *On-Off Switch* (Cab Command if used) to OFF position or place *Run-Stop Switch* in the STOP position to stop unit.

2.3 STARTING AND STOPPING INSTRUCTIONS – STANDBY MOTOR DRIVE

WARNING

Beware of unannounced starting of fans and V-belts caused by thermostatic cycling.

1. Plug in the power plug.

2.a For Truck Units, place the *On-Off Switch* (Cab Command) to ON position and press the *Standby Key*.

2.b For Trailer Units, place the Engine/Standby Switch in the STANDBY position and place the Run/Stop Switch in the RUN (I) position.

3. The microprocessor will perform a self-test (all display messages will appear in display window). Next, setpoint and box temperature will be displayed.

"NO POWER" will be displayed if truck unit is switched to standby and power plug is not plugged in.

2.4 COMPARTMENT OPERATION

a. Starting Compartment

1. Switch unit Engine-Start run switch ON. For starting instructions on the nosemount unit, refer to section 2.2.

2. Press system on/off button to ON position (see Figure 2-1).

3. Press required compartment on/off button to ON position (see Figure 2-1).

4. The unit will start and display DEF–– for 20 seconds. The last temperature setpoint and current compartment temperature will then be displayed.

5. Set required temperature by pressing up or down arrow keys as required.

6. Turn compartment button OFF when evaporator is not required.

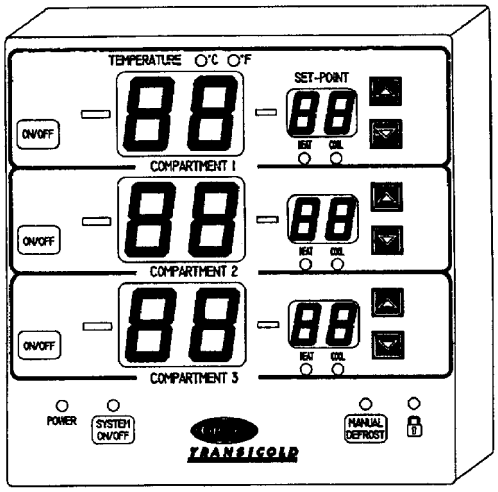


Figure 2-1. Compartment Control Box

b. To Set Pre-set Setpoint

1. Switch main on/off switch on the unit to ON. Press system on/off button to ON position (see Figure 2-1).

2. Switch OFF each compartment, unit will stop.

3. Press manual defrost button for 10 seconds. P1 will be displayed in all compartments.

4. Set lowest setpoint temperature required.

5. Press compartment on/off button – P2 will be displayed. Set next lowest temperature required up to five pre-set setpoints are available.

6. Switch system on/off switch on the unit to OFF. This stores the pre-set setpoints in memory.

c. To Remove a Pre-set Setpoint

1. Start unit and press system on/off button to ON position (see Figure 2-1).

2. Switch OFF each compartment, unit will stop.

3. Press manual defrost button for 10 seconds. P1 will be displayed in all compartments.

4. Set temperature to lowest possible and OF will be displayed .

5. Switch system on/off switch on the unit to OFF. This erases the pre-set setpoints in memory.

2.5 CONTROL CIRCUIT OPERATION – ENGINE DRIVE

2.5.1 Introduction

NOTE

To make it easier to locate the schematic components referred to in the written text, the schematic in this manual has map coordinates added to the margins. These locations have also been added to the legend.

The controller boards shown on the electrical schematic (Figure 5-1) that interface with unit components are: analog interface or processor board on the left and the relay module on the right.

Connections to these boards are made through three multiple-pin plug connectors HC, HC2, & MP. The address system (i.e. HCD2-MPW2) indicates a wire between plug HC, pin D2 and microprocessor MP & pin W2.

The processor board connections are mainly inputs and outputs for control switches, temperature sensors, safety, and auto start functions that control the operation of the unit. The processor board also controls the operation of the relay board through plug connections.

The relay module, which contains plug-in interchangeable relays, provides the microprocessor with a means for switching the unit components to achieve a desired operating mode.

2.5.2 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 (see Figure 2-2 or Figure 2-4).

If the unit is in high speed cool, the microprocessor will pull terminal N3 low to energize the speed relay. A set of normally open contacts (SR) close to energize the speed control solenoid (SCS). The engine will be in high speed.

For truck units, as the box temperature falls toward set point, the microprocessor will place the unit in low speed cool. The speed relay (SR) de-energizes to open the circuit to the speed control solenoid (SCS). Engine speed decreases from high speed to low speed.

With decreasing temperature, the unit will shift to Null and then to low speed heat.

The unit will remain in various stages of heating until the box temperature increases enough to place the unit in the null mode. As the box temperature increases, the unit will shift to cool mode.

2.5.3 Heating

Refer to Section 1.15 for a description of the heating cycle.

The controller automatically selects the mode necessary to maintain box temperature at set point. The heating modes are as follows with descending temperatures:

(a) Low Speed Heating

(b) High Speed Heating

The controller will shift the unit into low speed unloaded heat when the box temperature falls below set point. The microprocessor pulls terminal X1 low to complete the ground paths for the heat relay (HR1).

If more heating capacity is required, the unit will shift to high speed heating. The microprocessor energizes HR1 and speed relay (SR) coils. Terminals X1 and N3 will be pulled low. SR contacts close to energize the speed control solenoid (SCS). The engine will be in high speed.

2.5.4 Defrost

Refer to Sections 1.15 and 2.8for the heat and defrost cycle.

NOTE

The unit will be in high speed in the defrost mode.

The defrost mode may be initiated two different methods if the evaporator coil is below 1.7_C (35_F). (Refer to Section 1.5)

Method one, to initiate defrost press the *Manual Defrost Key*.

Method two is that defrost may be initiated automatically at preset intervals by the defrost timer in the microprocessor. (Refer to Section 1.8.4). The manual defrost key and defrost timer are part of the microprocessor and are not shown on the schematic.

In defrost, the microprocessor pulls terminals X1 and N3 low to shift the unit into high speed heat. The processor also pulls terminal W2 low to energize the defrost relay coil. The defrost and heat display will also be illuminated.

Normally closed defrost relay contacts open to to stop the evaporator fans.

2.6 CONTROL CIRCUIT OPERATION – STANDBY MOTOR DRIVE

NOTE

To make it easier to locate the schematic components referred to in the written text, the schematic in this manual has map coordinates added to the margins. These locations have also been added to the legend.

The relay module, which contains plug-in interchangeable relays, provides the controller with a means for switching the unit components to achieve a desired operating mode.

2.6.1 Electric Standby Features

1. Two Operating Modes
2. Minimum "ON" Time (5 Minutes)
3. Minimum "OFF" Time (5 Minutes)
4. Low Battery Protection

1. Two operating modes are available: Electric Standby can operate in the Start/Stop mode or the Continuous Run mode.

In the Start/Stop mode, when the box temperature gets close to setpoint, the controller will cycle the Standby Motor(SBM) OFF to conserve energy.

2. Minimum "ON" time (five minutes): The unit *must* run for the minimum run-time before it can consider shutting off. This minimum run time is to prevent short cycling and ensure adequate air flow through the load to allow the controller to accurately sense load temperature and bring the battery up to minimum voltage level. It also prevents "hot spots" in a properly loaded box.

After the minimum run time is complete, the microprocessor will look at the remaining conditions that must be satisfied to allow a shutdown. These are:

A) Battery condition – Battery voltage must be above 13.4 volts (measured at Y1).

B) The box temperature (active probe) must be satisfied:

Perishable Range Setpoints +/– 0.5_C

Frozen Range Setpoints + 0.5_C

If *ALL* of these conditions are not satisfied, the motor will continue to run until they are. This prevents rapid cycling of the electric drive motor.

3) 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 can change rapidly, but it takes time for the product temperature to change.

4) Low battery voltage protection: The microprocessor will restart the unit, if the battery voltage drops below 11.0 volts, to recharge the battery after the minimum off-time delay.

NOTE

When in Continuous Run, Perishable range, the unit will 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.

2.6.2 Standby Cool

When in standby cool, Start/Stop, the microprocessor will energize the following circuits:

After a five second delay the Diesel Electric Relay (DER) will be energized, this will open the N.C. (DER) contacts to prevent the Fuel Heater Relay (FHR), Fuel Pump (FP) and the Fuel Solenoid (FS) from being energized during standby operation. At the same time the N.O. (DER) contacts will close. This will energize the Motor Contactor (MC). With the motor contactor energized, the N.O. (MC) contacts will close, supplying voltage to energize the standby motor.

At the same time, (RR) will be energized, closing the N.O. (RR) contacts supplying voltage to the refrigeration control circuitry.

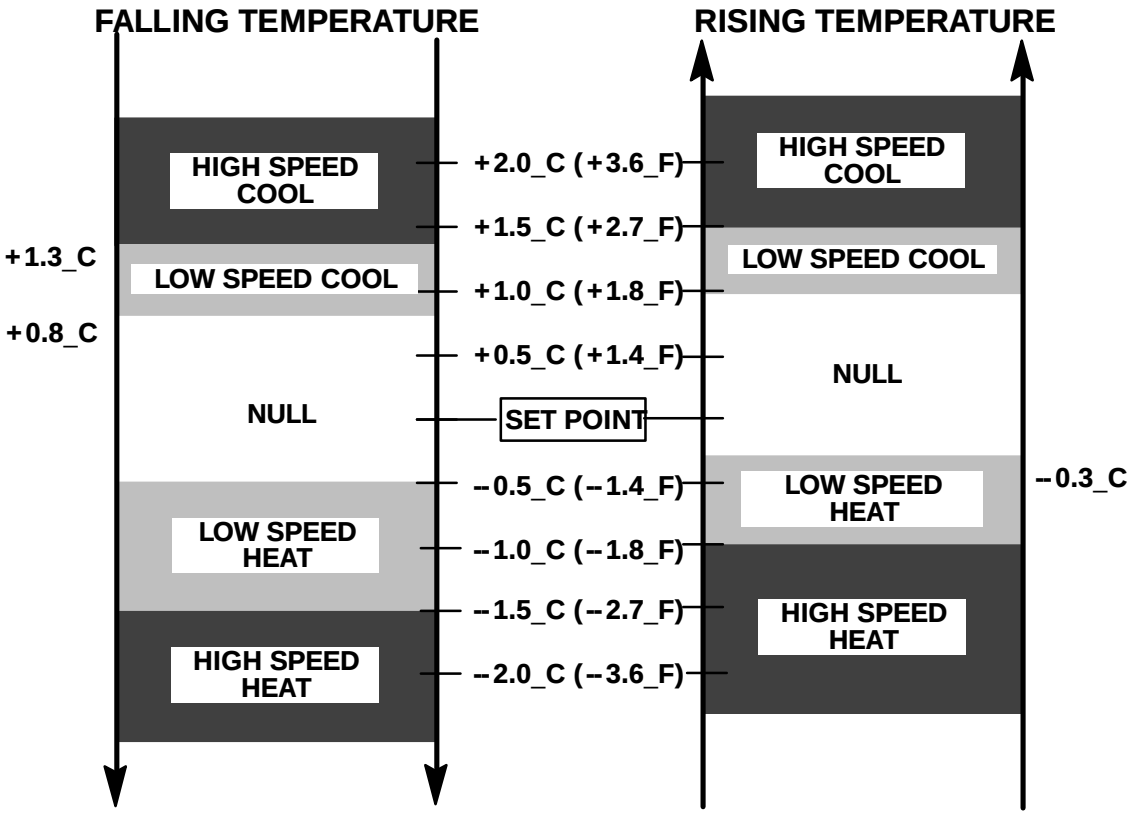
2.6.3 Standby OFF

In the start/stop mode, after the standby motor has run at least five minutes and the controller is ready to switch from cool to heat (box temperature near setpoint), the microprocessor will de-energize the (RR) causing the standby motor to cycle off.

The unit will remain off for at least five minutes before restarting. If after five minutes, the battery voltage drops below 11.0 volts or the box temperature drifts out-of-range, +/– 2.0_C (3.6_F) from setpoint for perishable range and +2.0_C (3.6_F) above setpoint for frozen range, the standby motor will restart.

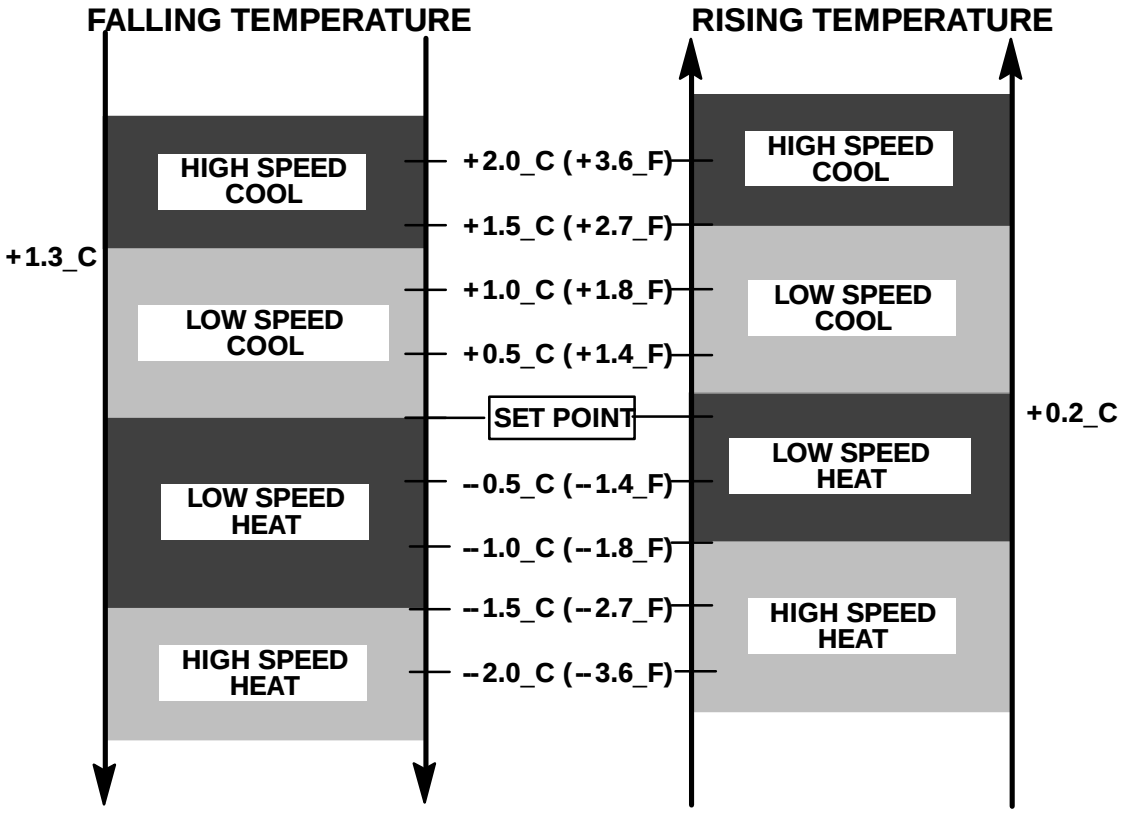
2.6.4 Standby Defrost

Standby defrost operates the same as engine drive defrost. Refer to Section 2.5.4.



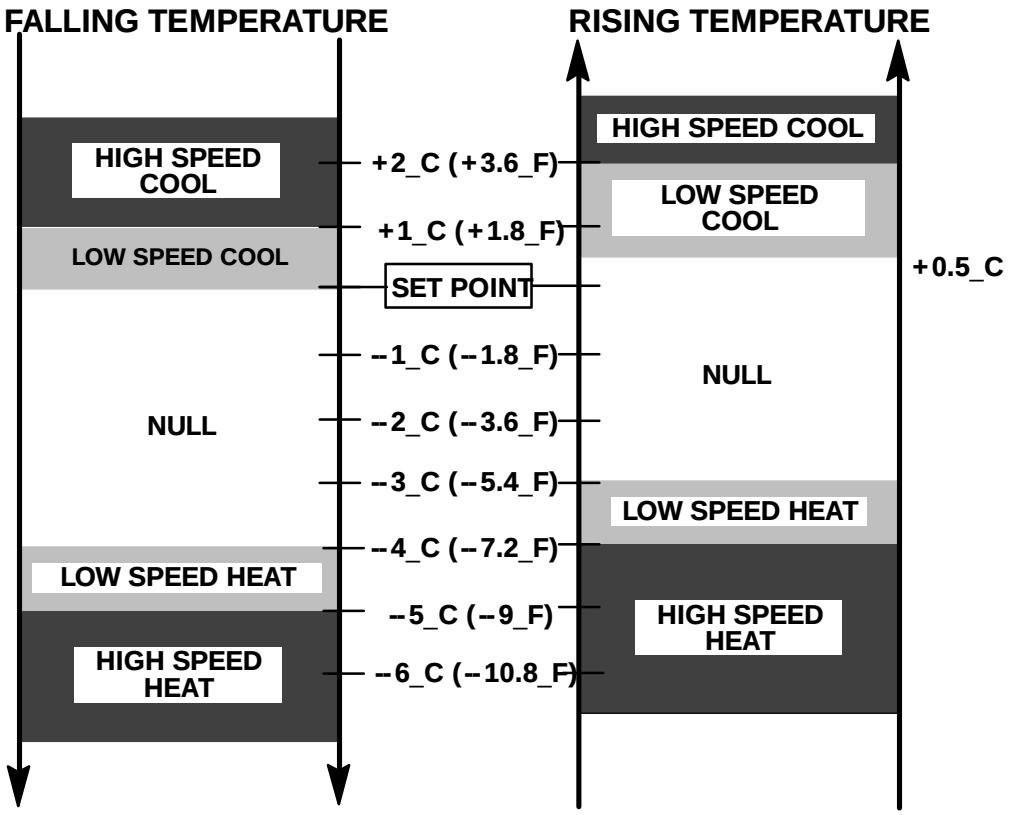
NOTE: Trailer units are single speed.

Figure 2-2. Temperature Controller Operating Sequence (Perishable Range) Controller Set Point Above –12_C (+10_F)



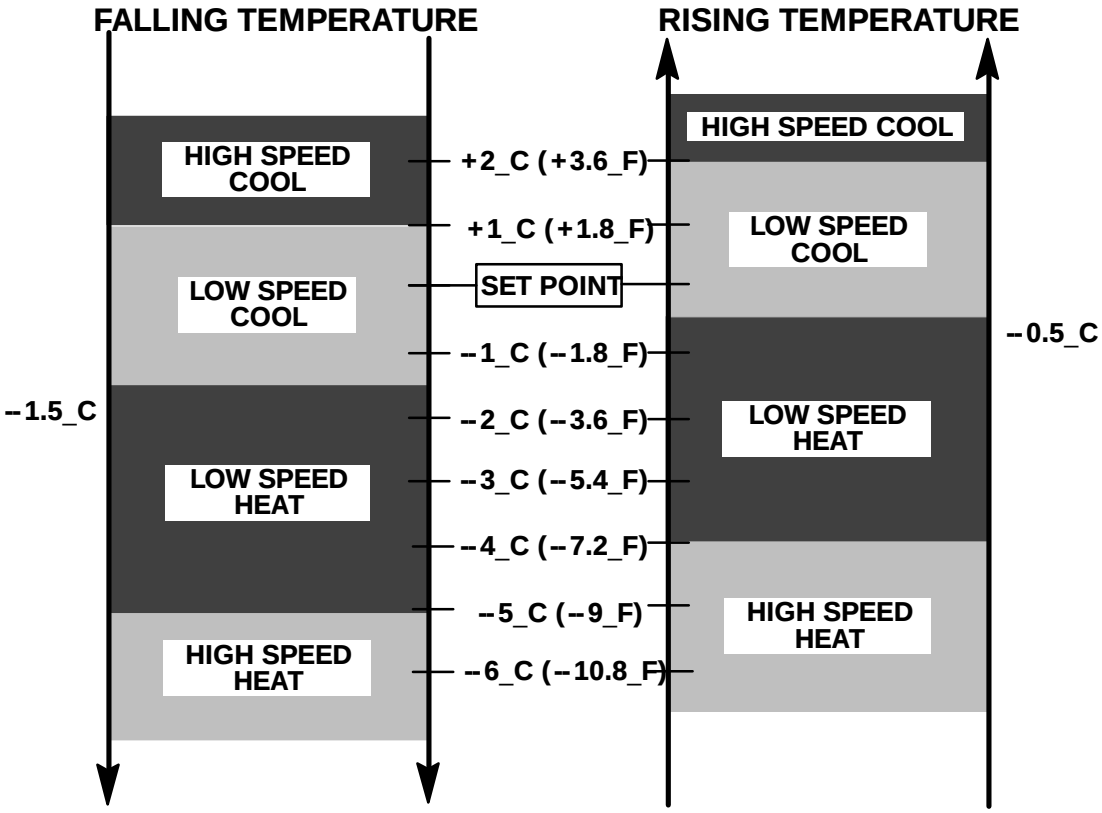
NOTE: Trailer units are single speed.

Figure 2-3. Temperature Controller Operating Sequence "Lead" Evaporator (Perishable Range) Controller Set Point Above –12_C (+10_F)



NOTE: Trailer units are single speed.

Figure 2-4. Temperature Controller Operating Sequence (Frozen Range) Controller Set Point Below --12_C (+10_F)



NOTE: Trailer units are single speed.

Figure 2-5. Temperature Controller Operating Sequence "Lead" Evaporator (Frozen Range) Controller Set Point Below --12_C (+10_F)

Table 2-2. 2 Compartment Logic Control											
Operating Mode		1CR	1HGR	1EHR	2CR	2HGR	2EHR	*Engine Speed	Fans Front	Fans Rear	Unloader
Front	Rear										
Cool	Cool	I	O	O	I	O	O	High	I	I	O
Cool	Heat	I	O	O	O	O	I	High	I	I	M
Cool	Null	I	O	O	O	O	O	Micro	I	I	M
Heat	Cool	O	O	I	I	O	O	High	I	I	M
Heat	Heat	PRI	PRI	PRI	PRI	PRI	PRI	High	I	I	one
Heat	Null	I	I	O	O	O	O	Micro	I	I	M
Null	Cool	O	O	O	I	O	O	Micro	I	I	M
Null	Heat	O	O	O	I	I	O	Micro	I	I	M
Null	Null	PRI	PRI	O	PRI	PRI	O	Micro	I	I	one
Defrost	Defrost	SEQ	SEQ	SEQ	SEQ	SEQ	SEQ	High	SEQ	SEQ	one

*= Engine speed is for truck units only. Trailer unit is one speed.
I = Output is ON
O = Output is OFF
PRI = Hot gas priority logic, Refer to Section 2.7
SEQ = Defrost logic, Refer to Section 2.8
Micro = Micro control on temperature demand
M = Control both suction pressure and temperature demand
one = one unloader energized (unloaded)

2.7 Hot Gas Heating Logic

If hot gas heating is available (no compartment requires cooling) the hot gas will be sent to the compartment which is the furthest below set point. This check is made every time that hot gas becomes available.

Hot gas will stay with this evaporator (now known as the lead evaporator) until another compartment generates a cooling demand or this compartment reaches the cooling mode itself.

To initiate hot gas heat, the main heat relay (MHR) is activated, along with (CR) and (HGR) for that compartment, and (EHR) for that compartment is de-energized.

If two compartments are exactly the same temperature away from set point, then hot gas shall go to the compartment with the highest set point. If everything is the same, hot gas should go to the lowest number active compartment.

If all compartments call for “null” mode, then one compartment must become the lead compartment and always accept hot gas heating and cooling. This compartment will be the one with the highest set point, or if there are two (or three) compartments running the same set point, then the lowest numbered compartment will become the lead compartment.

2.8 Defrost Logic

Defrost will be handled sequentially, starting with the rear most (highest number) active compartment in which the (DTS) reads low enough to allow defrost.

To energize defrost, DCR is energized, along with the CR, HGR, and EHR associated with that compartment.

During defrost, all other compartments will run in null mode (CR, EHR, and HGR off)

In order to start a defrost, the DTS reading must be 1˚C (34˚F) or below.

Defrost shall terminate when the DTS reading exceeds 10˚C (50˚F).

When defrost terminates in each compartment, there will be a recovery period under normal control until all compartments read within 2˚C of set point or for 15 minutes, whichever comes first. Following this, the next lowest numbered compartment will defrost within the constraints of DTS.

At the end of the entire defrost period (all compartments) the defrost timer shall be reset to 0 and restarted.

Defrost can be initiated via internal timer, manually via the microprocessor keypad/cab command, and by RS232 from the remote panel.

If defrost is initiated manually (either through the panel or cab command, or the RS232), there will be no recovery period between compartments.

If any DTS reads open or shorted, defrost will not occur in that compartment, the alarm shall light, and “defrost fail” shall be displayed on the panel. Other functions shall remain normal for that compartment.

Table 2-3. 3 Compartment Logic Control

Operating Mode			1CR	1HGR	1EHR	2CR	2HGR	2EHR	3CR	3HGR	3EHR	*Engine Speed	Fans			Unloader
Front	Middle	Rear											Front	Middel	Rear	
Cool	Cool	Cool	I	O	O	I	O	O	I	O	O	High	I	I	I	O
Cool	Cool	Heat	I	O	O	I	O	O	O	O	I	High	I	I	I	O
Cool	Cool	Null	I	O	O	I	O	O	O	O	O	High	I	I	I	O
Cool	Heat	Cool	I	O	O	O	O	I	I	O	O	High	I	I	I	O
Cool	Heat	Heat	I	O	O	O	O	I	O	O	I	High	I	I	I	M
Cool	Heat	Null	I	O	O	O	O	I	O	O	O	High	I	I	I	M
Cool	Null	Cool	I	O	O	O	O	O	I	O	O	High	I	I	I	O
Cool	Null	Heat	I	O	O	O	O	O	O	O	I	High	I	I	I	M
Cool	Null	Null	I	O	O	O	O	O	O	O	O	Micro	I	I	I	M
Heat	Cool	Cool	O	O	I	I	O	O	I	O	O	High	I	I	I	O
Heat	Cool	Heat	O	O	I	I	O	O	O	O	I	High	I	I	I	M
Heat	Cool	Null	O	O	I	I	O	O	O	O	O	High	I	I	I	M
Heat	Heat	Cool	O	O	I	O	O	I	I	O	O	High	I	I	I	M
Heat	Heat	Heat	PRI	PRI	PRI	PRI	PRI	PRI	PRI	PRI	PRI	High	I	I	I	one
Heat	Heat	Null	PRI	PRI	PRI	PRI	PRI	PRI	O	O	O	High	I	I	I	M
Heat	Null	Cool	O	O	I	O	O	O	I	O	O	High	I	I	I	M
Heat	Null	Heat	PRI	PRI	PRI	O	O	O	PRI	PRI	PRI	High	I	I	I	M
Heat	Null	Null	I	I	O	O	O	O	O	O	O	Micro	I	I	I	M
Null	Cool	Cool	O	O	O	I	O	O	I	O	O	High	I	I	I	O
Null	Cool	Heat	O	O	O	I	O	O	O	O	I	High	I	I	I	M
Null	Cool	Null	O	O	O	I	O	O	O	O	O	Micro	I	I	I	M
Null	Heat	Cool	O	O	O	O	O	I	I	O	O	High	I	I	I	M
Null	Heat	Heat	O	O	O	PRI	PRI	PRI	PRI	PRI	PRI	High	I	I	I	M
Null	Heat	Null	O	O	O	I	I	O	O	O	O	High	I	I	I	M
Null	Null	Cool	O	O	O	O	O	O	I	O	O	Micro	I	I	I	M
Null	Null	Heat	O	O	O	O	O	O	I	I	O	High	I	I	I	M
Null	Null	Null	PRI	PRI	O	PRI	PRI	O	PRI	PRI	O	Micro	I	I	I	one
Defrost	Defrost	Defrost	SEQ	SEQ	SEQ	SEQ	SEQ	SEQ	SEQ	SEQ	SEQ	High	SEQ	SEQ	SEQ	one

* = Engine speed is for truck units only. Trailer unit is one speed.
I = Output is ON
O = Output is OFF
PRI = Hot gas priority logic, Refer to Section 2.7
SEQ = Defrost logic, Refer to Section 2.8
Micro = Micro control on temperature demand
M = Control both suction pressure and temperature demand
one = one unloader energized (unloaded)

SECTION 3

TROUBLESHOOTING

CAUTION

Under no circumstances should anyone attempt to service the microprocessor!(see section 4.21) Should a problem develop with the microprocessor, contact your nearest Carrier Transicold dealer for replacement.

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1 DIESEL ENGINE **3.1.1 Engine Will Not Start**		
Starter motor will not crank or low cranking speed	Battery insufficiently charged Battery terminal post dirty or defective Bad electrical connections at starter Starter motor malfunctions Starter motor solenoid defective Open starting circuit Incorrect grade of lubricating oil	Check Check Check 3.1.3 Engine Manual 3.1.4 1.2
Starter motor cranks but engine fails to start	No fuel in tank Air in fuel system Water in fuel system Plugged fuel filters Plugged fuel lines to injector (s) Fuel control operation erratic Glow plug(s) defective Run solenoid defective Fuel pump (FP) malfunction	Check Check Drain Sump Replace Check Engine 4.4.7 4.4.3 4.4.6
Starter cranks, engages, but dies after a few seconds	Engine lube oil too heavy Voltage drop in starter cable(s)	1.2 Check
3.1.2 Engine Starts Then Stops		
Engine stops after several rotations	Fuel supply restricted No fuel in tank Leak in fuel system Faulty fuel control operation Fuel filter restricted Injector nozzle(s) defective Injection pump defective Air cleaner or hose restricted Safety device open Open wiring circuit to run solenoid Fuel pump (FP) malfunction	Check Check Check Engine Replace Engine Manual Engine Manual 4.4.4 1.7 Check 4.4.6
3.1.3 Starter Motor Malfunction		
Starter motor will not crank or turns slowly	Battery insufficiently charged Battery cable connections loose or oxidized Battery cables defective Starter brushes shorted out Starter brushes hang up or have no contact Starter solenoid damaged Run-Stop or Start-Run-Stop switch defective Engine lube oil too heavy	Check Check Replace Engine Manual Engine Manual Engine Manual Replace 1.2

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1.3 Starter Motor Malfunction (CONTINUED)		
Starter motor turns but pinion does not engage	Pinion or ring gear obstructed or worn	Clean both, remove burrs, or replace; apply grease
Starter motor does not disengage after switch was depressed	Run-Stop or Start-Run-Stop switch defective Starter motor solenoid defective	Replace Engine Manual
Pinion does not disengage after engine is running	Defective starter	Engine Manual
3.1.4 Malfunction In the Engine Starting Circuit		
No power to starter motor solenoid (SS)	Battery defective Loose electrical connections	Check Tighten
Run solenoid does not energize or does not remain energized	Battery defective Loose electrical connections Oil pressure safety switch (OP) defective Run relay (RR) defective Water temperature safety switch open Water temperature sensor (WTS) defective Run (Fuel) solenoid defective Run-Stop or Start-Run-Stop switch defective	Check Tighten Replace Replace 1.2 Replace 4.4.3 Replace
3.2 ALTERNATOR (AUTOMOTIVE TYPE)		
Alternator fails to charge	Limited charging system operating time Battery condition Alternator belt loose/broken Loose, dirty, corroded terminals, or broken leads Excessively worn, open or defective brushes Open blocking diode Regulator faulty Open isolation diode Open rotor (field coil)	Check Check 4.5 Check/Repair Check Check Check Check Replace
Low or unsteady charging rate	Alternator belt loose Loose, dirty, corroded terminals, or broken leads Excessively worn, sticky or intermittent brushes Faulty regulator Grounded or shorted turns in rotor Open, grounded or shorted turns in stator	4.5 Check/Repair Check Check Check Replace
Excessive charging rate (as evidenced by battery requiring too frequent refilling) or charge indicator shows constant “charge with engine idling”	Regulator leads loose, dirty, corroded terminals, or wires broken Defective regulator	Clean/Repair Check
Noisy alternator	Defective or badly worn V-belt Worn bearing(s) Misaligned belt or pulley Loose pulley	4.5 Replace 4.5 Tighten

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3 REFRIGERATION **3.3.1 Unit Will Not Cool**		
Diesel engine	Malfunction(s)	3.1
Compressor malfunction	Compressor drive defective Compressor defective	4.11 4.11
Refrigeration system	Defrost cycle did not terminate Abnormal pressure Solenoid valve malfunction	3.3.5 3.3.6 3.3.11
3.3.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor valves defective Unloader malfunction	4.11 4.14
Refrigeration system	Abnormal pressure Unloader malfunction Expansion valve malfunction No or restricted evaporator airflow	3.3.6 4.14 3.3.10 3.3.9
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.4.3 3.1
3.3.3 Unit Operates Long or Continuously in Cooling		
Container	Hot Load Defective box insulation or air leak	Allow time to pull down Correct
Refrigeration system	Abnormal pressure Temperature controller malfunction	3.3.6 3.3.8
Compressor	Defective	4.11
3.3.4 Unit Will Not Heat or Has Insufficient Heating		
Refrigeration	Abnormal pressure Temperature controller malfunction Solenoid valve malfunction	3.3.6 3.3.8 3.3.11
Compressor	Compressor drive defective Compressor defective	4.11 4.11
Engine does not develop full rpm	Speed control linkage (Truck) Engine malfunction	4.4.3 3.1

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.5 Defrost Cycle Malfunction		
Will not initiate defrost automatically	Defrost thermostats sensors defective Loose terminal connections	Replace Tighten
Will not initiate defrost manually	Microprocessor defective Loose terminal connections Defrost thermostats sensors defective Glow/Defrost switch defective	Replace Tighten Replace Replace
Initiates but does not defrost	Solenoid valve malfunction Defrost relay (DR) defective	3.3.11 Replace
Frequent defrost	Wet load	Normal
Does not terminate or cycles on defrost	Defrost thermostats sensors defective Glow/Defrost switch defective	Replace Replace
3.3.6 Abnormal Pressure **3.3.6.1 Cooling**		
High discharge pressure	Condenser coil dirty Condenser fan defective V-belt broken or loose Discharge check valve restricted Noncondensibles or refrigerant overcharge	4.19 Check 4.5 Replace Replace
Low discharge pressure	Compressor valves(s) worn or broken Solenoid valve malfunction	4.11 3.3.11
High suction pressure	Compressor valves(s) worn or broken Compressor gasket(s) defective	4.11 4.11
Low suction pressure	Suction service valve partially closed King 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 Open 4.15 4.10 3.3.10 3.3.9 Check
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective	4.11

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.6.2 Heating		
High discharge pressure	Overcharged system Condenser fan defective V-belts broken or loose Noncondensibles in system	4.10.1 Check 4.5 Check
Low discharge pressure	Compressor valve(s) worn or broken Low refrigerant charge	4.11 4.10
Low suction pressure	Refrigerant shortage Compressor pressure regulating valve malfunction Suction service valve partially closed	4.10 4.20 Open
3.3.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	Tighten 4.11 4.11 3.3.10 4.13
Condenser or evaporator fan	Loose or striking shroud Bearings defective Bent shaft	Check Check Check
V-belts	Cracked or worn	4.5
3.3.8 Control System Malfunction		
Will not control	Sensor defective Relay(s) defective Microprocessor controller malfunction	4.23 Check 4.21
3.3.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil Dirty coil Fan motor(s) malfunction	Check 4.32 4.31
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 4.5 Check 4.31

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.10 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	4.8/4.10 Clean 4.9 4.30 4.30 Replace Replace 4.30
Low superheat and liquid slugging in compressor	Superheat setting too low External equalizer line plugged Ice holding valve open Foreign material in valve Pin and seat of expansion valve eroded or held open by foreign material	4.30 Open 4.9 Clean 4.30
Fluctuating suction pressure	Improper bulb location or installation Low superheat setting	4.30 4.30
High superheat	Broken capillary	4.30
3.3.11 Solenoid Valve Malfunction		
Solenoid valve does not function properly	No power to valve Improper wiring or loose connections Coil defective 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 tub	Check Check 4.18 4.18 4.18 4.18 4.18 4.18
Solenoid valve closes but refrigerant continues to flow	Foreign material lodged under seat Defective seat	Clean Replace
3.4 Standby Motor Malfunction		
Standby motor fails to start	Motor contactor (MC) defective Motor Overload (OL) open Improper power supply Oil pressure switch (OPS) open Selector switch (SSW) defective	Replace Replace motor 1.6 Check Replace
Standby motor starts, then stops	Motor Overload (OL) open High amperage draw	1.6 Check

SECTION 4

SERVICE

WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run-Stop switch is in the STOP 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.

4.1 MAINTENANCE SCHEDULE (TRUCK)

UNIT		OPERATION	REFERENCE SECTION
ON	OFF		
a. Daily Inspection			
	X	Pre-Trip Inspection – before starting	2.1.a
X		Pre-Trip Inspection – after starting	2.1.b
b. First 250 Hour Inspection and Maintenance			
X	X	Perform daily inspection	4.1
	X	Check wire harness for chafing and loose terminals	Replace/Tighten
	X	Check unit mounting bolts for tightness	4.28
	X	Check standby motor bearings for end play	None
	X	Change engine lube oil and filter	4.4.2
c. Every 750 Hour Inspection and Maintenance			
X	X	Perform daily inspection	4.1
	X	Tighten all electrical connections	None
	X	Check that evaporator drain lines are clear	None
	X	Replace fuel filter	4.4.6
X		Check engine speeds	1.2

d. Oil Change Intervals

MODEL	Without Bypass Oil Filter	With Bypass Oil Filter
Truck Units	750 Hours	1000 Hours

4.2 MAINTENANCE SCHEDULE (TRAILER)

UNIT ON	UNIT OFF	OPERATION	REFERENCE SECTION
a. Daily Maintenance			
	X	1. Pre-Trip Inspection – before starting	2.1.a
X		2. Pre-Trip Inspection – after starting	2.1.b
X		3. Check engine hours	Run 10 min.
b. First 400 Hour Maintenance			
	X	1. Pre-Trip Inspection – before starting	2.1.a
	X	2. Change lube oil and filter	4.4.2
X		3. Pre-Trip Inspection – after starting	2.1.b
X		4. Check engine hours	Run 10 min.
c. Every 1500 Hour Maintenance (Normal Operating Conditions)			
X	X	1. Complete 400 Hour Maintenance (Refer to paragraph 1.2 for oil change intervals)	4.1.b
	X	2. Tighten engine, compressor and unit mounting bolts	None
	X	3. Tighten all electrical connection in control box	Tighten
	X	4. Clean air cleaner, check hose and connections	4.4.4
	X	5. Check water pump bearing end play	None
	X	6. Check alternator brushes	None
	X	7. Clean evaporator and condenser coils	4.32/4.19
	X	8. Check fuel pump (FP) filter	4.4.6
	X	9. Replace fuel filters	4.4.6
d. Every 3000 Hour Maintenance			
X	X	1. Complete a 1500 Hour Maintenance	4.1.c
	X	2. Clean crankcase breather	4.4.5
	X	3. Replace all V-belts	4.5
	X	4. Check starter condition	Engine Manual
	X	5. Check and adjust injector nozzles	Engine Manual
e. Every 6000 Hour or 2 Years Maintenance			
	X	1. Check and adjust injector nozzles	Engine Manual
	X	2. Check engine compression	Engine Manual
	X	3. Adjust engine valves	Engine Manual
X	X	4. Drain and flush cooling system	4.4.1

f. Oil Change Intervals

MODEL	API Class CD	MOBIL DELVAC 1
Trailer Unit	1500 Hours	3000 Hours

Oil change intervals are: First 400 hours, thereafter as listed above.

CAUTION

The maximum oil change interval is one year (for either approved oil). The only approved synthetic lube oil is Mobil Delvac 1. The normal oil change intervals (listed above) should be reduced if the equipment is operated under extreme conditions such as in dirty environments.

4.3 PRIMING THE FUEL SYSTEM (Trailer)

a. Mechanical Fuel Pump

The trailer unit is equipped with a mechanical fuel lift pump, which is mounted on the engine next to the injection pump (also see section 4.4.6). This pump has a manual plunger for bleeding fuel when the fuel tank has been run dry.

Since the unit employs a closed fuel circuit, the following steps are recommended:

1. Turn bleed valve (Red) counter-clockwise until fully opened (see Figure 1-6).

2. Turn the top of the manual plunger counter-clockwise to unlock it (see Figure 1-6). Next, rapidly hand pump the manual plunger until a positive pressure (resistance) is felt, which will indicate fuel flow.

3. Depress and turn the top of the manual plunger clockwise to lock in place.

4. Start engine.

5. When engine is running properly, turn bleed valve clockwise until fully closed.

b. Electrical Fuel Pump

If the unit is equipped with electrical fuel pumps, they are mounted on the fuel tank mounting bracket (also see section 4.4.6). Follow these steps to prime the system :

1. Open bleed valve located on top of the injection pump (see Figure 1-6).

2. Start engine.

3. When engine is running properly, turn bleed valve clockwise until fully closed.

4.4 SERVICING ENGINE RELATED COMPONENTS

4.4.1 Cooling System

The condenser and radiator assembly is designed with the radiator circuits located behind the condenser coil circuits. The condenser fans draw the air through the condenser and radiator coil. To provide maximum air flow, the condenser fan belt should be checked periodically and adjusted if necessary to prevent slippage.

The condenser and radiator can be cleaned at the same time. The radiator must be cleaned internally as well as externally to maintain adequate cooling.

CAUTION

Use only ethylene glycol anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system. Always add pre-mixed 50/50 anti-freeze and water to radiator/engine. Never exceed more than a 50% concentration of anti-freeze. Use a low silicate anti-freeze.

a. Remove all foreign material from the radiator/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.

b. Drain coolant by removing lower radiator hose and radiator cap.

c. Install hose and fill system with clean, untreated water to which 3 to 5 % of an akaline based radiator cleaner should be added (six ounces – dry 151 grams to one gallon = 3.78 liters) of water.

d. Run engine 6 to 12 hours and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

e. Run engine to operating temperature. Drain system again and fill with treated water/anti-freeze. (see Caution and refer to section 1.2) NEVER POUR COLD WATER INTO A HOT ENGINE. Hot water can always be added to a cold engine.

4.4.2 Changing Lube Oil and Lube Oil Filters

After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil.

CAUTION

When changing oil filters, the new filters should be primed with clean oil. if the filters are not primed, the engine may operate for a period with no oil supplied to the bearings.

Replace filter(s), lightly oil gasket on filter before installing and add lube oil. (Refer to section 1.2.) Warm up engine and check for leaks.

4.4.3 Replacing the Speed and Run Control Solenoids (Truck Unit)

a. Run Solenoid (see Figure 4-1).

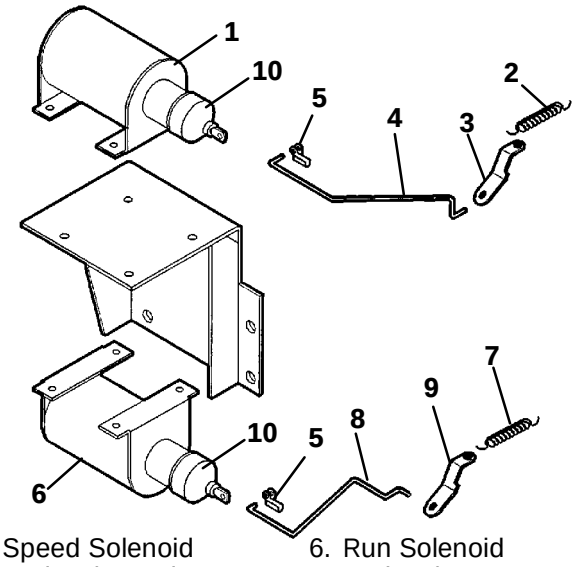
1. Remove spring (item 7) from the engine run lever.

2. Disconnect wiring to solenoid. Remove clip (item 5) from linkage rod (item 8). Remove mounting hardware and solenoid.

3. Attach linkage to new solenoid and install the clip to the linkage rod. Install the replacement solenoid and mounting hardware loosely. Connect the ground wire and spring.

4. Energize the solenoid with a jumper wire connected to a battery. Slide the solenoid far enough back on the bracket to set the engine run lever (item 9) against the stop. Tighten solenoid mounting hardware.

5. De-energize the solenoid. If the engine does not shut off, repeat step 4 and adjust the solenoid forward slightly. When operating correctly, tighten solenoid mounting hardware and reconnect the positive wire.



1. Speed Solenoid
2. Spring (Speed Control)
3. Engine Speed Lever
4. Linkage Rod (Speed)
5. Clip
6. Run Solenoid
7. Spring (Run Control)
8. Linkage Rod (Run)
9. Engine Run Lever
10. Boot

Figure 4-1. Speed and Run Control Solenoids (Truck)

b. Speed Control Solenoid (see Figure 4-1).

1. Remove spring (item 2) from the engine speed lever (item 3).

2. Disconnect wiring to solenoid. Disconnect linkage rod (item 4) from solenoid. Remove mounting hardware and solenoid.

3. Attach linkage to new solenoid and install the clip (item 5) to the linkage rod. Install the replacement solenoid and mounting hardware loosely. Connect the ground wire and spring.

4. Energize the solenoid with a jumper wire connected to a battery. Slide the solenoid far enough back on the bracket to set the engine speed lever against the stop. Tighten solenoid mounting hardware.

5. With the engine stopped, place a mark on the crankshaft sheave (white paint for example). Check engine speed. Speed may be verified by a Strobette model 964 (strobe–tachometer) Carrier Transicold P/N 07-00206.

6. Disconnect the jumper wire and start the engine. The engine is in low speed. Refer to Section 1.2 for engine speed. Reconnect the jumper wire to energize the solenoid. The engine should increase to high speed. If engine speed is not correct (engine lever against stop), stop engine and move the solenoid forward slightly. Repeat procedure if adjustments need to be made.

7. When operating correctly, tighten solenoid mounting hardware and reconnect the positive wire.

8. If adjustment is not achieved by performing step 6, stop engine and remove linkage from solenoid. Remove boot (item 10) from solenoid and pull solenoid shaft out (far enough to loosen jam nut on solenoid shaft). Energize solenoid for maximum force (pull) and then turn shaft clockwise to shorten.

9. De-energize solenoid, tighten shaft jam nut and replace boot. Connect linkage and repeat steps 5 and 6.

4.4.4 Engine Air Cleaner

a. Inspection

The dry type or oil bath air cleaner should be inspected regularly for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. The air cleaner is designed to effectively remove contaminants from the air stream entering the engine. An excessive accumulation of these contaminants in the air cleaner will impair its operation; therefore, a service schedule must be set up and followed. Remember that the air cleaner cleans the air, but the air cleaner requires cleaning. The following simple service steps are easily made while the engine is being serviced in the field.

The simple inspection steps are as follows:

1. Check all connections for mechanical tightness. Be sure cleaner outlet pipe is not fractured.

2. In case of leakage and if adjustment does not correct the trouble, replace necessary parts or gaskets. *Swelled or distorted gaskets must always be replaced.*

b. Air Cleaner Service Indicator

The air cleaner service indicator is connected to the engine air intake manifold. Its function is to indicate when the air cleaner requires replacing. In operation: When a plugged air cleaner decreases intake manifold pressure to 20" (500 mm) WG, the indicator moves to the red line. The air cleaner should be replaced and the indicator reset by pressing the reset button.

c. Service Procedure (Dry Type)

The air cleaner has a primary and secondary element. The secondary (inner) element should be changed every 3rd or 4th primary element change.

1. Stop the engine, remove air cleaner element. Install new air cleaner element.

d. Service Procedure (Oil Type)

CAUTION
Always cover the engine inlet tube while the air cleaner is being serviced.

1. Oil Cups

When to Service:

Remove the oil cup at regular intervals. Initially inspect daily or as often as conditions require. Never allow more than 1/2 inch (12.7 mm) of dirt deposit in either cup. More than 1/2 inch accumulation could result in oil and dirt carrying over into the engine, causing accelerated engine wear. Heavily contaminated oil will not allow the air cleaner to function properly.

How to Service:

Stop the engine and remove the oil cups from the air cleaner. Dump the oil from the oil cups. Remove the inner cup from the oil cup and clean both cups of sludge.

Reassemble and fill both oil cups to the *indicated level* with SAE #10 oil for temperatures below freezing or SAE #30 for temperatures above freezing. It is generally a recommended practice to use the same oil as required in the engine crankcase.

CAUTION

Do not underfill or overfill the cups. Overfilling of cups means loss of capacity and underfilling means lack of efficiency.

2. Body Assembly

When to Service:

The lower portion of the fixed element should be inspected each time the oil cup is inspected or serviced. If there is any sign of contaminant buildup or plugging, the body assembly should be removed and back flushed. At least one a year or at regular engine service periods, remove the entire air cleaner and perform the following:

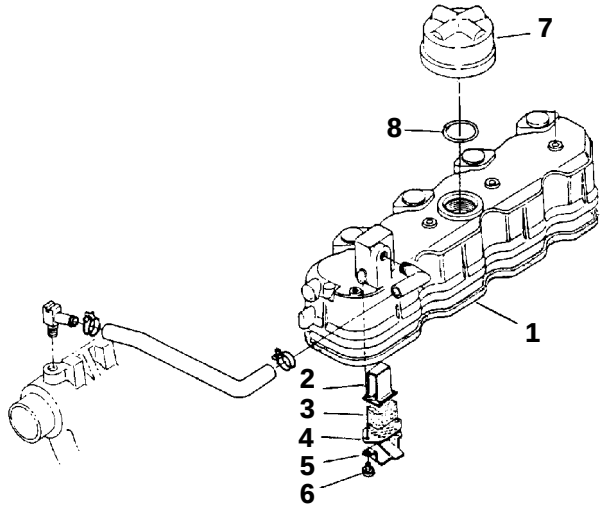
(a) Remove oil cup. Check and clean center tube. *DO NOT USE GASOLINE*.

(b) Pump solvent through the air outlet with sufficient force and volume to produce a hard, even stream out the bottom of the body assembly. Reverse flush until all foreign material is removed.

4.4.5 Engine Crankcase Breather (Trailer Unit)

The engine uses a closed type breather with the breather line attached to the cylinder head cover. (See Figure 4-2)

The breather assembly should be cleaned once a year or at every 3000 hours maintenance interval, whichever comes first.



1. Cylinder Head Cover
2. Breather Cover
3. Breather Element
4. Plate
5. Breather Oil Shield
6. Bolt
7. Breather Assembly
8. O-Ring

Figure 4-2. Engine Crankcase Breather (Trailer)

4.4.6 Servicing Fuel Pump

a. Mechanical Pump (Trailer Unit See Figure 4-3)

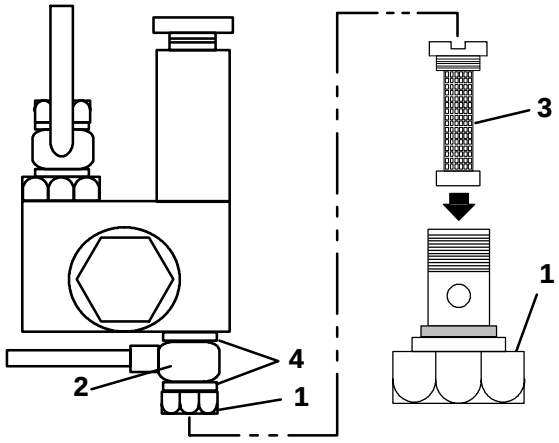
Due to foreign particles in the fuel and wax as a result of using the wrong grade of fuel or untreated fuel in cold weather. The fuel filter may become plugged or restricted, and the engine will loose capacity. The filter must be cleaned on a regular schedule, such as unit pre-trip or when the oil and fuel filters are changed (refer to Section 4.1).

1. Turn nut counter-clockwise to loosen and remove (item 1, Figure 4-3).

2. Remove banjo fitting (item 2) and let it hang loose, making sure to keep copper rings (item 4) for replacement.

3. Turn filter (item 3) counter-clockwise and remove. Check and clean.

4. To re-install filter reverse steps 1 through 3.



1. Nut
2. Banjo
3. Filter
4. Copper Rings

Figure 4-3. Mechanical Fuel Pump (Trailer Unit)

b. Electrical Pump (See Figure 4-4)

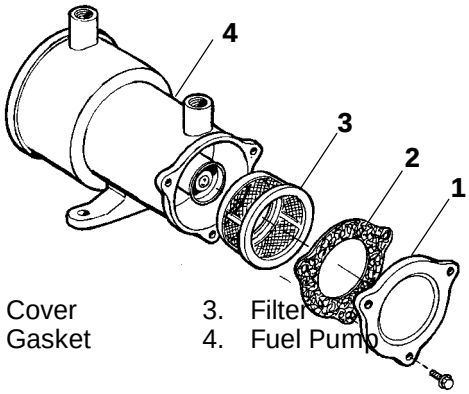
To Check or Replace Filter

1. Remove three screws from cover (item 1, Figure 4-4).

2. Remove cover, gasket and filter.

3. Wash filter in cleaning solvent and blow out with air pressure. Clean cover.

4. To re-install reverse above steps.



1. Cover
2. Gasket
3. Filter
4. Fuel Pump

Figure 4-4. Electric Fuel Pump

4.4.7 Servicing Glow Plugs

The glow plugs, when energized, draw a nominal 7.0 amps at 10.5 vdc. When servicing, the glow plug is to be fitted carefully into the cylinder head to prevent damage to glow plug. Torque value for the glow plug is 0.8 to 1.5 mkg (6 to 11 ft-lb).

Checking for a Defective Glow Plug

a. One method is to place an ammeter (or clip-on ammeter) in series with each glow plug and energize the plugs. Each plug (if good) should show amperage draw.

b. A second method is to disconnect the wire connection to the plug and test the resistance from the plug to a ground on the engine block. The reading should be 0.7 to 1.2 ohms if the plug is good.

4.5 SERVICING AND ADJUSTING V-BELTS

WARNING

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

4.5.1 Belt Tension Gauge

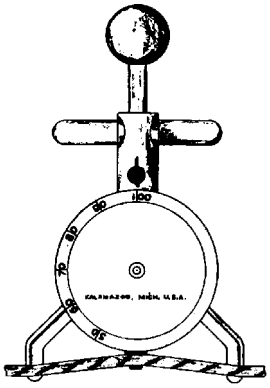
It is recommended using one of the belt tension gauges (tester) shown in Figure 4-5 whenever V-belts are adjusted or replaced.

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 specified for Carrier Transicold units are applicable only for our belts and applications, 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 4-6)

The V-belts must be kept in good condition with the proper tension to provide adequate air movement across the coils.

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.



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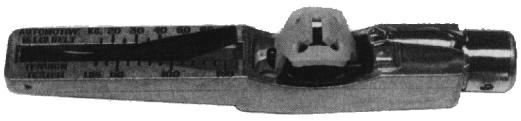
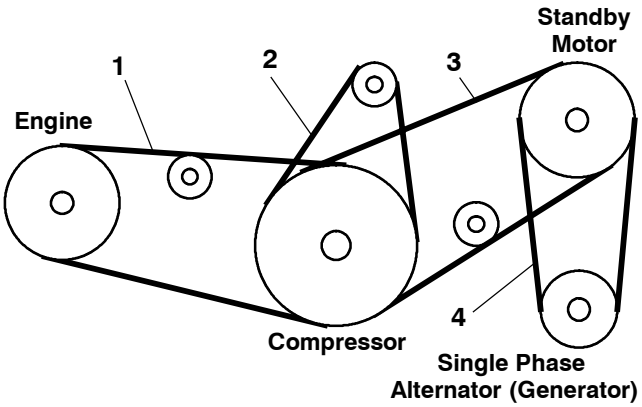


(Part No. 07-00253)

Figure 4-5 Belt Tension Gauge

4.5.2 Servicing and Adjusting V-belts (Truck Units)

Table 4-1. Belt Tension (Truck Units) (See Figure 4-5)	
BELTS	**Tension**
CT3-44TV engine (D722) Water pump	30 to 40
Engine to Compressor	30 to 50
Alternator	30 to 50
Standby Motor to Compressor	30 to 50
Standby Motor to 1ph Alternator / Gen	30 to 50



1. Engine to Compressor V-Belt
2. Alternator V-Belt
3. Standby Motor to Compressor V-Belt
4. Standby Motor to Single Phase Alternator (Generator) V-Belt

Figure 4-6. V-Belt Arrangement (Truck Units)

a. Alternator V-Belt (Truck Units)

1. Make sure negative battery terminal is disconnected.

2. Place V-belt on alternator sheave and driving pulley.

3. Pivot alternator to place tension on belt using hand force only. *Do not use pry bar or excessive force as it may cause bearing failure.* For correct belt tension see Table 4-1. Tighten pivot and adjustment bolts.

b. Water Pump Belt Tensioner (Truck Units)

Water pump belt is driven by the diesel engine crankshaft pulley. The automatic belt tensioner ensures the correct tension.

To change the water pump belt, proceed as follows:

1. To compress the tensioner spring, place a threaded bolt or rod into hole and turn clockwise. This will draw the spring up and slacken V-belt for easy removal.

2. After replacing V-belt, remove the bolt to release the spring to return the idler to the correct tension.

c. Standby Motor–Compressor V-Belt (Truck Units)

1. Remove alternator V-belt.

2. Loosen the V-belt idler securing bolt (22mm).

3. Replace V-belt and alternator V-belt. Position the idler to correct belt tension. Tighten the idler retaining bolt.

d. Single phase Alternator (generator) V-Belts (Truck Units)

1. Loosen single phase alternator bolts.

2. Replace V-belt and check belt tension. Tighten the alternator bolt.

e. Engine–Compressor V-Belts (Truck Units)

1. To allow for easy removal, installation and adjustment of the V-belts, it is recommended that the muffler be disconnected from the muffler bracket and moved.

2. Remove alternator V-belt.

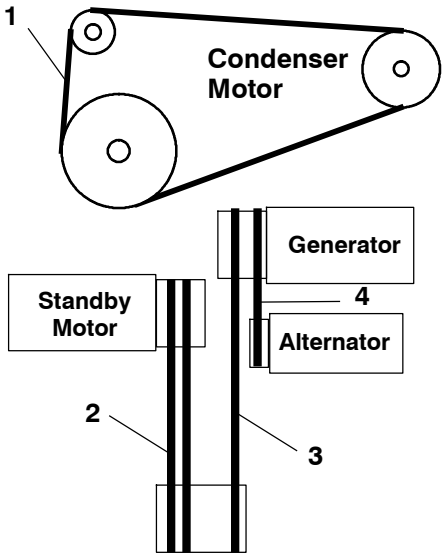
3. Remove the standby motor–compressor V-belt.

4. Loosen belt idler bolt (24 mm). Move idler to remove V-belts.

5. Replace V-belts. Position the idler to the correct belt tension. Tighten the idler retaining bolt.

4.5.3 Servicing and Adjusting V-belts (Trailer Unit)

Table 4-2. Belt Tension (Trailer Unit) (See Figure 4-5)	
BELTS	**Tension**
Water pump	35 to 40
Condenser Fan	35 to 40
Generator	50 to 55
Alternator	80 to 90
Standby Motor	50 to 55



1. Condenser Fan V-Belt
2. Standby Motor V-Belt Set
3. Generator V-Belt
4. Alternator V-Belt

Figure 4-7. V-Belt Arrangement (Trailer Unit)

a. Alternator V-Belts (Trailer Unit)

1. Make sure negative battery terminal is disconnected.

2. Remove generator V-belt and then alternator V-belt (see Figure 4-7).

3. Place V-belt on alternator sheave and then install alternator with two bolts loosely in position.

4. Check the center alignment of the generator driving pulley and alternator pulley to ensure proper drive. Pulley misalignment will create excess belt wear and limit alternator bearing life. The center line of the alternator sheave and the driving sheave must be in line.

5. Pivot alternator to place tension on belt using hand force only. *Do not use pry bar or excessive force as it may cause bearing failure.* For correct belt tension, see Table 4-1. Tighten pivot and adjustment bolts.

6. Replace generator V-belt.

b. Water Pump V-Belt (Trailer Unit)

The water pump V-belt is driven by a sheave on the engine crankshaft. Frayed, cracked or worn belts must be replaced. Adjustment is achieved by altering the position of the front side idler.

When replacing V-belt, avoid excessive force when applying tension to the V-belt to prevent damage to the water pump bearings. (Refer to Table 4-1)

c. Condenser Fan V-Belt (Trailer Unit)

1. Disconnect negative battery cable.

2. Through top of the unit, loosen condenser fan idler pulley.

3. Remove old belt and replace with new belt. (See Figure 4-7)

4. Using a belt tension gauge (Figure 4-5) on the belt, rotate idler pulley so that the gauge reads the correct tension (refer to Table 4-1).

5. Tighten idler and carriage bolt.

6. Operate unit for 5 to 10 minutes. Repeat steps 4 and 5.

d. Generator V-Belt (Trailer Unit)

1. Disconnect negative battery cable and remove V-belt guard. Loosen idler bolt.

2. To remove generator V-belt from drive shaft, follow instructions for standby motor V-belt.

3. Replace belt using a belt tension gauge (Figure 4-5) on the belt, rotate idler pulley so that the gauge reads the correct tension (refer to Table 4-1).

4. Tighten idler and carriage bolt.

5. Start unit and run for 10 minutes to allow for belt stretch.

6. Turn unit off and recheck belt tension.

e. Standby Motor V-belts (Trailer Unit)

NOTE

The standby motor V-belts are a matched set. Always replace both belts.

1. Remove V-belt guard.

2. Remove six bolts on rear face of clutch flange (see Figure 4-8).

3. Slide clutch flange forward inside clutch sheave until holes line up, and press forward for ease of belt removal.

4. Remove and replace V-belt through opening.

5. Adjust belt tension as indicated in Table 4-1. Install V-belt guard. DO NOT START UNIT UNTIL V-BELT GUARD IS INSTALLED.

6. Start unit and run for 10 minutes to allow for belt stretch.

7. Turn unit off and recheck belt tension.

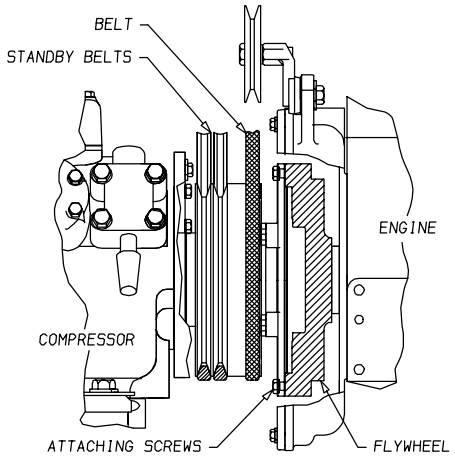


Figure A

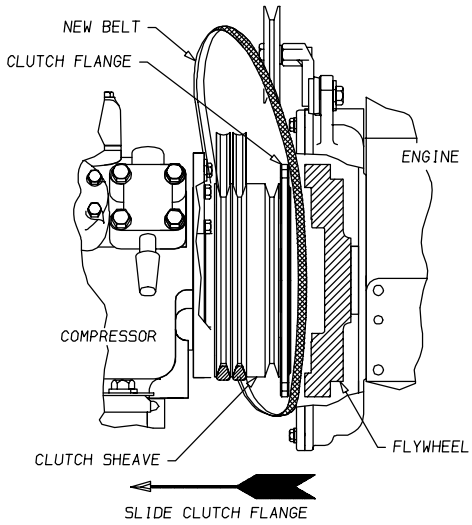


Figure B

Figure 4-8. Removing V-Belt from Clutch (Trailer)

4.6 SERVICING CLUTCH (Trailer)

The clutch must be inspected if the clutch slips or grabs. The clutch automatically engages (clutch engagement 550 ¦ 50 rpm) during starting cycle of the engine as the engine accelerates to low speed. The clutch does not engage during standby motor operation.

a. Remove the two rear compressor bracket mounting bolts (compressor shockmount end).

b. Block up engine.

c. Remove clutch V-belts.

d. Pump down the unit.

e. Remove suction and discharge service valve.

f. Attach sling or other device to the compressor.

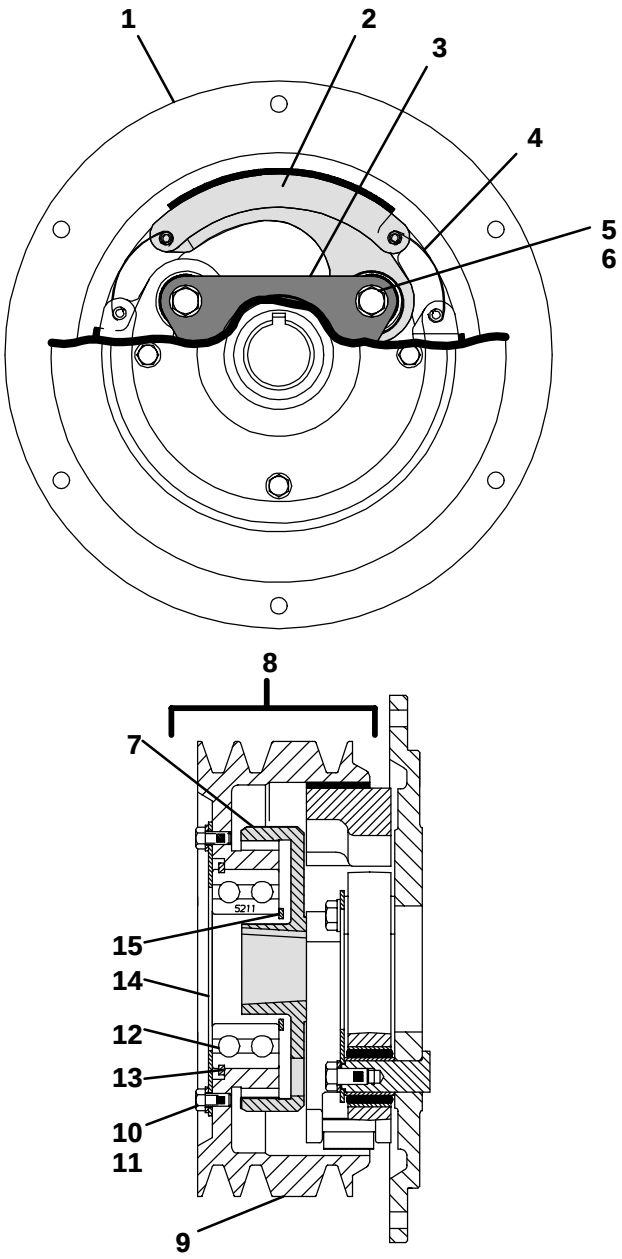
g. Slide compressor enough to remove clutch.

h. Remove six (6) 5/16-18 capscrews from rotor assembly (Item 2, Figure 4-9).

i. Using three of the capscrews as jacking screws, remove the center section of the clutch housing. This will expose the snap ring holding the housing to the drive hub. Remove snap ring and housing.

j. After replacing necessary parts, reassemble by reversing above steps.

k. Start unit and check operation.



1. Rotor Plate
2. Friction Shoe
3. Delta Bridge
4. Spring, Leaf
5. Screw
6. Washer
7. Coupling, Adapter
8. Housing Assembly
9. Housing
10. Screw
11. Washer
12. Ball Bearing Assembly
13. Snap Ring
14. Retaining Plate
15. Snap Ring, External

Figure 4-9. Clutch Assembly (Trailer)

4.7 PUMPING THE UNIT DOWN OR 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

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

1. Backseat suction and discharge service valve (turn counterclockwise) to close off gauge connection and attach manifold gauges to valves.

2. Open valves two turns (clockwise). Purge gauge line.

3. Close the receiver outlet (king) valve by turning clockwise. Start unit and run in high speed cooling. Place Run-Stop switch in the STOP position when unit reaches 0.1 kg/cm@ (1 psig).

4. Frontseat (close) suction service valve and the refrigerant will be trapped between the compressor suction service valve and the manual shutoff (king) valve.

5. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge.

6. When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.

7. Open (backseat) king valve and midseat suction service valve.

8. Leak check connections with a leak detector. (Refer to section 4.8)

9. Start the unit in cooling and check for noncondensibles.

10. Check the refrigerant charge. (Refer to section 4.10.1)

NOTE

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

Whenever the system is opened, it must be evacuated and dehydrated. (Refer to section 4.9)

b. Removing the Refrigerant Charge

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

4.8 REFRIGERANT LEAK CHECKING

If system was opened and repairs completed, leak check the unit.

a. The recommended procedure for finding leaks in a system is with a electronic leak detector for HFC.

b. If system is without refrigerant, charge system with refrigerant to build up pressure between 2.1 to 3.5 kg/cm@ (30 to 50 psig). Remove refrigerant cylinder and leak check all connections.

NOTE

It must be emphasized that 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 4.9) Charge unit with refrigerant. (Refer to section 4.10)

4.9 EVACUATION AND DEHYDRATION

4.9.1 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.

4.9.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.8)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5 cfm = 8m#H volume displacement, CTD P/N 07-00176-01) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator). (Available through Robinair Manufacturing, Montpelier, Ohio, Part Number 14010.)

NOTE

It is not recommended using a compound gauge 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 may form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise system temperature.

4.9.3 Procedure for Evacuating and Dehydrating System

a. Remove refrigerant using a refrigerant recovery system.

b. There are two methods to evacuate and dehydrate the system with one or two vacuum pumps as shown in Figure 4-10 or Figure 4-11. One is to connect three evacuation hoses (Do not use standard service hoses, as

they are not suited for evacuation purposes.) to the vacuum pump and refrigeration unit. Also, as shown, connect a evacuation manifold, with evacuation hoses only, to the vacuum pump, electronic vacuum gauge, and refrigerant recovery system.

c. With the unit service valves closed (back seated) and the vacuum pump and electronic vacuum gauge valves open, start the pump and draw a deep vacuum. Shut off the pump and check to see if the vacuum holds. This operation is to test the evacuation setup for leaks. Repair any leaks if necessary.

d. Midseat the refrigerant system service valves.

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.

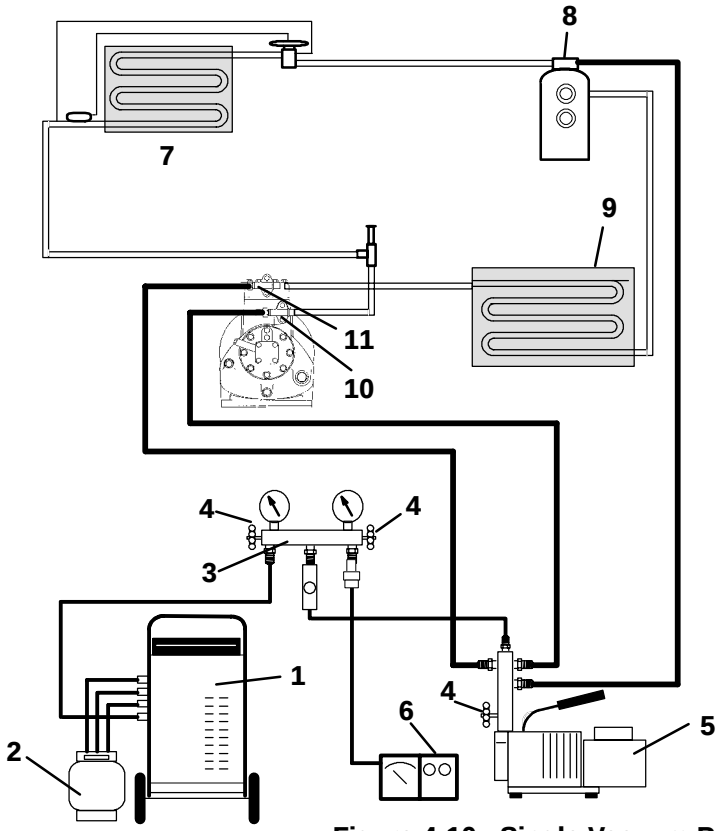
f. Break the vacuum with clean dry refrigerant. Use refrigerant called for in the unit specifications. Raise system pressure to approximately 2 psig.

g. Remove refrigerant using a refrigerant recovery system.

h. Repeat steps (e) through (g) once.

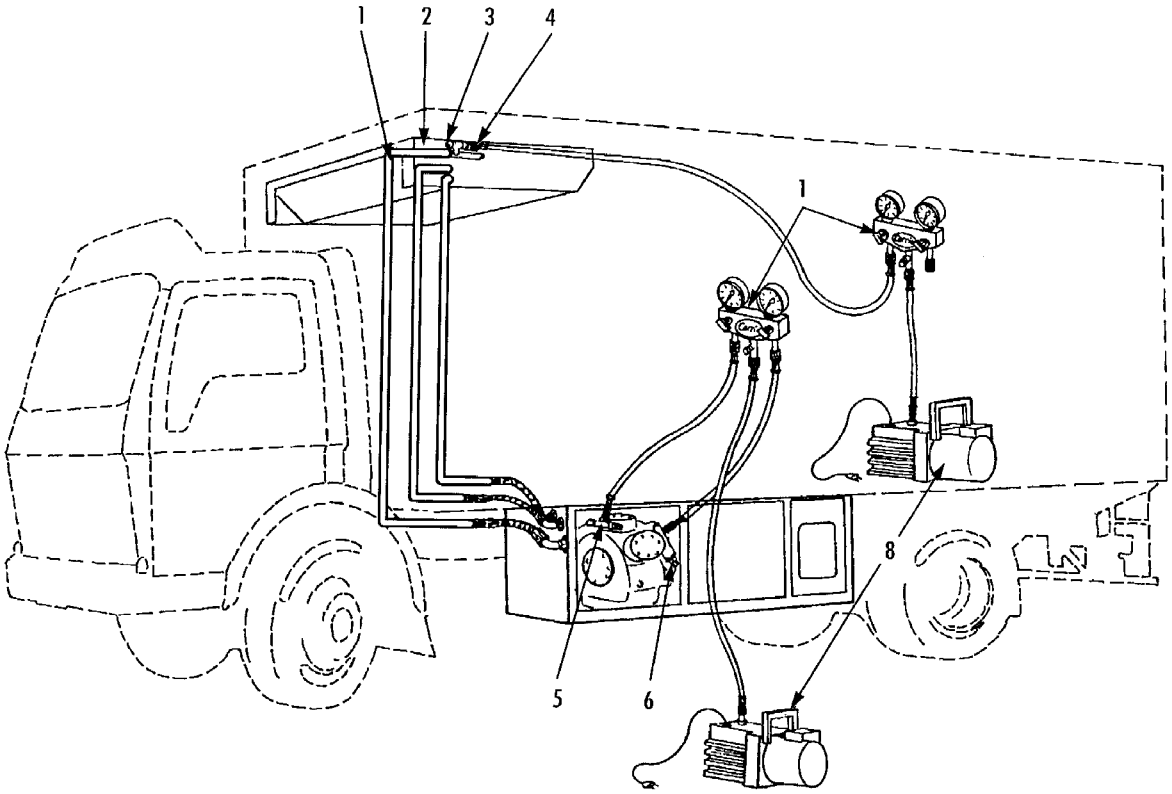
i. Evacuate unit to 500 microns. Close off vacuum pump valve and stop pump. Wait five minutes to see if vacuum holds. This checks for residual moisture and/or leaks.

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. (Refer to section 4.10)



1. Refrigerant Recovery Unit
2. Refrigerant Cylinder
3. Evacuation Manifold
4. Valve
5. Vacuum Pump
6. Electronic Vacuum Gauge
7. Evaporator Coil
8. Receiver Outlet (King) Valve
9. Condenser Coil
10. Suction Service Valve
11. Discharge Service Valve

Figure 4-10. Single Vacuum Pump Connections



1. Suction Line
2. Equalizer Line
3. Tee on Suction Line
4. Schrader Valve
5. Discharge Service Valve
6. Suction Service Valve
7. Manometer
8. Vacuum Pump

Figure 4-11. Dual Vacuum Pumps Connections

4.10 CHARGING THE REFRIGERATION SYSTEM

CAUTION

Do not vapor charge R-404A. Only liquid charging through the liquid line king valve is acceptable.

a. Dehydrate unit and leave in deep vacuum. (Refer to section 4.9)

b. Place refrigerant cylinder on scale and connect charging line from cylinder to receiver 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 1.3.

NOTE

It is possible that all liquid may not be pulled into the receiver, as outlined in step (d). In this case, frontseat the receiver outlet valve (king valve) and the liquid will be pulled into the system. Unit must be operating in the cooling mode.

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

4.10.1 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 rises to 14.8 kg/cm@ (210 psig).

The unit is correctly charged when the middle receiver sight glass is full and no refrigerant is in the upper receiver sight glass.

4.11 REPLACING THE COMPRESSOR (TRUCK)

a. Removing

If compressor is inoperative and unit still has refrigerant pressure, frontseat suction and discharge service valves to trap most of the refrigerant in the unit.

If compressor runs, pump down the unit. (Refer to Section 4.7.a)

1. Slowly release compressor pressure to a recovery system.

2. Remove bolts from suction and discharge service valve flanges.

3. Disconnect wiring to compressor discharge temperature sensor (CDT), suction pressure transducer and the wiring to the high pressure switch (HP).

4. Release idler pulleys and remove belts.

5. Remove the four bolts holding the compressor to the power tray. Remove the compressor from chassis.

6. Remove the pulley from the compressor.

7. Drain oil from defective compressor before shipping.

b. Installing

1. To install the compressor, reverse the procedure outlined when removing the compressor. Refer to Section 4.28 for torque values.

NOTE

The service replacement compressor is sold without shutoff valves (but with valve pads). Customer should retain the original capacity control valves for use on replacement compressor. Check oil level in service replacement compressor. (Refer to Sections 1.3, and 4.13.)

2. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on both lines to pump.

3. Fully backseat (open) both suction and discharge service valves.

4. Remove vacuum pump lines and install manifold gauges.

5. Check refrigerant level (Refer to section 4.10.1.)

NOTE

It is important to check the compressor oil level of the new compressor and fill if necessary.

6. Check compressor oil level. (Refer to Section 4.13.) Add oil if necessary.

7. Check refrigerant cycles.

4.12 REPLACING THE COMPRESSOR (TRAILER)

If compressor is inoperative and unit still has refrigerant pressure, frontseat suction and discharge service valves to trap most of the refrigerant in the unit.

If compressor runs, pump down the unit. (Refer to Section 4.7.a.)

a. Remove the two rear compressor bracket mounting bolts (compressor shockmount end).

b. Block up engine.

c. Slowly release compressor pressure to a recovery system.

d. Remove bolts from suction and discharge service valve flanges.

e. Remove oil filter and bracket from 05G compressor.

f. Disconnect wiring to unloader valve assemblies, compressor discharge temperature sensor (CDT), suction pressure transducer and the wiring to the high pressure cutout switch (HP-1).

g. Remove 10 bolts from the engine-compressor spacer.

h. Disconnect ground strap from frame.

i. Disconnect suction pressure transducer from compressor .

j. Attach sling or other device to the compressor.

k. Slide compressor enough to clear clutch housing and remove compressor from unit.

l. Drain oil from defective compressor before shipping.

m. The original unloader valves must be transferred to the replacement compressor. The plug arrangement removed from the replacement is installed in the original compressor as a seal. If piston is stuck, it may be extracted by threading socket head cap screw into top of piston. A small teflon seat ring at bottom of piston must be removed.

NOTES

The service replacement compressor is sold without shutoff valves (but with valve pads). Customer should retain the original capacity control valves for use on replacement compressor. Check oil level in service replacement compressor. (Refer to sections 1.3, and 4.13)

n. Remove the complete high pressure switch assembly (HP-1) and install on new compressor after checking switch settings. Remove compressor discharge temperature sensor (CDT) and suction pressure transducer and install on new compressor. Install compressor frame to new compressor (if removed with defective compressor).

o. Install compressor in unit by reversing steps 4.12.c through (n). It is recommended using new locknuts when replacing compressor. Torque bolts to a value of 46 ft/lb (6.4 mkg). Install new gaskets on service valves and tighten bolts uniformly.

p. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on both lines to pump.

q. Fully backseat (open) both suction and discharge service valves.

r. Remove vacuum pump lines and install manifold gauges.

s. Start unit and check for noncondensibles.

t. Check refrigerant level. (Refer to Section 4.10.1.)

u. Check compressor oil level. (Refer to Section 4.13) Add oil if necessary.

v. Check compressor unloader operation. (refer to Section 4.14)

w. Check refrigerant cycles. (refer to Section 2)

4.13 CHECKING COMPRESSOR OIL LEVEL

a. To Check Oil Level in Compressor:

1. Operate the unit in high speed cooling for at least 20 minutes.

2. Check the oil sight glass on the compressor to ensure that no foaming of the oil is present after 20 minutes of operation. If the oil is foaming excessively after 20 minutes of operation, check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before performing step 3.

3. Check the level of the oil in the sight glass with the compressor operating (See Figure 4-12).

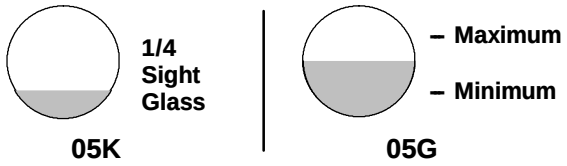


Figure 4-12. Oil Level in Sight Glass

b. Adding Oil with Compressor in System

Two methods for adding oil are the oil pump method and closed system method.

1. Oil Pump Method

One compressor oil pump that may be purchased is a Robinair, part no. 14388. This oil pump adapts to a one U.S. gallon (3.785 liters) metal refrigeration oil container and pumps 2-1/2 ounces (0.0725 liters) per stroke when connected to the suction service valve port. Also there is no need to remove pump from can after each use.

When the compressor is in operation, the pump check valve prevents the loss of refrigerant, while allowing servicemen to develop sufficient pressure to overcome the operating suction pressure to add oil as necessary.

Backseat suction service valve and connect oil charging hose to port. Crack the service valve and purge the oil hose at oil pump. Add oil as necessary.

2. Closed System Method

In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

CAUTION

Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times, otherwise air and moisture will be drawn into the compressor.

Connect the suction connection of the gauge manifold to the compressor suction service valve port, and immerse the common connection of the gauge manifold in an open container of refrigeration oil. Crack the suction service valve and gauge valve to vent a small amount of refrigerant through the common connection and the oil to purge the lines of air. Close the gauge manifold valve.

With the unit running, frontseat the suction service valve and pull a vacuum in the compressor crankcase. SLOWLY crack the suction gauge manifold valve and oil will flow through the suction service valve into the compressor. Add oil as necessary.

c. Adding Oil to Service Replacement Compressor

Service replacement compressors may or may not be shipped with oil.

If compressor is without oil:

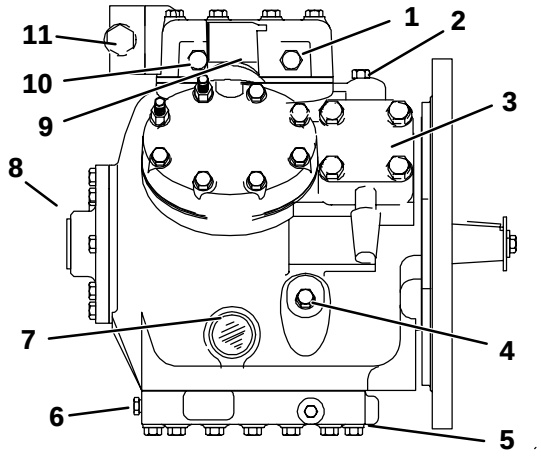
Add correct oil charge (Refer to section 1.3) by removing the oil fill plug (See Figure 4-14)

d. To remove oil from the compressor:

1. Close suction service valve (frontseat) and pump unit down to 0.1 to 0.3 kg/cm@ (2 to 4 psig). Frontseat discharge service valve and slowly bleed remaining refrigerant.

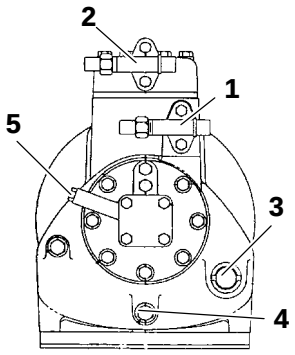
2. Remove the oil drain plug from compressor and drain the proper amount of oil from the compressor. Replace the plug securely back into the compressor.

3. Open service valves and run unit to check oil level. Repeat as required to ensure proper oil level.



1. High Pressure Switch Connection
2. Suction Pressure Transducer Connection
3. Suction Service Valve
4. Oil Fill Plug
5. Bottom Plate
6. Oil Drain Plug
7. Oil Level Sight Glass
8. Oil Pump
9. Unloader Solenoid
10. Discharge Thermistor Connection
11. Discharge Service Valve

Figure 4-13. Compressor -- Model 05G



2 CYLINDER

1. Suction Service Valve
2. Discharge Service Valve
3. Oil Level Sight Glass
4. Oil Drain Plug
5. Oil Fill Plug

Figure 4-14. Compressor -- Model 05K

4.14 COMPRESSOR UNLOADER VALVE

The compressor unloaders (located on the compressor cylinder heads) are controlled by relays UFR,URR and the temperature controller. (refer to Section 1.12)

a. Checkout Procedure

1. Connect manifold gauges to the compressor suction and discharge service valves and start unit in cooling mode with the trailer temperature at least 5_F (2.8_C) above set point. The compressor will be fully loaded (both unloader coils are de-energized). Note suction pressure.

2. Remove wiring from the front unloader coil. Place electrical tape over wire terminals.

3. Set controller upscale (cooler to warmer). This mechanically simulates falling temperature. Approximately 2_F (1.1_C) below box temperature, the unloader coils will energize, but only the rear unloader valve will unload. Note suction pressure. A rise of approximately 3 psig (0.2 kg/cm@) should be noted on the suction pressure gauge.

4. Reconnect wiring on the front unloader. The front unloader will retract and an additional 3 psig (0.2 kg/cm@) rise on the suction gauge will be noted. Compressor is now fully unloaded and only the top bank is loaded (two cylinders).

5. Reverse the above procedure to check compressor loading. Suction pressure will drop with this test.

NOTE

If either unloader coil energizes and the suction pressure does not change, the unloader assembly must be checked.

b. Solenoid Coil Replacement

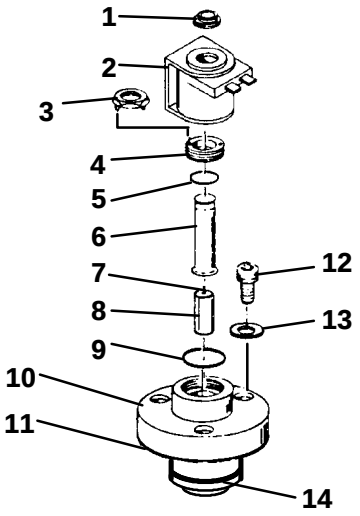
NOTE

The coil may be removed without pumping the unit down.

1. Disconnect leads. Remove retainer. Lift off coil. (see Figure 4-15.)

2. Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.

3. Place new coil over enclosing tube. Add retainer and connect wiring.



1. Retainer
2. Coil Assembly
3. Installation/Removal Tool
4. Enclosing Tube Collar
5. "O" Ring
6. Enclosing Tube
7. Plunger Spring
8. Plunger Assembly
9. Gasket
10. Valve Body
11. Gasket
12. Bolt
13. Gasket, Bolt
14. Piston Ring

Figure 4-15. Unloader Solenoid Valve

c. Replacing Solenoid Valve Internal Parts (See Figure 4-15)

1. Pump down the unit. Frontseat both service valves to isolate the compressor.

2. Remove coil retainer and coil.

3. Remove enclosing tube collar (item 4, Figure 4-15) using installation/removal tool supplied with repair kit (item 3).

4. Check plunger for restriction due to: (a) Corroded or worn parts; (b) Foreign material lodged in valve; (c) Bent or dented enclosing tube.

5. Install new parts. Do not overtighten enclosing tube assembly. Torque to a value of 100 inch pounds (1.15 mkg).

6. Remove supplied installation/removal tool. Install coil, voltage plate, and retainer.

7. Evacuate and dehydrate the compressor. (Refer to Section 4.11.p through 4.11.w.)

8. Start unit and check unloader operation (refer to section 4.14.a).

4.15 CHECKING AND REPLACING FILTER-DRIER

To Check Filter-Drier

Check for a restricted or plugged filter-drier by feeling the liquid line inlet and outlet connections of the drier cartridge. If the outlet side feels cooler than the inlet side, then the filter-drier should be changed.

To Replace Filter-Drier

a. Pump down the unit per Section 4.7. Remove bracket, then replace drier.

b. Check refrigerant level. (Refer to section 4.10.1.)

4.16 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCH

4.16.1 Replacing High Pressure Switch

a. Pump down the unit. (Refer to Section 4.7.a) Frontseat both suction and discharge service valves to isolate compressor.

b. *Slowly* release compressor pressure through the service valve gauge ports.

c. Disconnect wiring from defective switch. The high pressure switch is located near the top of the compressor. (See Figure 4-14)

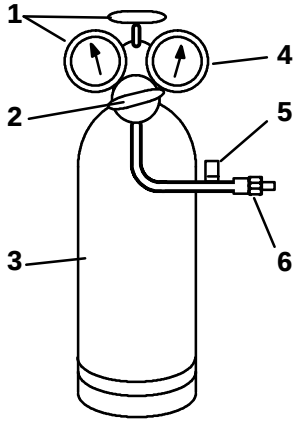
d. Install new cutout switch after verifying switch settings. (Refer to Section 4.16.2)

e. Evacuate and dehydrate the compressor. (Refer to Section 4.11)

4.16.2 Checking High Pressure Switch

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 165 kg/cm@ (2350 psi). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 4-16)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 28 kg/cm@)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-16. Typical Setup for Testing High Pressure Switch

a. Remove switch as outlined in Section 4.16.1.

b. Connect ohmmeter or continuity light across switch terminals. Ohmmeter will indicate resistance and continuity light will be lighted if switch closed after relieving pressure.

c. Connect switch to a cylinder of dry nitrogen. (See Figure 4-16)

d. Set nitrogen pressure regulator higher than cutout point on switch being tested. Pressure switch cutout and cut-in points are shown in Section 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. 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).

4.17 REPLACING RECEIVER SIGHT GLASS ASSEMBLY

NOTE

There are two types of receiver sight glasses; the floating ball type, and the prism type; both are interchangeable.

a. Store the refrigerant in an evacuated container. (Refer to Section 4.7.b)

b. Unscrew the sight glass assembly. Spread some sealing compound on pipe threads of new sight glass assembly and install.

c. Leak check receiver sight glass per Section 4.8.

d. After leak checking unit, evacuate and dehydrate as outlined in section 4.9.

e. Add refrigerant charge. (Refer to Section 4.10)

f. Check for noncondensibles.

4.18 SERVICING SOLENOID VALVES

4.18.1 Solenoid Valves -- Alco

CAUTION

Do not damage or overtighten the enclosing tube assembly. Torque to 200-inch pounds (2.3 mkg). Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burnout.

a. Replacing the Coil

NOTE

The coil may be replaced without removing the refrigerant or pumping the unit down.

1. Disconnect leads. Remove coil retainer and coil assembly.

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

3. Place new coil over enclosing tube. Add retainer and connect wiring.

b. Replacing Solenoid Valve Internal Parts (See Figure 4-17)

The liquid line solenoid valve may be serviced by pumping the unit down. (Refer to section 4.7.a.)

Remove and store the refrigerant charge in an evacuated container to service hot gas solenoid valve. (Refer to Section 4.7.b.)

1. Remove coil retainer and coil assembly from valve. Remove enclosing tube assembly and related items.

2. Check for foreign material in valve body.

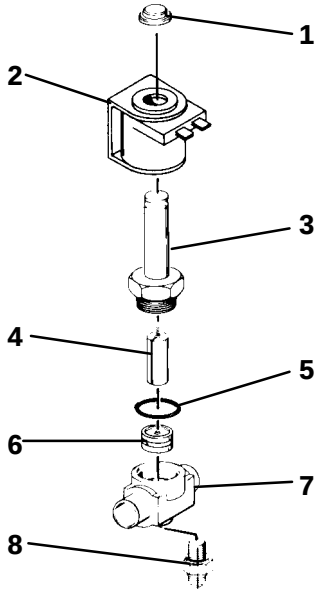
3. Install new parts.

4. Tighten enclosing tube assembly to a torque value of 200 inch pounds (2.3 mkg) and leak check the valve. (Refer to Section 4.8.)

5. Install coil assembly and retainer.

6. Start unit and check refrigerant charge per Section 4.10.1

7. Check refrigeration cycles. (Refer to Section 2.)



1. Retainer
2. Coil Assembly
3. Enclosing Tube Assembly
4. Plunger Assembly
5. Gasket
6. Piston Assembly
7. Body
8. Bracket Adapter

Figure 4-17. Solenoid Valve -- Alco

4.18.2 Solenoid Valve -- Sporlan

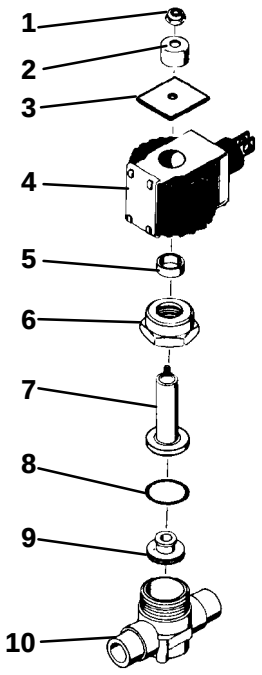
a. Replacing the Coil

NOTE

The coil may be replaced without removing the refrigerant or pumping the unit down.

1. Remove top locknut, spacer cup and nameplate.
2. Disconnect wiring and remove coil.
3. Replace coil by reversing steps 1 and 2.

b. Replacing Internal Components (See Figure 4-18)



1. Locknut/Screw
2. Spacer Cup
3. Nameplate
4. Coil
5. Spacer
6. Locknut
7. Enclosing Tube
8. Gasket
9. Seat Disc
10. Body

Figure 4-18. Solenoid Valve (MHV) -- Sporlan

1. Remove and store the refrigerant charge in an evacuated container. (Refer to Section 4.7.b)

2. Remove the top locknut, spacer cup, nameplate, coil assembly and spacer.

3. Using a 12 point, 1-3/8 inch box wrench, loosen the enclosing tube locknut and bleed off remaining refrigerant.

4. Remove enclosing tube and locknut assembly. The gasket is inside the enclosing tube.

5. Remove seat disc from inside of body and check for obstructions and foreign material.

6. Place the seat disc into the valve body with the smaller diameter end facing up.

7. Place the enclosing tube locknut over the enclosing tube. Install spacer over enclosing tube making sure it is seated properly in the enclosing tube locknut. Tighten enclosing tube locknut to a torque value of 20 ft-lb (2.78 mkg). Do not overtighten.

8. Install coil assembly, nameplate and top locknut or screw.

9. Dehydrate and evacuate the system. (Refer to Section 4.9) Charge unit with refrigerant per Section 4.10.

10. Start unit and check operation.

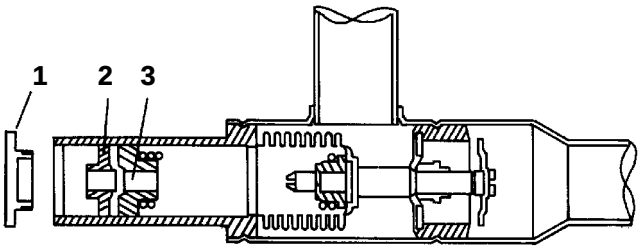
4.19 CONDENSER COIL CLEANING

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.

4.20 ADJUSTING THE COMPRESSOR PRESSURE REGULATING VALVE (CPR)

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 4-19. Compressor Pressure Regulating Valve

To adjust the CPR valve, proceed as follows:

a. Install a manifold gauge set.

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

c. With an 8 mm Allen wrench, loosen the jam nut (Figure 4-19, 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 1.5 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 vibration in the unit. Replace the cap.

4.21 MICROPROCESSOR

NOTE

The erasable, programmable, read only memory (EPROM) chip (component U3 on the microprocessor logic board) has a window on it which is covered with a label listing the revision level of the software. The window is used to erase the chip's memory with the use of ultraviolet light. The label prevents light from entering the chip and erasing the memory. Under NO circumstances should this label be removed.

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.

As mentioned above, some microprocessor inputs operate at voltage levels other than the conventional 12 vdc. Connector points and the associated approximate voltage levels are listed below for reference only. Under no circumstances should 12 vdc be applied at these connection points.

Grounded wrist cuffs are available at most radio, computer and electronic supply stores. It is recommended that these be worn whenever handling a microprocessor.

Table 4-3. Connection Point Voltage

Connection Point	Approximate Voltage
CDT, RAS, WTS	2.5 vdc (Variable)
MPF1	5.0 vdc

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 truck/trailer 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.

During emergency situations, the test board may be used to keep a unit running and prevent a critical load from spoiling. Since the microprocessor is totally disconnected from the unit, it cannot monitor the engine's safety switches for oil pressure and coolant temperature. *Since the engine is running unprotected when the test board is used,* it is imperative that should a problem develop with the microprocessor, it be replaced immediately. *The test board is intended to be a trouble-shooting tool only.*

When using the test board to troubleshoot, the unit should be started in low speed, unloaded cool in the same way as when the processor starts the unit. *Good judgment should also be used when cycling any unit with the test board. Rapid cycling should be avoided.*

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 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.

a. Replacing Key Board (Trailer Unit)

Should damage to the Key Board of the microprocessor occur, it is possible to replace only the Key Board.

It is absolutely imperative that whenever a microprocessor is removed from a unit for any reason, that the old Key Board gasket be removed, and a new one be installed. All replacement microprocessors and Key Boards are packaged with replacement gaskets for this purpose.

The tightening sequence shown below should be adhered to when tightening the retaining bolts or nuts. The recommended torque for securing nuts or bolts is 15 inch-lbs. Over tightening the nuts or bolts, or using a tightening sequence other than the one shown, may cause warping of the Key Board.

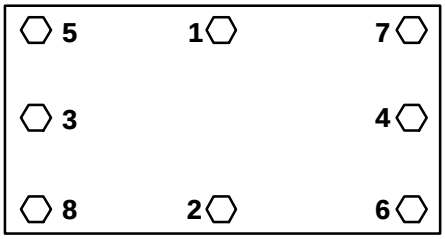


Figure 4-20. Tightening Sequence for Microprocessor (Trailer Unit)

b. Hour Meter

The hour meter can be set to any value via the serial port, if the meter has less then five hours on it. This allows a replacement microprocessor to be set to the same hours as the microprocessor it is replacing.

The microprocessor has two programmable registers which are set via the serial port. These registers are compared to one of the hour meters (diesel, standby, or switch on). If the hour meter is greater than the register then the proper alarm is set.

4.22 CONFIGURATION OF MICROPROCESSOR

When replacing a microprocessor it is important to check that the configurations are compatible for the unit into which it will be installed. (This same board fits both trailer and truck model units.) All configuration fields should be viewed before starting the unit.

To reach the configuration fields:

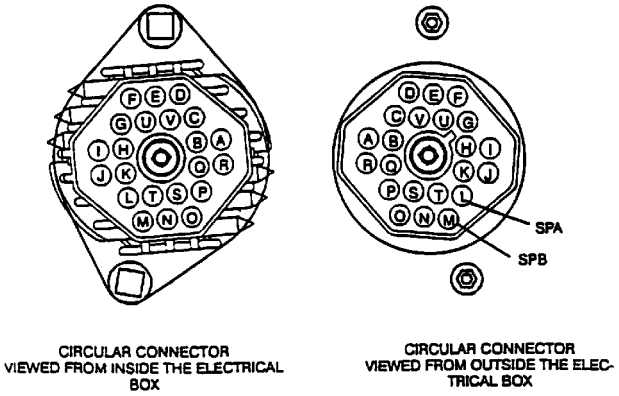
1. Turn the Run/Stop switch to the Stop position.

2a. Trailer units only – With the unit off, locate the serial port plug located below the control panel. Remove the protective plug to gain access to the wire terminals. Place an insulated jumper wire between wires SPA and SPB at the serial port plug.

2b. Truck units only – Place an insulated jumper wire between plug terminals L (SPA) and M (SPB) in the "CC" plug (see plug drawing below for terminal locations.)

CAUTION

Do not allow jumper wire to touch any ground.



CIRCULAR CONNECTOR VIEWED FROM INSIDE THE ELECTRICAL BOX

CIRCULAR CONNECTOR VIEWED FROM OUTSIDE THE ELECTRICAL BOX

3. Turn the Run/Stop switch to the Run position. The FAULT light will come on, and the micro display will read "CNF1 TV" or "CNF1 DI". Remove the jumper wire from the serial port and reinstall the protective plug. The configuration screen will now remain available for 5 minute. Scroll through the configuration list using the *Function Key* and compare the settings with those shown on the table in the next column. If any of the configurations need to be changed, continue with step (4) below.

4. To change the configuration selection:

a. Bring the configuration to be changed onto the display. Press the *Enter Key* to allow change access to the displayed configuration.

b. Press either the *Up or Down Keys* to display available selections for that configuration. Leave the correct selection on the screen. The selection display will flash, warning the operator that the displayed value has not been entered. Press the *Enter Key* to enter the new selection into memory. (The display will revert to the original selection if no further action is taken for the next five seconds.)

c. Continue to scroll through the configuration list by pressing the *Function Key*. Change any other configurations as required.

d. When finished turn the Run/Stop switch to the Stop position, then back to the Run position to start the unit.

Configuration		Description
CNF1	OFF	DI Engine
	ON	TV Engine
CNF2	OFF	CDT not used
	ON	CDT used
CNF3	OFF	86_ Setpoint
	ON	90_ Setpoint
CNF4	OFF	Heat lockout on +10_F
	ON	Heat lockout off (Truck units)
CNF5	–	Not Used
CNF6	OFF	Trailer unit
	ON	Truck unit
CNF7	OFF	High speed start (Truck unit)
	ON	Low speed start (Trailer unit)
CNF8	OFF	Belt driven fans
	ON	Electric fan motors
CNF9	OFF	Out-of-range alarm
	ON	Out-of-range alarm and unit shut down
CNF10	–	Not Used
CNF11	OFF	Functions normal
	ON	Functions locked
CNF12	–	Not Used
CNF13	–	Not Used
CNF14	–	Not Used
CNF15	–	Not Used
CNF16	OFF	Alt aux alarm only
	ON	Alt aux alarm shut unit down

4.23 CONTROLLER SENSOR CHECKOUT

An accurate ohmmeter must be used to check resistance values shown in Table 4-4.

Due to variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within 2% of the chart value would indicate a good sensor. If a sensor is bad, the resistance reading will usually be much higher or lower than the resistance values given in Table 4-4.

At least one lead from the sensor (1RA, terminals D1 or E1) must be disconnected from the unit electrical system before any reading is taken. Not doing so will result in a false reading. Two preferred methods of determining the actual test temperature at the sensor, are an ice bath at 0_C (32_F) or a calibrated temperature tester.

Table 4-4. Sensor Resistance -- Micro Units (CDT,1 RA, 2RA, 3RA & WTS)

Temperature		RAS & WTS Resistance In Ohms	CDT Resistance In Ohms
_F	_C		
–20	–28.9	165,300	1,653,000
–10	–23.3	117,800	1,178,000
0	–17.8	85,500	855,000
10	–12.2	62,400	624,000
20	– 6.7	46,300	463,000
30	– 1.1	34,500	345,000
32	0	32,700	327,000
40	4.4	26,200	262,000
50	10.0	19,900	199,000
60	15.6	15,300	153,000
70	21.1	11,900	119,000
77	25	10,000	100,000
80	26.7	9,300	93,000
90	32.2	7,300	73,000
100	37.8	5,800	58,000
110	43.3	4,700	47,000
120	48.9	3,800	38,000
194	90	915	9,150
212	100	680	6,800
266	130	301	3,010
302	150	186	1,860

4.24 SUCTION PRESSURE TRANSDUCER

A new suction pressure transducer must be calibrated, before it is installed .

The calibration will not be performed if the run relay is energized. This prevents the operator from calibrating the unit with the sensor in the system. The reading of the sensor must be at atmospheric pressure (0 psig or 14.7 psi). If the sensor reading is greater than 20 psig (34.7 psi) or less than –6.7 psig (8 psi) it cannot be calibrated. Once the microprocessor is calibrated, the display will readout the actual value.

a. Turn power off and remove starter solenoid wire, then let unit fail to start. This will de-energize run relay.

b. Connect wiring to new suction pressure transducer. Before installing suction pressure transducer into unit, display the suction pressure via the unit status display. While the suction pressure is being displayed press *Enter Key* for three seconds. The display should read “0”. If display reads “0” install suction pressure transducer into unit.

Table 4-5. Suction Pressure Transducer Voltage

Psig	Voltage	Psig	Voltage	Psig	Voltage
20”	0.369	30	0.761	70	1.155
10”	0.417	35	0.810	75	1.204
0	0.466	40	0.860	80	1.253
5	0.515	45	0.909	85	1.303
10	0.564	50	0.958	90	1.352
15	0.614	55	1.007	95	1.401
20	0.663	60	1.056	100	1.450
25	0.712	65	1.106		

4.25 5KW GENERATOR -- TRAILER

The 5KW generator requires very little preventative maintenance to ensure good performance.

Belt tension should be maintained at 50 ft-lbs.

When trouble-shooting the 5KW generator, it is important to check the internal capacitor, the forward/reverse rotating diodes, and the internal windings.

The forward/reverse rotating diodes are located at the filter end of the generator. The reverse diode is marked with a red dot on the solder terminal. The forward diode is unmarked. A faulty diode will give a short circuit or open circuit reading in both directions.

Generally, premature capacitor failure can be attributed to over-speeding or over-heating of the generator. The maximum speed for the generator is 3600 rpm. Setting engine speed on multi-temp units is critical to proper operation of the generator. The engine speed should be set to 1500 rpm with unit operating in fully loaded high speed cool mode, with all compartments turned on. Refer to Table 4-6 for corresponding generator voltage output.

Table 4-6. Generator Voltage Output

Engine RPM	Generator RPM	Volts / HZ.
1530	3600	240 /60

A generator fault finding guide is shown in Figure 4-21. This should be used whenever troubleshooting a problem with a 5KW generator.

ROTOR	MAIN STATOR PER SECTION	AUXILIARY WINDING
10.7 Ohms	0.89 Ohms	1.18 Ohms
The rotating diodes can be tested during this same operation. The diode(s) must be removed from the circuit to test either diode or rotor winding resistance.	Disconnect each lead and test resistance between U1 & U2 and U5 & U6. (Note: Unit wiring must be disconnected from generator for this test.)	Remove the wires from capacitor to test.

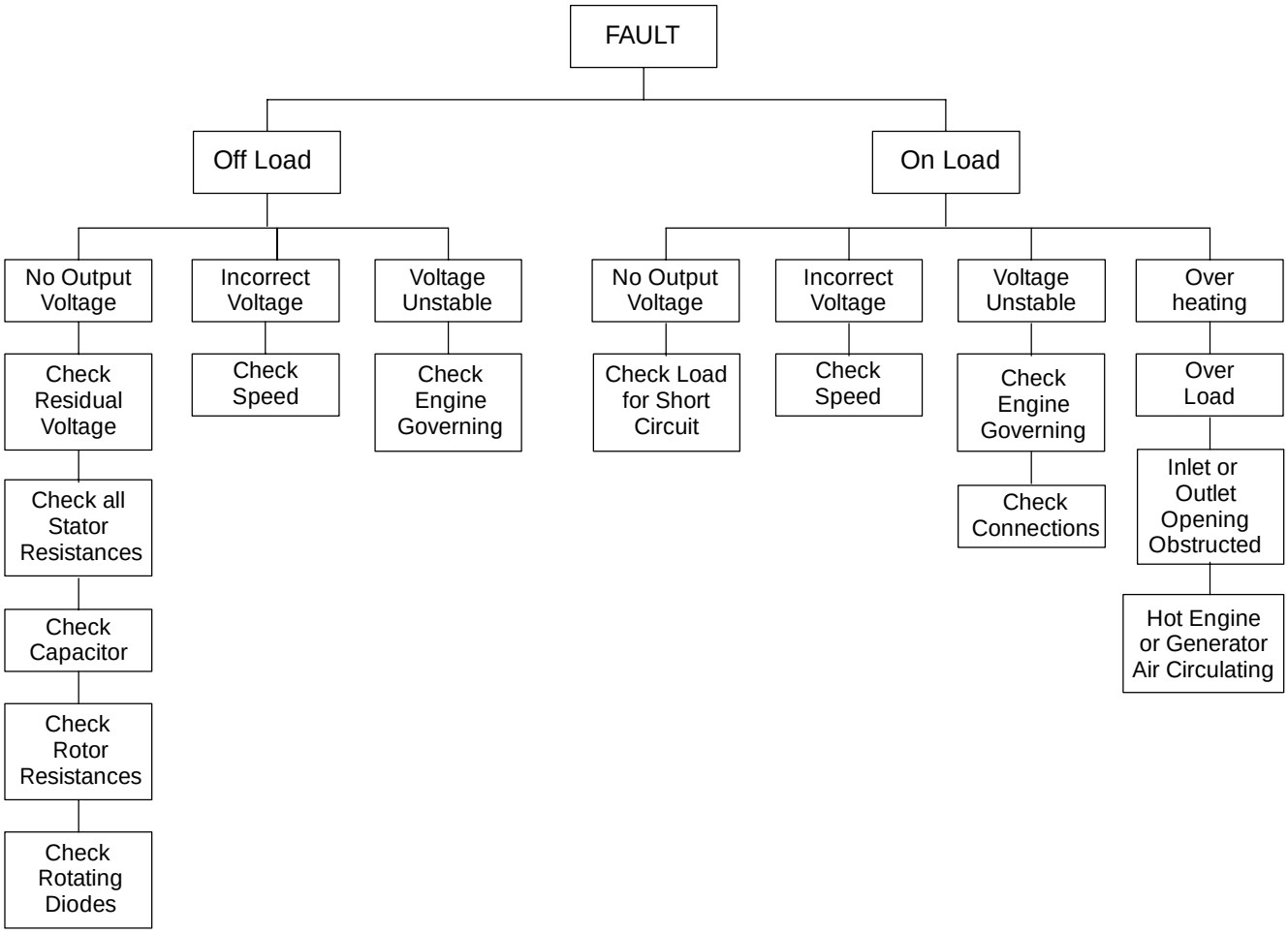


Figure 4-21. Generator Fault Finding Guide

4.26 SINGLE PHASE ALTERNATOR (GENERATOR) -- TRUCK

The single phase alternator is mounted under the compressor. The belt drive arrangement ensures that when the diesel engine is in high speed, the alternator delivers 240 vac 60Hz and when the diesel engine is in low speed the generator delivers 240 vac 50Hz.

The alternator has a brushless compound excitation, using an auxiliary phase capacitor to provide the self excitation. The alternator has only one rotating component, no electronic controls and sealed-for-life bearings, combining simplicity with reliability.

a. Checking Capacitor

1. Unscrew top plastic cover.

2. Disconnect capacitor wires. Connect capacitor to a main voltage with a switch and an ammeter to read current (see table below).

Capacitor MF	220/50 Hz IA	240/60 Hz IA
12	0.83	1.08

b. Fault Finding Parts to be Checked -- Without Load

Fault	Cause	Action to take
No voltage with no load when starting	Loss of residual magnetism	Apply a battery 4.5 V to capacitor terminals. Load alternator and run engine above nominal speed for a few seconds.
	Defective capacitor	Change capacitor
	Rotor diode out of order or short circuit	Change 2 diodes on rotor
	Winding short circuit or loose connections	Check resistance of coils
Voltage with no load less than 80% of nominal voltage	Speed of engine low	Set engine speed Refer to 1.2
	1 rotor diode out of order or short circuit	Change 2 diodes on rotor
	short circuit in winding	Check resistance of coils
To high Voltage with no load	Speed of engine high	Set engine speed Refer to 1.2

c. Fault Finding Parts to be Checked -- With Load

Fault	Cause	Action to take
Correct voltage with no load, low voltage with load	Rotor diode out of order or short circuit	Change 2 diodes on rotor
	The engine slows down or stalls	Check engine
		Check value of load
Excessive heat (over heating)	Ventilator holes partially blocked	Dismantle and clean

4.27 SERVICING PHASE SEQUENCE

WARNING
High voltage in electrical box. Disconnect power before servicing unit.

One of the phase relays (PR-1 or PR-2) must pull-in when power is applied to the unit.

To check Phase Sequence Module:

a. Verify that three phase power exists on supply side and that the same voltage is present between terminals H4 and 46 on the phase sequence module. (See Figure 4-22)

b. Verify that 17 to 26 vac exists between terminals 4 and X2 on module.

c. If 17 to 26 vac does not exist between either terminals 5 and X2, or 6 and X2 on the module, module is defective and should be replaced.

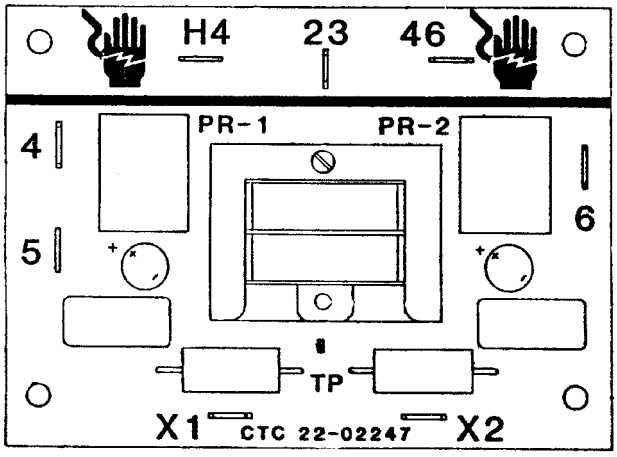


Figure 4-22. Phase Sequence Module

4.28 TORQUE VALUES -- TRUCK

Assembly	kg--m	ft--lb
Power Tray to Frame	5.5	40
Standby Motor to Power Tray	5.5	40
Engine to Power Tray	7.0	50
Compressor to Power Tray	5.5	40
Standby Motor Pulley	4.5	32
Engine Pulley	3.0	22
Compressor Pulley	3.0	22
Evaporator Fan Motor	1.8	13
Evaporator Fan Grille	1.0	7
Condenser Coil to Chassis	1.0	7
Tensioner to Power Tray	3.0	22
Engine Support	5.5	40
Run & Speed Solenoids	1.0	7
Condenser Fan Blade	2.5	18
Engine Clutch	5.5	40
Alternator 1ph	4.0	28

4.29 UNIDRIVE TORQUE REQUIREMENTS -- TRAILER

Extensive damage may occur if the proper hardware and procedures are not followed. Periodic inspection of hardware and bolt torque is recommended to insure the integrity of the unidrive.

NOTE
Thread locking sealant, 5/16 flat washer and 5/16 lock washer *must* be used on bolts between the compressor mounting flange and the adapter spacers. The recommended sealant is Loctite screw lock no. 262.

Figure 4-23 shows the torque value, size and grade of hardware to be used when reassembling the unidrive assembly.

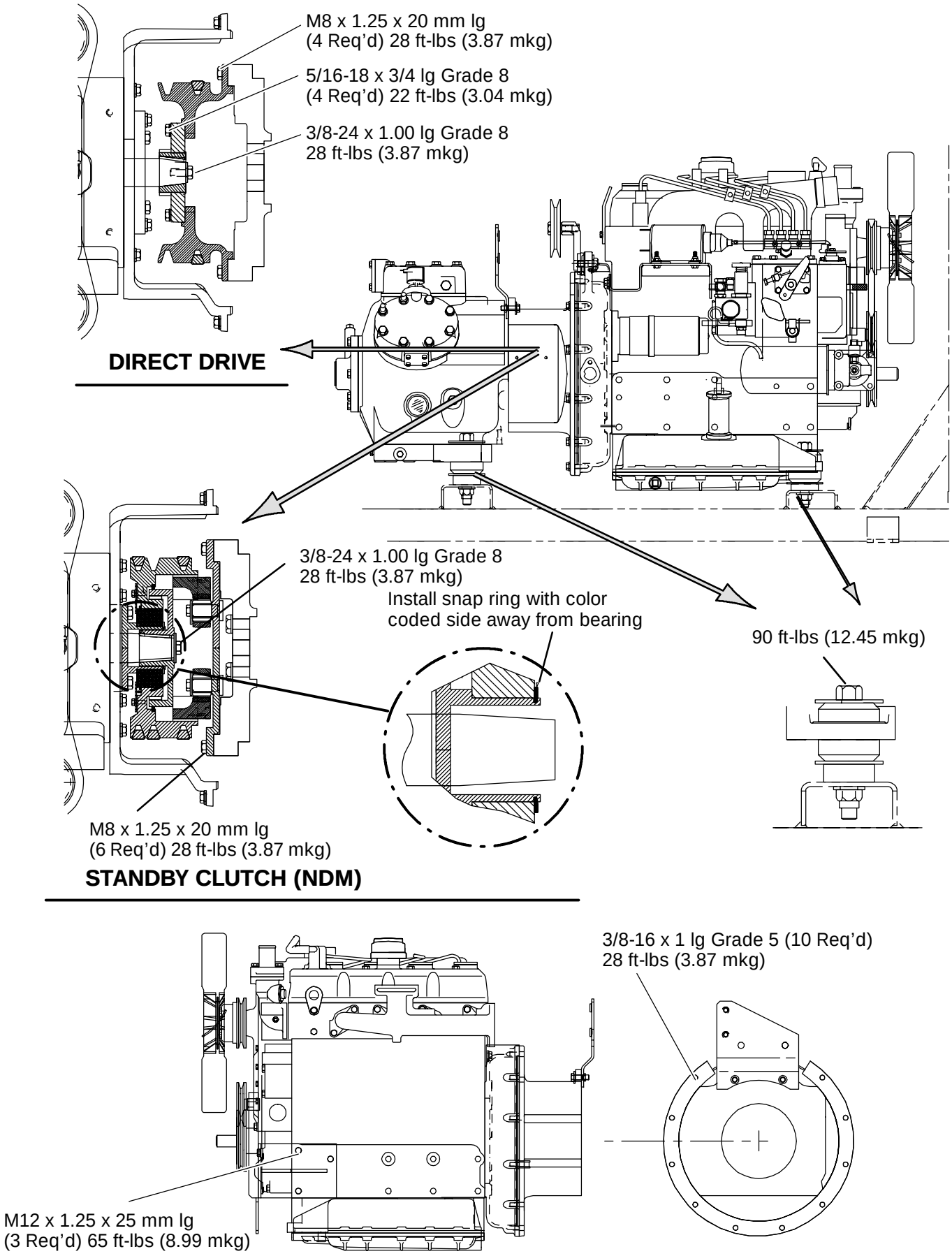


Figure 4-23. Genesis TR1000 -- Unidrive Torque Requirements

4.30 THERMOSTATIC EXPANSION VALVE

The thermal expansion valve is an automatic device that 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.

a. Replacing Expansion Valve

1. Pump down the unit by closing the receiver service valve (king valve). (Refer to section 4.7.a)

2. Remove insulation from expansion valve bulb. Note position of bulb in relation to the suction line. Remove bulb from suction line.

3. Loosen the ORS fitting nut on the liquid line and remove "O" Ring.

4. Wrap valve in wet rags to act as a heat sink (it is imperative that no moisture enter the system). Unsolder the equalizer line and distributor pipe from the valve and remove the valve.

5. Clean the suction line where the bulb is located.

6. Solder the equalizer line and distributor pipe into the valve.

7. Install the new valve after smearing the ORS fitting with clean refrigerant oil. Tighten the liquid line nut.

CAUTION

Overheating the expansion valve body can cause the valve to malfunction.

8. Install the thermal bulb in the correct position. Tighten the clamp and re-insulate.

9. Install new drier.

10. Evacuate by placing a vacuum pump on the suction service valve.

11. Open the receiver service valve and check the refrigerant level.

12. The valve should be factory pre-set. If the unit is slow in pulling temperature, or the pressures do not correspond to the relevant temperature, check superheat.

b. Checking Superheat

NOTE

It is not recommended to adjust the Superheat unless absolutely necessary.

The valve is pre-set at the factory . Make sure that all other problems are diagnosed and rectified prior to adjusting the superheat. Due to the time involved in setting the superheat, it is recommend to replace the valve rather than adjust it.

c. To Measure Superheat

The three thirds dual flow evaporators and the two thirds dual flow evaporators use two expansion valves. Setting the superheat on these evaporators will be dealt with separately. All the other evaporators used in Multi-Temp the superheat can be measured as follows:

CAUTION

Always make sure that only one evaporator is working. Adjust one evaporator and then switch that evaporator off and adjust the other evaporators.

The air outlet profiles must be in their widest position and no obstruction to the airflow should be present.

The unit should be in high speed cool.

The unloaders should be disconnected if fitted to make sure compressor is working at maximum efficiency.

The Superheat check should be carried out inside a workshop or with a minimum air ambient of 5˚C.

The coil should be clean and free of ice.

1. Remove Presstite 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.

4. Connect an accurate gauge to the 1/4" port on the suction service valve.

5. Open the CPR valve fully by turning the adjusting screw clockwise until valve is fully open.

6. Run unit until stabilized at 0_C.

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

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

9. Subtract the saturation temperature determined in Step 7 from the average temperature measured in Step 8. The difference is the superheat of the suction gas.

e. Adjusting Superheat

One thirds Dual flow and three thirds Dual flow evaporators have two expansion valves per evaporator.

CAUTION

Make sure only one evaporator is operating and that the air outlet profiles are fully open. No obstruction to the airflow should be present.

The unit should be in high speed cool.

The unloaders should be disconnected if fitted to make sure compressor is working at maximum efficiency.

The Superheat check should be carried out inside a workshop or with a minimum air ambient of 5˚C.

The CPR valve should be fully open. The coil should be clean and free of ice.

Remove the Presstolite from both bulbs and loosen the clamps. Put a thermocouple above (parallel) TXV bulb next to each bulb. Retighten clamp and re-insulate with Presstolite. Make the standard adjustment to both expansion valves which is unscrew completely the superheat setting screw in the counter-clockwise direction. Then, tighten three turns (3X360˚) in the clockwise direction.

Allow the unit to stabilize at 0˚C, making sure that the unit is in high speed cool.

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

Subtract the saturation temperature taken from the suction gauge to determine superheat.

Adjust each valve, a ¼ turn at a time, allowing the unit to stabilize between adjustments. Always adjust both valves equally to avoid priority of refrigerant to any evaporator coil.

4.31 REPLACING EVAPORATOR FAN MOTOR

Remove two retaining screws which hold the door assembly in position. The complete hinged assembly drops down, allowing access to the fan.

Disconnect wires in terminal box relative to fan being removed. Remove four bolts and fan assembly.

Fit new fan to mounting plate. Install fan assembly into evaporator.

4.32 EVAPORATOR COIL CLEANING

The use of recycled cardboard cartons is increasing across the country. The recycled cardboard cartons create much more fiber dust during transport than "new" cartons. 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.

The evaporator coil should be cleaned on a regular basis, not only to remove cardboard dust, but to remove any grease or 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. Remove rubber check valves (Kazoo) from drain lines.

b. Spray coil with a mild detergent solution such as Oakite 164 or any good commercial grade automatic dish washer detergent such as Electrosol or Cascade 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.

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

4.33 EVAPORATOR ELECTRICAL CONNECTIONS

All wiring harnesses to the evaporator section are identical. The only difference is the length.

WARNING

For safety, when disconnecting the harness at the condensing section end for testing purposes, always leave the separate earth cable connected.

A seventeen core cable is provided with a multi-pin connector on one end to connect directly to the condensing section. The other end of the cable is color coded to allow easy connection in the evaporator. When there are two wires of the same color, they will be numbered: i.e. yellow (1) yellow (2) / brown (1) brown (2)

Color	Wire
Yellow 1	Defrost termination sensor
Yellow 2	
Black 1	Return air sensor (B)
Black 2	Return air sensor (A)
Orange	Heater element safety klixon
Grey	Door switch
Red	Heater element
White	Liquid line solenoid valve
Red	Heater element
Purple	Hot gas solenoid valve
Red	Heater element
Dark blue	Door switch
Green	Earth
Blue	Live from alternator
Brown	Neutral – " – alternator
Green/Yellow	Earth

Table 4-7. R-404A Pressure -- Temperature Chart

To determine superheat use dew point (vapor) values.
To determine subcooling use bubble point (liquid) values **(shaded numbers)**.

* Based on Du Pont publication T-HP62-ENG dated 12/93.

Temperature		Pressure		
_F	_C	Psig	Kg/cm@	Bar
−40	−40	4.5	0.32	0.31
−35	−37	7.1	0.50	0.49
−30	−34	9.9	0.70	0.68
−25	−32	12.9	0.91	0.89
−20	−29	16.3	1.15	1.12
−18	−28	17.7	1.24	1.22
−16	−27	19.2	1.35	1.32
−14	−26	20.7	1.46	1.43
−12	−24	22.3	1.57	1.54
−10	−23	23.9	1.68	1.65
−8	−22	25.6	1.80	1.77
−6	−21	27.3	1.92	1.88
−4	−20	29.1	2.05	2.01
−2	−19	30.9	2.17	2.13
0	−18	32.8	2.31	2.26
2	−17	34.8	2.45	2.40
4	−16	36.8	2.59	2.54
6	−14	38.9	2.73	2.68
8	−13	41.1	2.89	2.83
10	−12	43.3	3.04	2.99
12	−11	45.6	3.21	3.14
14	−10	48.0	3.37	3.31
16	−9	50.4	3.54	3.47
18	−8	52.9	3.72	3.65
20	−7	55.5	3.90	3.83
22	−6	58.1	4.08	4.01
24	−4	60.9	4.28	4.20
26	−3	63.7	4.48	4.39
28	−2	66.5	4.68	4.59
30	−1	69.5	4.89	4.79

Temperature		Pressure		
_F	_C	Psig	Kg/cm@	Bar
32	0	72.5	5.10	5.00
34	1	75.6	5.32	5.21
36	2	78.8	5.54	5.43
38	3	82.1	5.77	5.66
40	4	85.5	6.01	5.90
42	6	89.0	6.26	6.14
44	7	92.5	6.50	6.38
46	8	96.2	6.76	6.63
48	9	99.9	7.02	6.89
50	10	103.7	7.29	7.15
55	13	115.4	8.11	7.96
60	16	126.1	8.87	8.69
65	18	137.4	9.66	9.47
70	21	149.4	10.50	10.30
75	24	162.1	11.40	11.18
80	27	175.5	12.34	12.10
85	29	189.6	13.33	13.07
90	32	204.5	14.38	14.10
95	35	220.2	15.48	15.18
100	38	236.8	16.65	16.33
105	41	254.2	17.87	17.53
110	43	272.4	19.15	18.78
115	46	291.6	20.50	20.11
120	49	311.8	21.92	21.50
125	52	332.9	23.41	22.95
130	54	355.0	24.96	24.48
135	57	378.1	26.58	26.07
140	60	402.3	28.28	27.74
145	63	427.6	30.06	29.48
150	66	454.0	31.92	31.30

SECTION 5
ELECTRICAL SCHEMATIC WIRING DIAGRAM

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, V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run - Stop switch is in the STOP position. Also disconnect the negative battery cable.

WARNING

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

WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (see section 4.21) 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. 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 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 truck/trailer microprocessor.

LOCATION	SYMBOL	DESCRIPTION	LOCATION IN FRAME
P-2/R-11,12,13	ALT	ALTERNATOR	MID FRAME
K-9	B	BUZZER	CONTROL BOX
N-1	BTY	BATTERY	
O-5	CAR	CAPACITOR ALTERNATOR RELAY	CONTROL BOX
B-8	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR	COMPRESSOR
I-9/M-8	1CR	COOL RELAY (1st COMPARTMENT)	CONTROL BOX
I-10/M-10	2CR	COOL RELAY (2nd COMPARTMENT)	CONTROL BOX
I-10/M-12	3CR	COOL RELAY (3rd COMPARTMENT)	CONTROL BOX
I-7/N-9/N-11/N-13	DCR	DEFROST COMPARTMENT RELAY	CONTROL BOX
H-8/Q-3	DER	DIESEL ELECTRIC RELAY	CONTROL BOX
A-1	DPS	DETECTOR POWER SUPPLY	CONTROL BOX
O-9/R-5	1DR	DEFROST RELAY (1st COMPARTMENT)	CONTROL BOX
O-11/R-5	2DR	DEFROST RELAY (2nd COMPARTMENT)	CONTROL BOX
O-13/R-6	3DR	DEFROST RELAY (3rd COMPARTMENT)	CONTROL BOX
S-7	1DS	DOOR SWITCH (1st COMPARTMENT)	EVAPORATOR
S-7	2DS	DOOR SWITCH (2nd COMPARTMENT)	EVAPORATOR
S-8	3DS	DOOR SWITCH (3rd COMPARTMENT)	EVAPORATOR
B-8	1DTS	DEFROST THERMISTOR SENSOR (1st COMPARTMENT)	EVAPORATOR
B-7	2DTS	DEFROST THERMISTOR SENSOR (2nd COMPARTMENT)	EVAPORATOR
B-7	3DTS	DEFROST THERMISTOR SENSOR (3rd COMPARTMENT)	EVAPORATOR
P-9/P-10/P-12	1,2,3DWR	DRAIN WATER RESISTANCE (1st,2nd,3rd)	EVAPORATOR
T-5	EFB	ELECTRIC FAN BOARD	CONTROL BOX
I-10	1EHR	ELECTRIC HEAT RELAY (1st COMPARTMENT)	CONTROL BOX
I-10	2EHR	ELECTRIC HEAT RELAY (2nd COMPARTMENT)	CONTROL BOX
I-11	3EHR	ELECTRIC HEAT RELAY (3rd COMPARTMENT)	CONTROL BOX
K-2	F1	FUSE (MAXI FUSE 80A)	CONTROL BOX
K-3/K-8	F3,F8	FUSE 25A	CONTROL BOX
K-4	F4	FUSE 15A	CONTROL BOX
K-5	F5	FUSE 7.5A	CONTROL BOX
D-1/K-8	F2,F6	FUSE 5A	CONTROL BOX
M-8/M-10/M-12	F9,F10,F11	FUSE 5A	CONTROL BOX
H-11	FLR	FLASHING RELAY	CONTROL BOX
O-9	FH	FUEL HEATER (OPTION)	ENGINE
R-2/L-8	FHR	FUEL HEATER RELAY (OPTION)	CONTROL BOX
S-2	FHTH	FUEL HEATER THERMOSTAT (OPTION)	ENGINE
H-9/H-8	FR	FAULT RELAY	CONTROL BOX
S-3	FP	FUEL PUMP	FUEL TANK
O-4	GP	GLOW PLUG	ENGINE
L-4/H-6	GPR	GLOW PLUG RELAY	CONTROL BOX

LOCATION	SYMBOL	DESCRIPTION	LOCATION IN FRAME
I-8/M-8	1HGR	HOT GAS RELAY (1st COMPARTMENT)	CONTROL BOX
I-8/M-10	2HGR	HOT GAS RELAY (2nd COMPARTMENT)	CONTROL BOX
I-9/M-12	3HGR	HOT GAS RELAY (3rd COMPARTMENT)	CONTROL BOX
O-8	1HGV	HOT GAS VALVE (1st COMPARTMENT)	EVAPORATOR
O-10	2HGV	HOT GAS VALVE (2nd COMPARTMENT)	EVAPORATOR
O-12	3HGV	HOT GAS VALVE (3rd COMPARTMENT)	EVAPORATOR
H-5	HP1	HIGH PRESSURE CUT-OUT SWITCH	COMPRESSOR
I-10	1HT	HEAT THERMOSTAT (1st COMPARTMENT)	EVAPORATOR
I-10	2HT	HEAT THERMOSTAT (2nd COMPARTMENT)	EVAPORATOR
I-11	3HT	HEAT THERMOSTAT (3rd COMPARTMENT)	EVAPORATOR
L-1	IP1	INSULATING PLUG 1	CONTROL BOX
R-3	IP2	INSULATING PLUG 2	FRAME
B-2	J1	JUMPER 1	CONTROL BOX
O-8	1LSV	LIQUID SOLENOID VALVE (1st COMPARTMENT)	EVAPORATOR
O-10	2LSV	LIQUID SOLENOID VALVE (2nd COMPARTMENT)	EVAPORATOR
O-12	3LSV	LIQUID SOLENOID VALVE (3rd COMPARTMENT)	EVAPORATOR
J-10	MGC	MANUAL GLOW/CRANK	CONTROL BOX
H-8/M-6	MHR	MAIN HEAT RELAY	CONTROL BOX
O-6	MHV	MAIN HEAT VALVE	FRAME
D-11/D-2	MP	MICROPROCESSOR BOARD	CONTROL BOX
G-2	OP	OIL PRESSURE SAFETY SWITCH (NO)	ENGINE
B-3	P1	CAB COMMAND PLUG CONNECTOR	CONTROL BOX
D-3	P2	MICROPROCESSOR-CAB COMMAND PLUG CONNECTOR	CONTROL BOX
B-6	1RAS	RETURN AIR SENSOR (1st COMPARTMENT)	EVAPORATOR
B-9	2RAS	RETURN AIR SENSOR (2nd COMPARTMENT)	EVAPORATOR
B-10	3RAS	RETURN AIR SENSOR (3rd COMPARTMENT)	EVAPORATOR
C-2/D-1	RCR	RUN CONTROL RELAY	CONTROL BOX
S-3	RC	RUN COIL	ENGINE
S-9/Q-5	1RR	RUN RELAY (1st COMPARTMENT)	CONTROL BOX
S-10/Q-6	2RR	RUN RELAY (2nd COMPARTMENT)	CONTROL BOX
S-11/Q-6	3RR	RUN RELAY (2rd COMPARTMENT)	CONTROL BOX
C-1	RS	RUN SWITCH	CONTROL BOX
O-4	SCS	SPEED CONTROL SOLENOID	ENGINE
Q-2	SM	STARTER MOTOR	ENGINE
F-2	SP	SERIAL PORT	CONTROL BOX
B-5	SPT	SUCTION PRESSURE TRANSDUCER	CONPRESSOR
L-4/H-9	SR	SPEED RELAY	CONTROL BOX
O-3	SS	STARTER SOLENOID	STARTER
P-2	SSC	STARTER SOLENOID CONTACTOR	STARTER
L-3/H-6	SSR	STARTER SOLENOID RELAY	CONTROL BOX
B-5	WTS	WATER TEMPERATURE SENSOR	ENGINE
Q-9	1ST	START-STOP SWITCH (1st COMPARTMENT)	CAB COMMAND
Q-9	2ST	START-STOP SWITCH (2nd COMPARTMENT)	CAB COMMAND
Q-9	3ST	START-STOP SWITCH (3RD COMPARTMENT)	CAB COMMAND

Figure 5-1. Truck Units – Electrical Schematic Wiring Diagram Dwg. No. 62-60251 (Sheet 1 of 2)

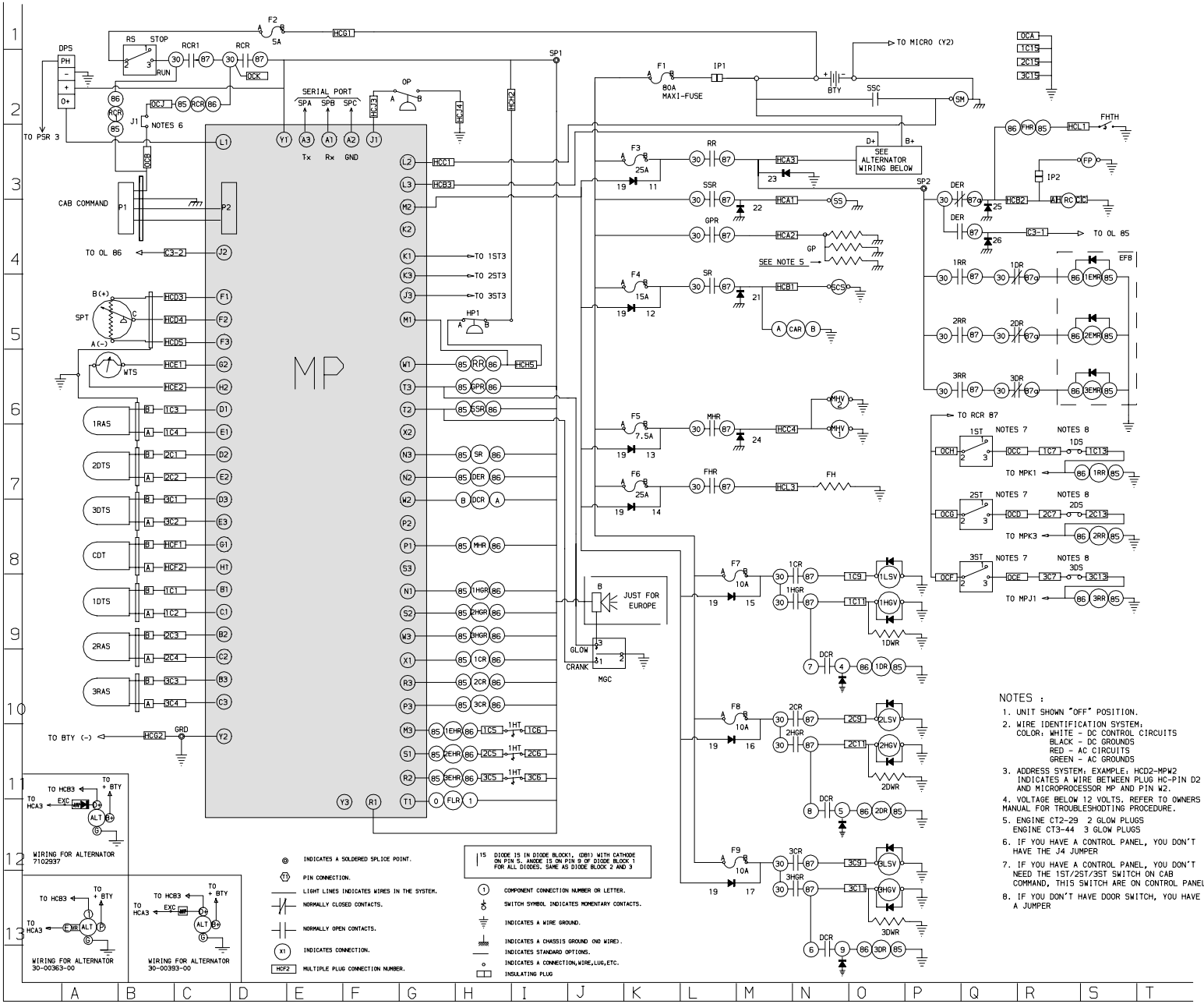


Figure 5-1. Truck Units – Electrical Schematic Wiring Diagram Dwg. No. 62-60251 (Sheet 2 of 2)

LOCATION	SYMBOL	DESCRIPTION	LOCATION IN FRAME
B-8	ALT ~	ALTERNATEUR (SINGLE PHASE)	FRAME
C-10	CAR	CAPACITOR ALTERNATOR RELAY	CONTROL BOX
R-6	C1	CAPACITOR (HEATERS)	CONTROL BOX
R-7	C2	CAPACITOR (HEATERS)	CONTROL BOX
Q-6	C3	CAPACITOR (HEATERS)	CONTROL BOX
B-10	C4	CAPACITOR (ALTERNATOR)	CONTROL BOX
B-11	C5	CAPACITOR (ALTERNATOR)	CONTROL BOX
D-8	EFB	ELECTRIC FAN BOARD	CONTROL BOX
H-8	1EM	ELECTRIC MOTOR (1ST COMPARTMENT)	EVAPORATOR
H-9	2EM	ELECTRIC MOTOR (2ND COMPARTMENT)	EVAPORATOR
H-11	3EM	ELECTRIC MOTOR (3RD COMPARTMENT)	EVAPORATOR
E-8	1EMR	ELECTRIC MOTOR RELAY (1ST COMPARTMENT)	CONTROL BOX
E-9	2EMR	ELECTRIC MOTOR RELAY (2ND COMPARTMENT)	CONTROL BOX
E-10	3EMR	ELECTRIC MOTOR RELAY (3RD COMPARTMENT)	CONTROL BOX
T-6	1EHR	ELECTRIC HEATER (1ST COMPARTMENT)	CONTROL BOX
T-8	2EHR	ELECTRIC HEATER (2ND COMPARTMENT)	CONTROL BOX
T-10	3EHR	ELECTRIC HEATER (3RD COMPARTMENT)	CONTROL BOX
V-6	F12	FUSE 2.5AMP	CONTROL BOX
V-6	F13	FUSE 2.5AMP	CONTROL BOX
V-7	F14	FUSE 2.5AMP	CONTROL BOX
V-7	F15	FUSE 2.5AMP	CONTROL BOX
V-8	F16	FUSE 2.5AMP	CONTROL BOX
V-8	F17	FUSE 2.5AMP	CONTROL BOX
V-9	F18	FUSE 2.5AMP	CONTROL BOX
V-10	F19	FUSE 2.5AMP	CONTROL BOX
V-10	F20	FUSE 2.5AMP	CONTROL BOX
F-8	F21	FUSE 2AMP	CONTROL BOX
F-9	F22	FUSE 2AMP	CONTROL BOX
F-10	F23	FUSE 2AMP	CONTROL BOX
O-9	FLR	FLASH RELAY	CONTROL BOX
X-6	1HE	HEATER ELEMENT (1ST COMPARTMENT)	EVAPORATOR
X-8	2HE	HEATER ELEMENT (2ND COMPARTMENT)	EVAPORATOR
X-10	3HE	HEATER ELEMENT (3RD COMPARTMENT)	EVAPORATOR
N-2/G-4/O-4	MC	MOTOR CONTACTOR	CONTROL BOX
I-4/P-4/L-2	OL	OVERLOAD PROTECTOR	CONTROL BOX
E-4/N-4	PSR	POWER SUPPLY RECEPTACLE	
J-4/R-4	SBM	STANDBY MOTOR	FRAME
P-10	SH	SHUNT	CONTROL BOX

Figure 5-2. Truck Units – Electrical Schematic Wiring Diagram Dwg. No. 62-60252 (Sheet 1 of 2)

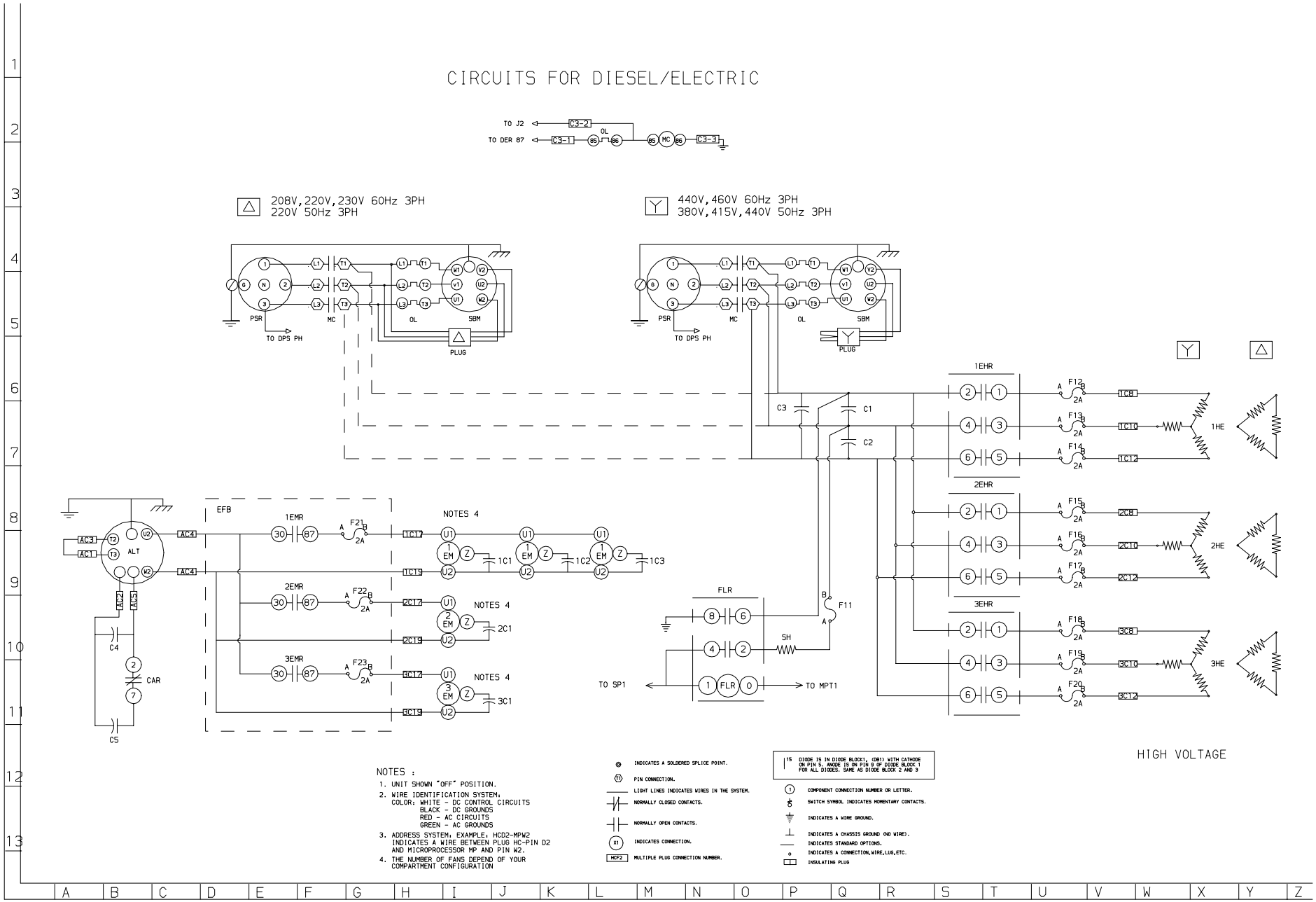


Figure 5-2. Truck Units – Electrical Schematic Wiring Diagram Dwg. No. 62-60252 (Sheet 2 of 2)