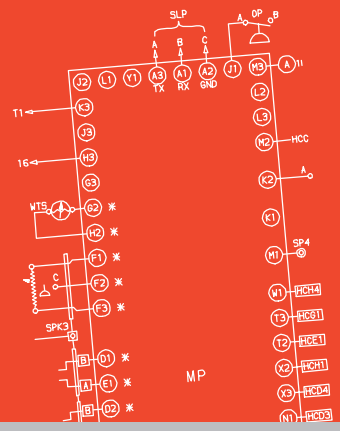
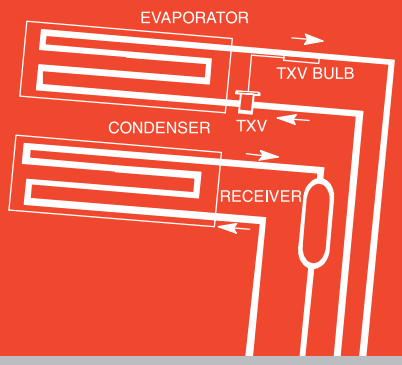
Carrier® Trailer Refrigeration





OPERATION & SERVICE

for

ULTIMA
PHOENIX ULTRA
PHOENIX ULTRA MULTI-TEMP
PHOENIX ULTRA XL
EXTRA & OPTIMA
WITH STANDARD MICROPROCESSOR

Prior To S/N HAR90573670

Trailer Refrigeration Units

62-02461 Rev F

Carrier

TRANSICOLD

OPERATION AND SERVICE MANUAL

TRAILER REFRIGERATION UNIT

Ultima NDX-93D

Phoenix Ultra, Phoenix Ultra Multi-Temp NDA/NDM-93A/94A

Phoenix Ultra XL NDA/NDM-93D/94D

Extra NDA/NDM-93E/94E

Optima NDA-93B/94B

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

Table 1-1. Model Chart

Models	Refrigerant				Compressor	Engine	Engine Speed		Electric Standby
	R-22		R-404A				High	Low	
	LB	KG	LB	KG					
ULTIMA									
NDX-93D	–	–	26	11.8	05G 41 cfm	CT4-134-DI	2200	1475	–
PHOENIX ULTRA									
NDA-93A	–	–	26	11.8	05G 41 cfm	CT4-134-TV	1900	1350	–
NDA-93A Euro					05G 37 cfm		1700		–
NDM-93A Euro					05G 37 cfm		1700		380V 50hz
NDA-94A	26	11.8	–	–	05G 41 cfm		1900		–
NDA-94A Euro					05G 37 cfm		1700		–
NDM-94A					05G 37 cfm		1900		230V 60hz
NDM-94A Euro					05G 37 cfm		1700		380V 50hz
PHOENIX ULTRA XL									
NDA-93D	–	–	26	11.8	05G 41 cfm	CT4-134-DI	1900	1350	–
NDM-93D Euro					05G 37 cfm		1700		380V 50hz
NDA-94D	26	11.8	–	–	05G 41 cfm		1900		–
NDM-94D					05G 37 cfm		1900		230V 60hz
NDM-94D Euro					05G 37 cfm		1700		380V 50hz
EXTRA									
NDA-93E	–	–	26	11.8	05G 37 cfm	CT4-114-TV	1700	1350	–
NDM-93E									230V 60hz
NDM-93E Euro									380V 50hz
NDA-94E	26	11.8	–	–	05G 37 cfm	CT4-114-TV	1700	1350	–
NDM-94E									230V 60hz
NDM-94E Euro									380V 50hz
OPTIMA									
NDA-93B	–	–	21	9.53	05K	CT4-91-TVO	2200	1650	–
NDA-94B	21.5	9.75	–	–					–

This manual contains Operating Data, Electrical Data and Service Instructions for the refrigeration units listed in Table 1-1.

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.

a. Model NDA

The unit is a one piece, self-contained, fully charged, pre-wired, refrigeration/heating "nosemount" diesel powered 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 on the rear frame as shown in Figure 1-4.

The evaporator fits into a rectangular opening in the upper portion of the trailer front wall. When installed, the evaporator section is located inside the trailer; and the condensing section is outside and on the front of the trailer.

The condensing unit consists of an engine–compressor drive package, condenser fan, condenser coil, radiator coil, control panel, relay module, refrigerant controls, piping, wiring, defrost air switch, and associated components.

The evaporator assembly consists of an evaporator coil, evaporator fan, expansion valve, two defrost thermostats

(termination switches). The location of the thermostats are shown in Figure 1-9. The return air sensor is also shown in Figure 1-9.

Heating is accomplished by circulating hot gas directly from the compressor to the evaporator coil. Four electric solenoid valves control the refrigerant circuit to operate the heating/cooling system.

Automatic evaporator coil defrosting is initiated by either sensing the air pressure drop across the coil with a differential air switch or with the defrost timer in the microprocessor.

The control door and relay module include manual switches, microprocessor, ammeter, fuses, and associated wiring. Also, the unit is equipped with a remote light bar as standard equipment. It is mounted separately on the front roadside corner of the trailer.

The temperature controller is a microprocessor solid state controller (Refer to section 1.10). Once the controller 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 within the trailer.

The refrigeration compressor used (Refer to Table 1-1) 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.

The diesel engine drives the compressor directly through a nylon drive gear and adapter. The adapter also includes a V-belt sheave which drives the clutch/gearbox. The condenser/evaporator fan shaft is driven with a V-belt from the clutch/gearbox. A separate V-belt from the clutch/gearbox drives the alternator.

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

Also 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).

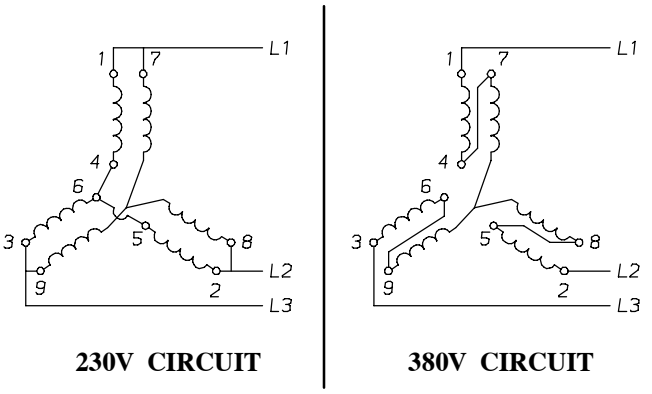
b. Model NDM

The model NDM is similar to the model NDA except that it contains a standby electric motor, standby motor contactor and a receptacle for a power plug.

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.

Table 1-2. Electric Standby Motor Data

	50HZ	60HZ
Horsepower	12hp	15hp
Voltage	380	230
Full Load Amps	17.6	35.6
Lock Rotor Amps	137	298
RPM	2935	3550



230V CIRCUIT **380V CIRCUIT**

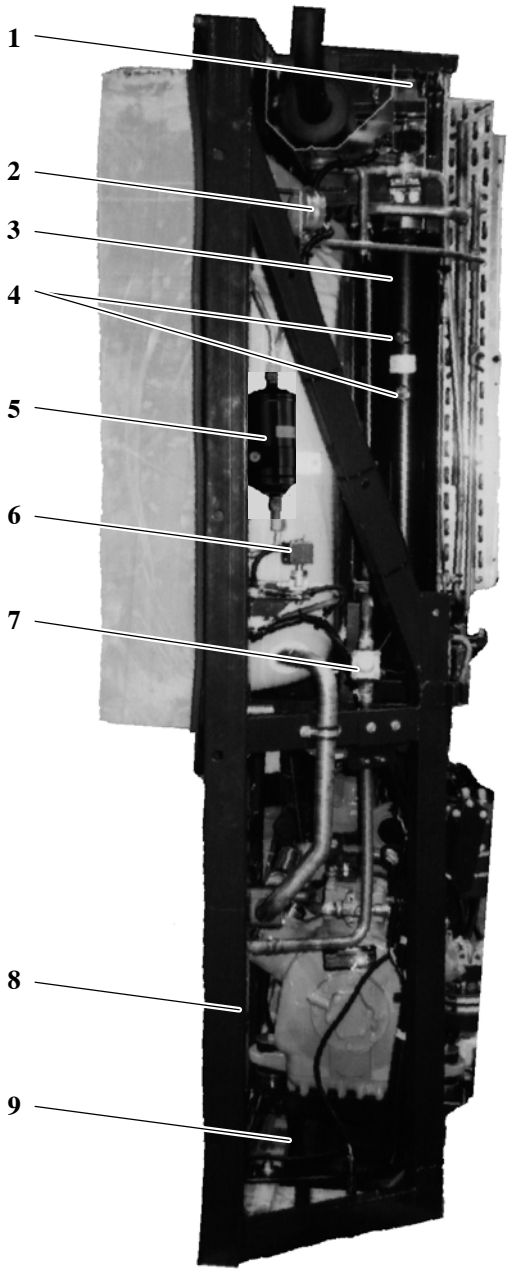
c. Model NDM with Phase Sequence Module

Some NDM have a Phase Sequence Module (See Figure 1-12 & Figure 4-29). This phase sequence sensing system provides a safe method of automatically providing correctly phased 3 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.

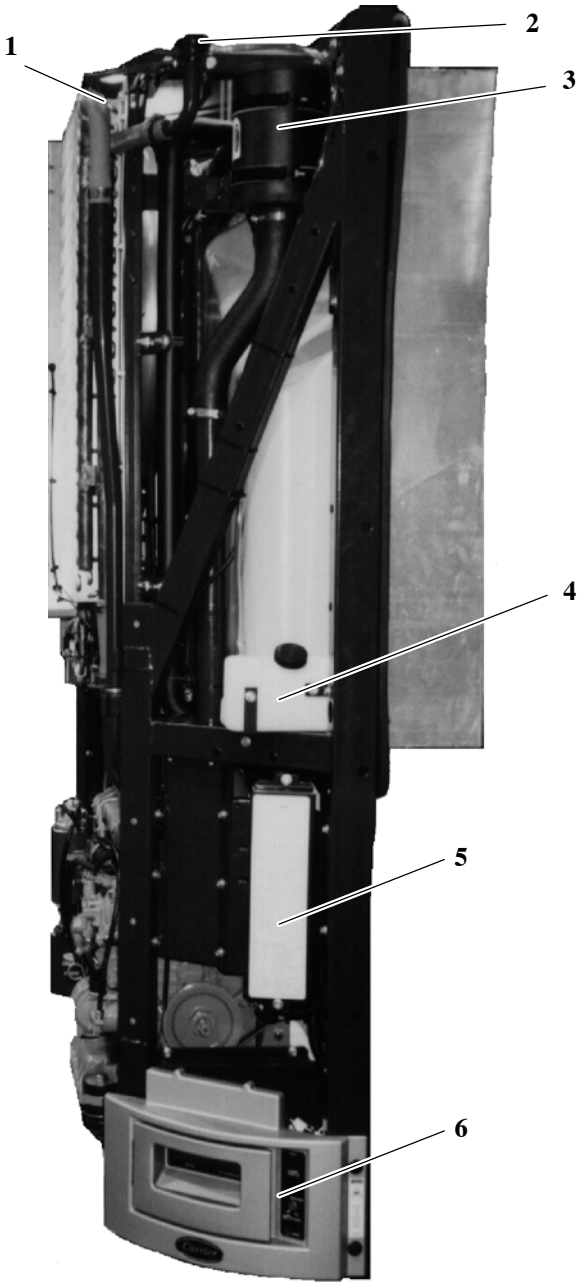
d. Model NDX

The model NDX is similar to the model NDA except that the evaporator extends into the trailer. The condenser coil/subcooler and radiator are combined. The clutch is moved from gearbox to fan shaft.



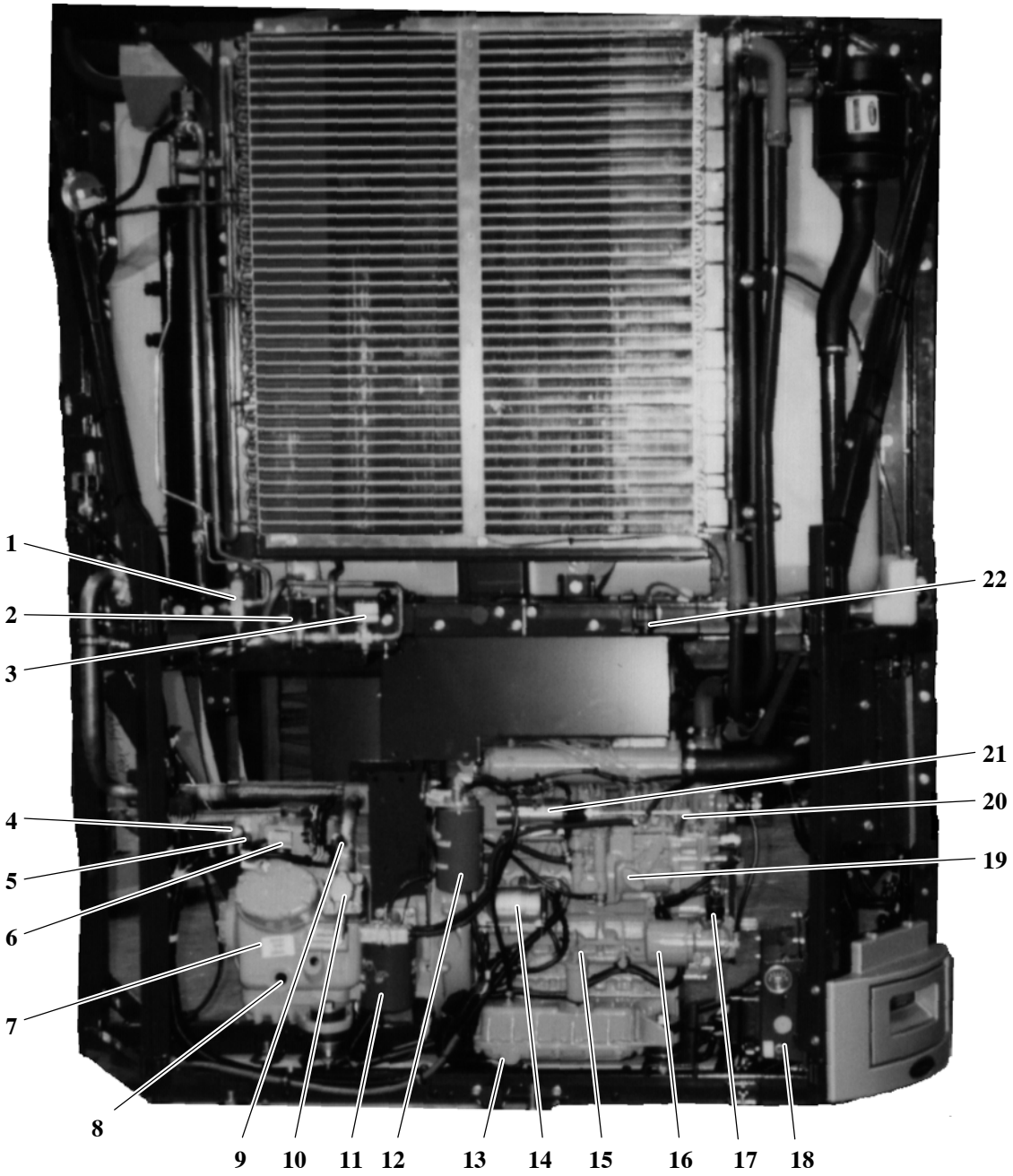
1. Condenser Pressure Control Solenoid Valve (SV-1)
2. Defrost Air Switch
3. Receiver
4. Receiver Sight Glass
5. Filter-Drier
6. Liquid Line Solenoid Valve (SV-2)
7. Discharge Check Valve
8. Model/Serial No. Location
9. Battery Location

Figure 1-1. Curbside – Ultima



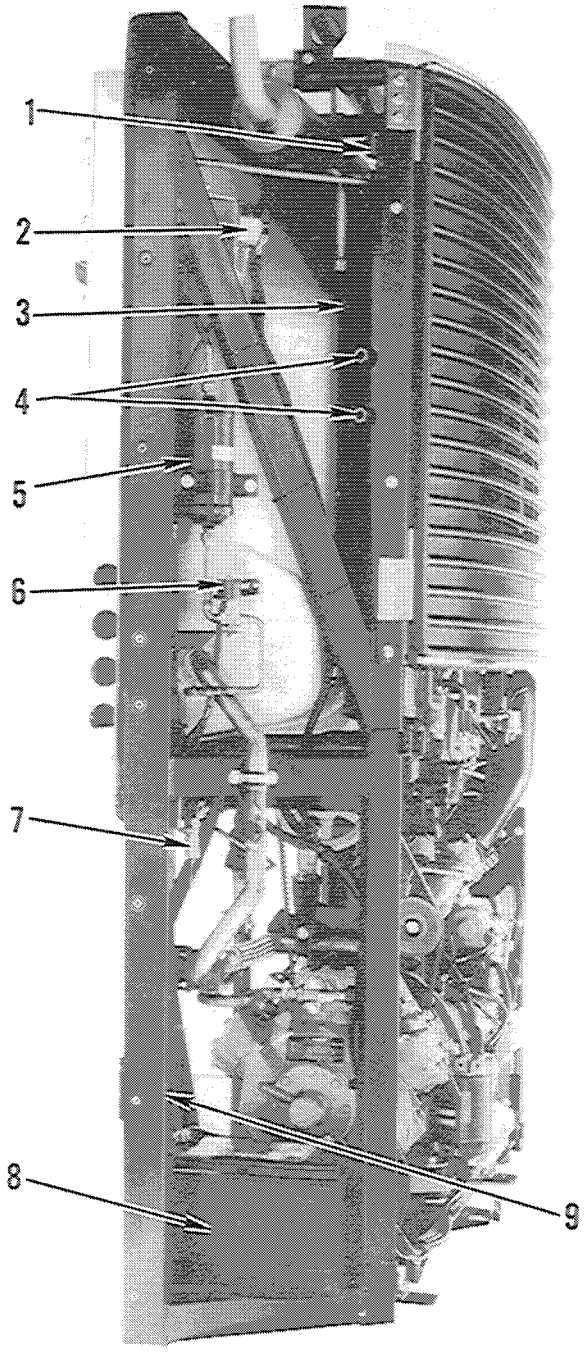
1. Condenser/Radiator
2. Radiator Fill Neck
3. Engine Air Cleaner
4. Radiator Overflow Reservoir
5. DataLink Recorder – See Figure 1-22
6. Control Box Door – See Figure 1-10

Figure 1-2. Roadside – Ultima



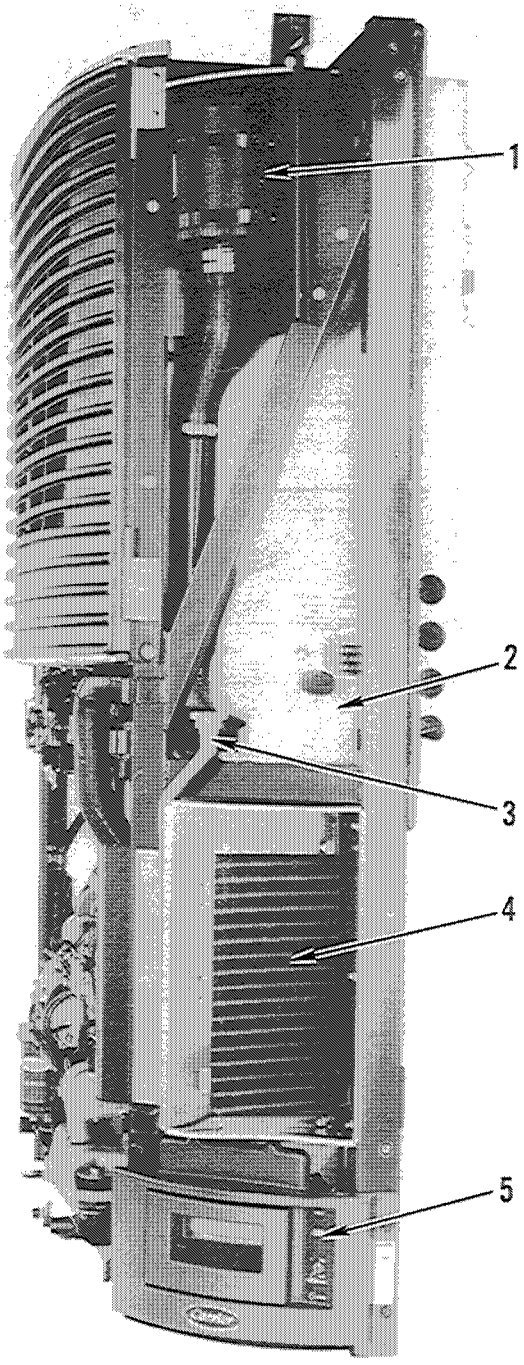
1. King Valve
2. Hot Gas Solenoid Valve - Large (SV-3)
3. Hot Gas Solenoid Valve - Small (SV-4)
4. Discharge Service Valve
5. High Pressure Cutout Switch (HP-1) and Head Pressure Control Switch (HP-2)
6. Unloader Solenoid Valve
7. Compressor – 05G
8. Compressor Sight Glass
9. Suction Pressure Transducer (SPT)
10. Suction Service Valve
11. Fuel Filter
12. By-pass Oil Filter
13. Oil Drain
14. Starter Motor
15. Lube Oil Fill
16. Lube Oil Filter
17. Oil Pressure Switch
18. Relay Module – See Figure 1-11
19. Injection Pump
20. Fuel Bleed Valve
21. Speed Control Solenoid
22. Air Cleaner Service Indicator

Figure 1-3. Front View – Ultima



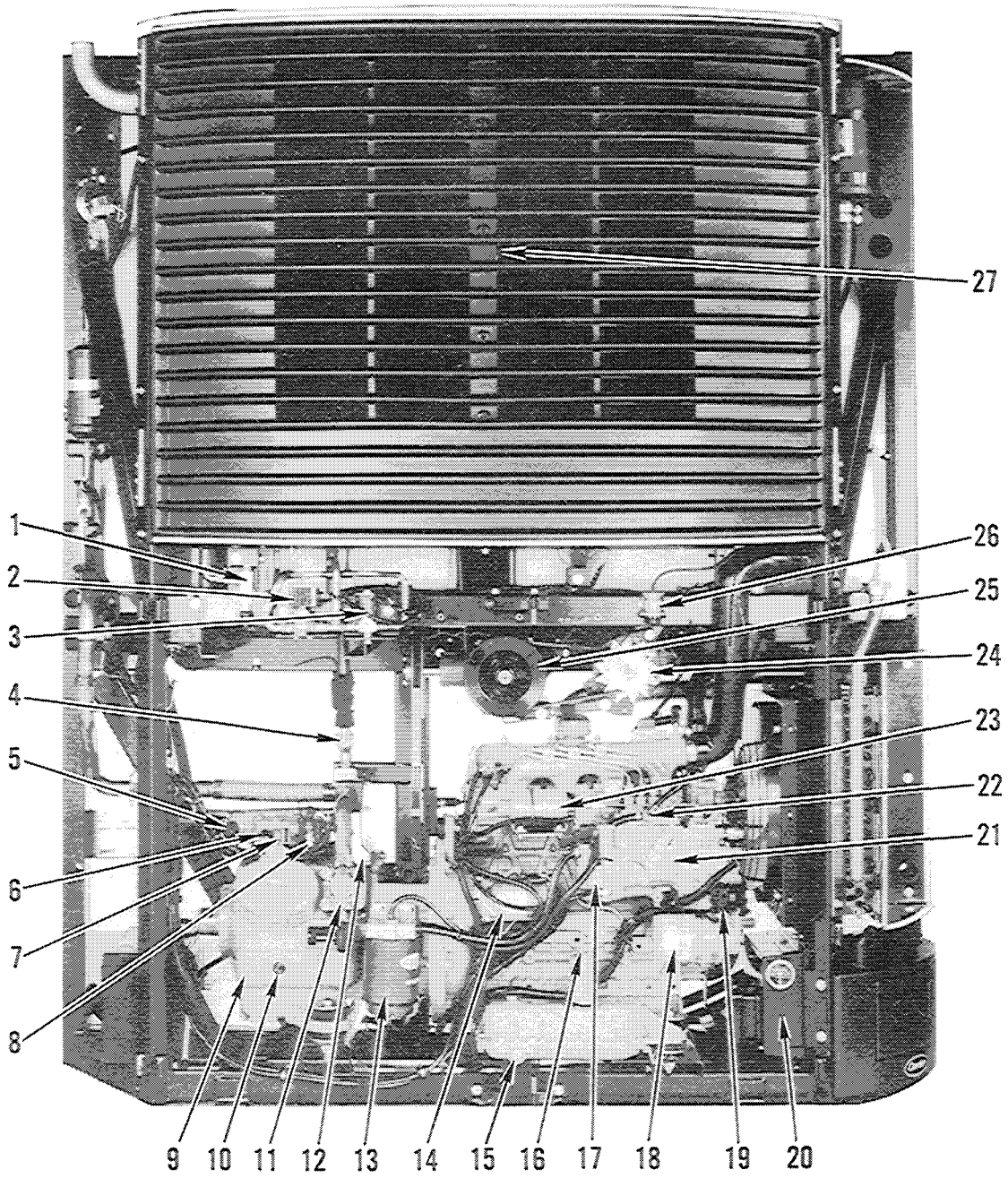
1. Condenser Pressure Control Solenoid Valve (SV-1)
2. Defrost Air Switch
3. Receiver
4. Receiver Sight Glass
5. Filter-Drier
6. Liquid Line Solenoid Valve (SV-2)
7. Quench Valve – R-22 Only
8. Battery
9. Model/Serial No. Location

Figure 1-4. Curbside – Phoenix Ultra



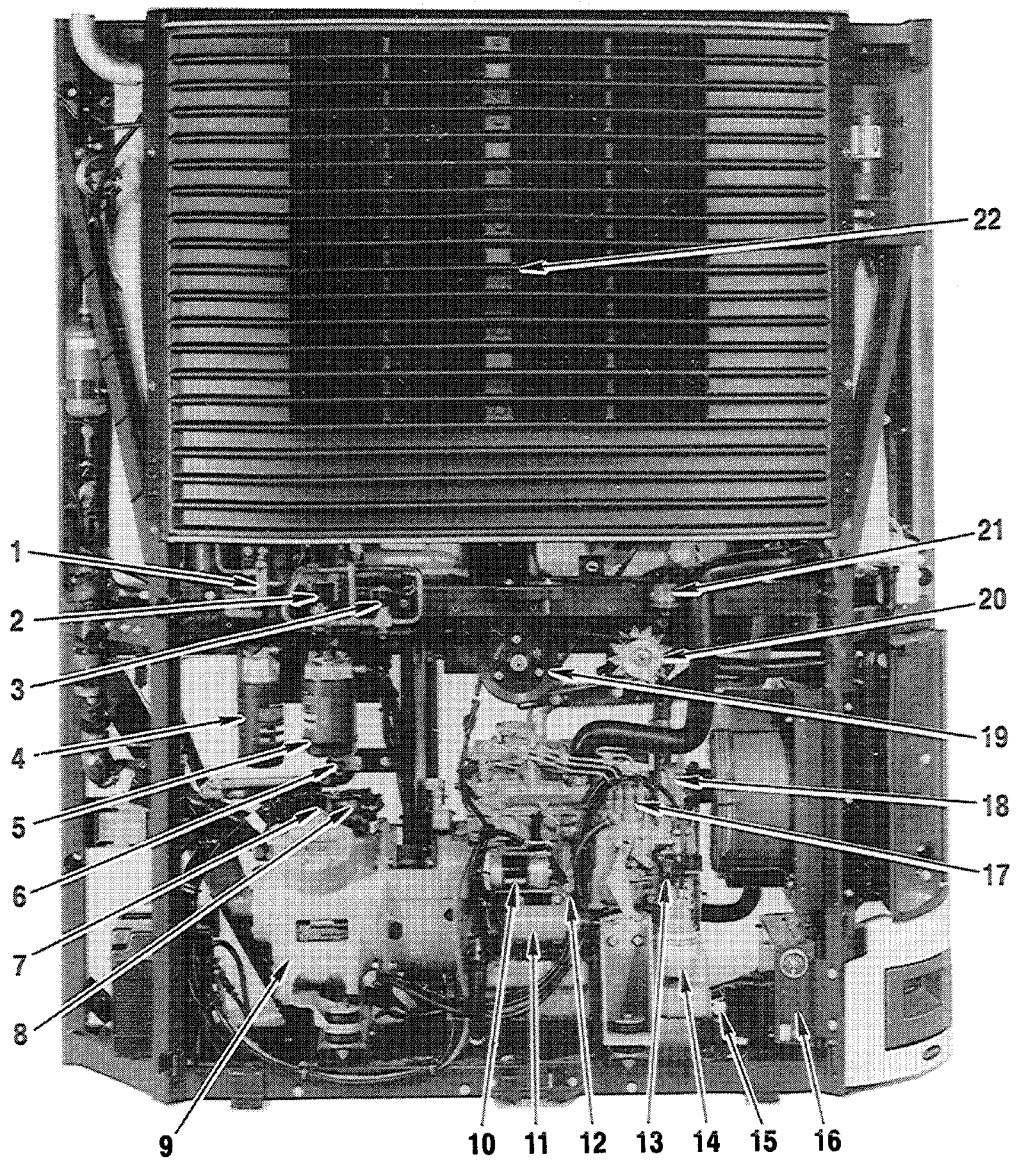
1. Engine Air Cleaner
2. Radiator Overflow Reservoir
3. Radiator Fill Neck
4. Radiator
5. Control Box Door – See Figure 1-10

Figure 1-5. Roadside – Phoenix Ultra



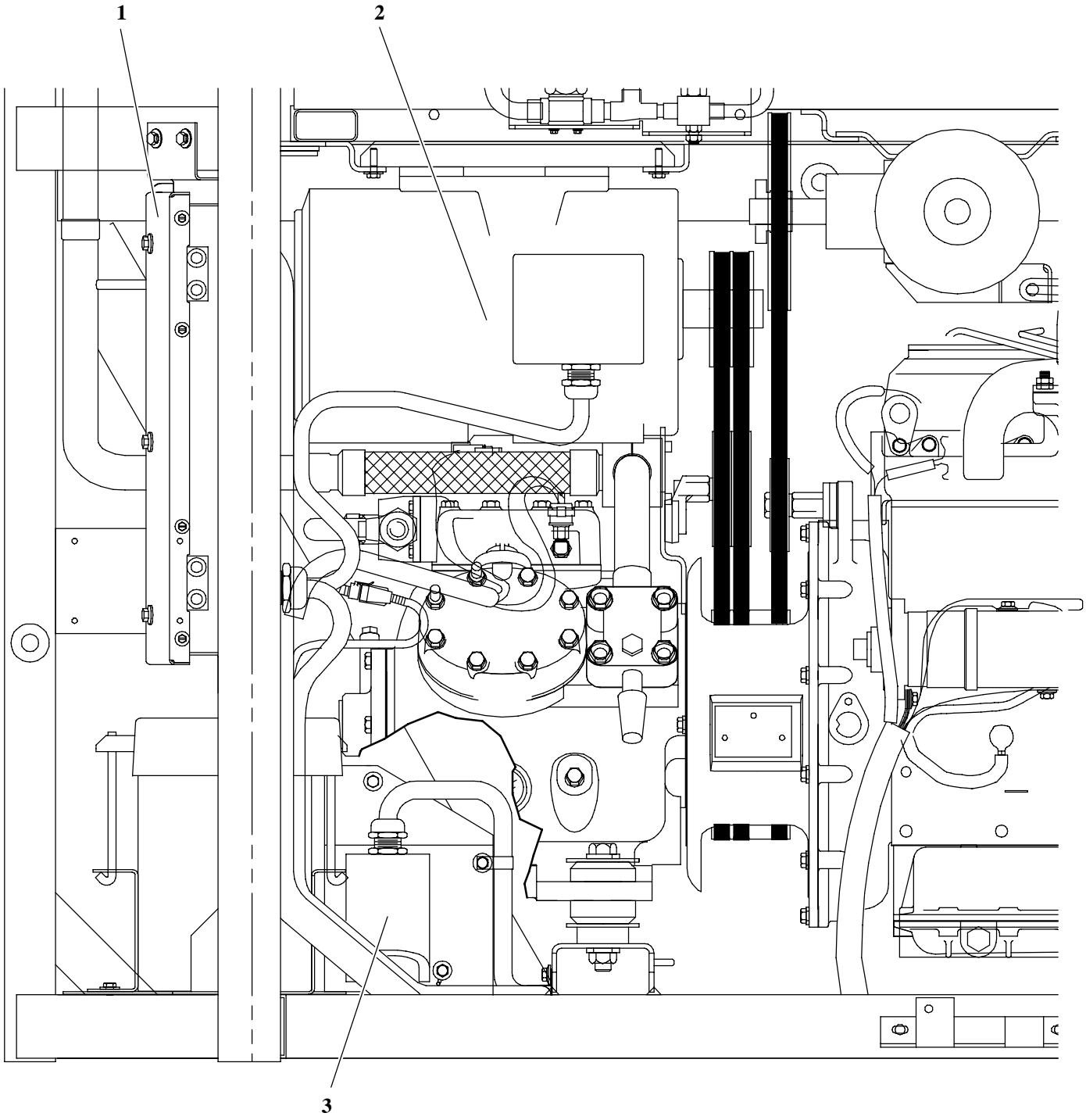
1. King Valve
2. Hot Gas Solenoid Valve - Large (SV-3)
3. Hot Gas Solenoid Valve - Small (SV-4)
4. Discharge Line Check Valve
5. Discharge Service Valve
6. Compressor Discharge Temperature Sensor (CDT)
7. Unloader Solenoid Valve
8. High Pressure Cutout Switch (HP-1) and Head Pressure Control Switch (HP-2)
9. Compressor – 05G
10. Compressor Sight Glass
11. Suction Service Valve
12. Suction Pressure Transducer (SPT)
13. Fuel Filter
14. Starter Motor
15. Oil Drain
16. Lube Oil Fill
17. Mechanical Fuel Pump
18. Lube Oil Filter
19. Oil Pressure Switch
20. Relay Module – See Figure 1-11
21. Injection Pump
22. Fuel Bleed Valve
23. Speed Control Solenoid
24. Alternator and Regulator
25. Clutch/Gearbox
26. Air Cleaner Service Indicator
27. Ambient Temperature Sensor (ATS)

Figure 1-6. Front View – Phoenix Ultra



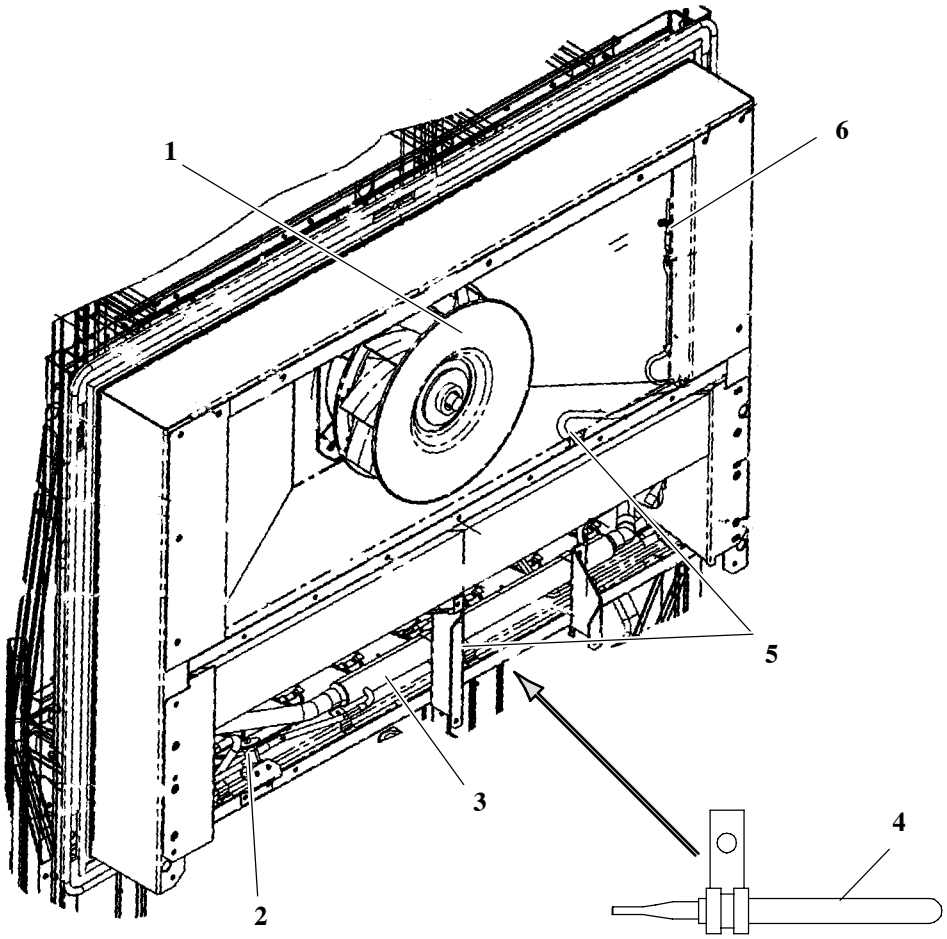
1. King Valve
2. Hot Gas Solenoid Valve (SV-3)
3. Hot Gas Solenoid Valve (SV-4)
4. Bypass Oil Filter
5. Fuel Filter
6. Discharge Line Check Valve
7. Unloader Solenoid Valve
8. High Pressure Cutout Switch (HP-1) and Head Pressure Control Switch (HP-2)
9. Compressor – 05K
10. Starter Motor
11. Speed Control Solenoid
12. Oil Dipstick
13. Oil Pressure Switch
14. Lube Oil Filter
15. Oil Drain
16. Relay Module – See Figure 1-11
17. Fuel Bleed Valve
18. Lube Oil Fill
19. Clutch/Gearbox
20. Alternator and Regulator
21. Air Cleaner Service Indicator
22. Ambient Temperature Sensor (ATS)

Figure 1-7. Front View – Optima



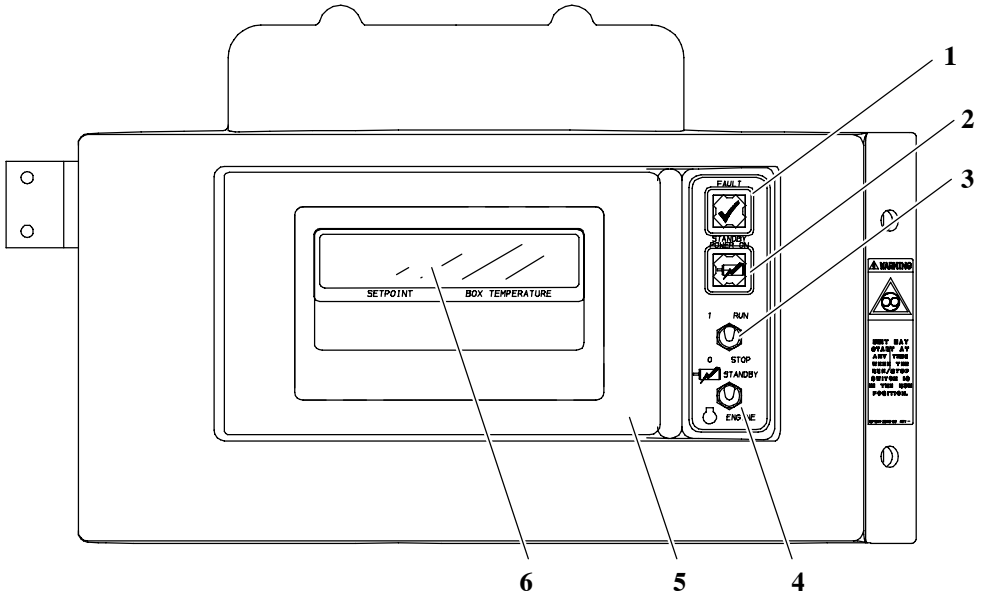
1. Standby Electric Box (See Figure 1-12)
2. Standby Motor
3. Power Receptacle

Figure 1-8. Front View – NDM-94



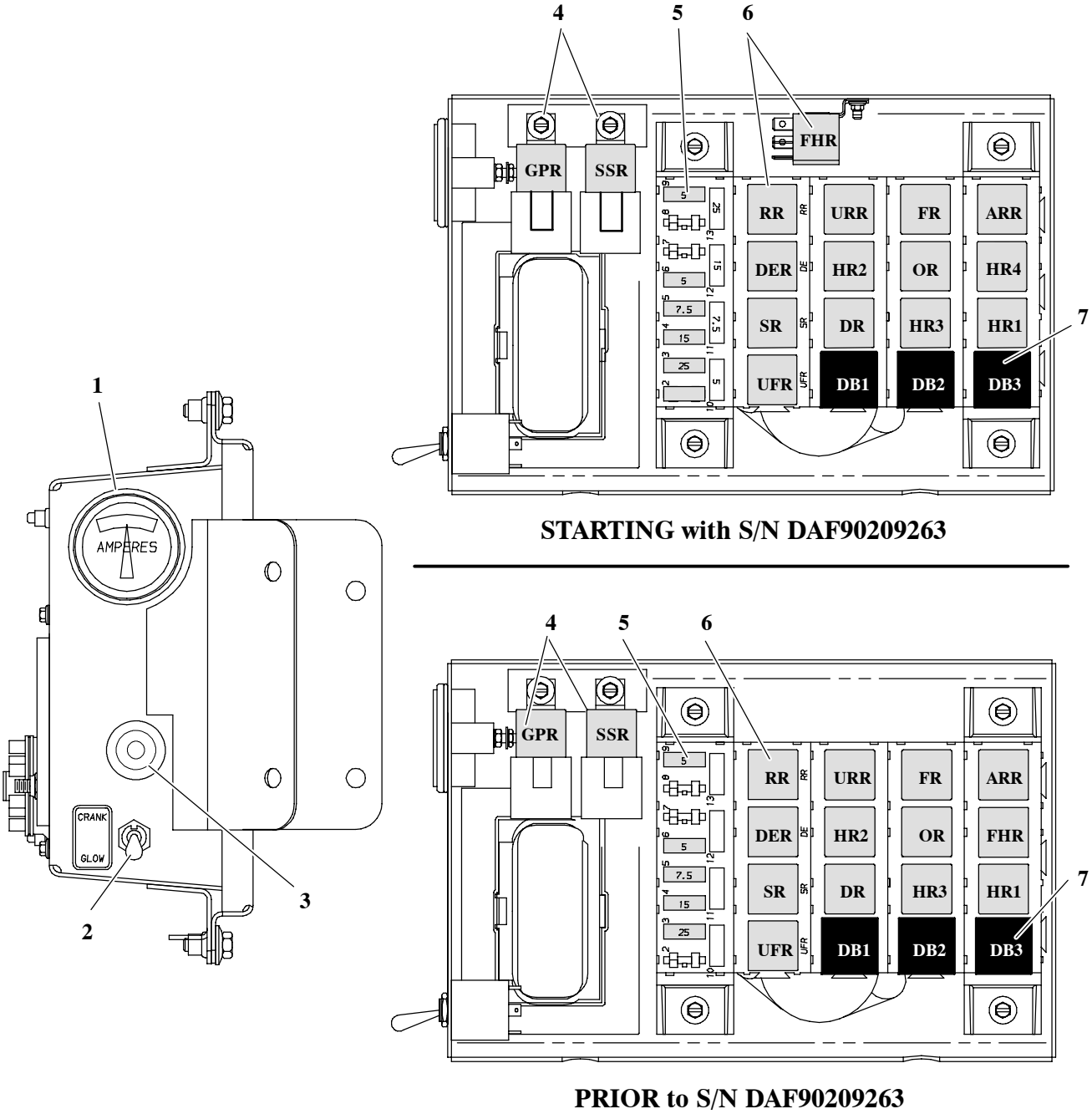
1. Evaporator Fan
2. Expansion Valve
3. Heat Exchanger – R404A Only
4. Return Air Sensor
5. Defrost Termination Thermostats
6. Supply Air Sensor (If Used)

Figure 1-9. Evaporator Section – Panels and Grille Removed



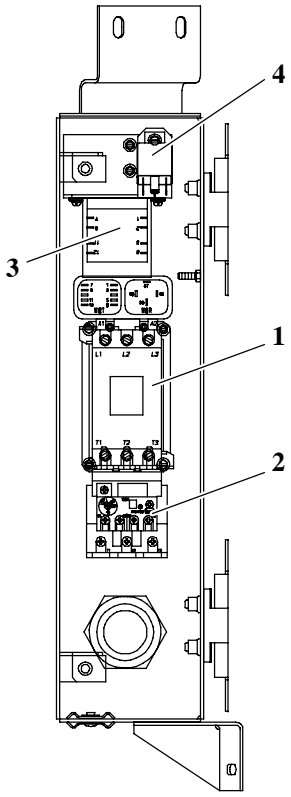
1. Fault Light
2. Standby Power Light (PL) – Model NDM
3. Run-Stop Switch
4. Selector Switch (SSW) – Model NDM
5. Keypad Door
6. Microprocessor Control Panel (See Figure 1-19)

Figure 1-10. Control Box Door

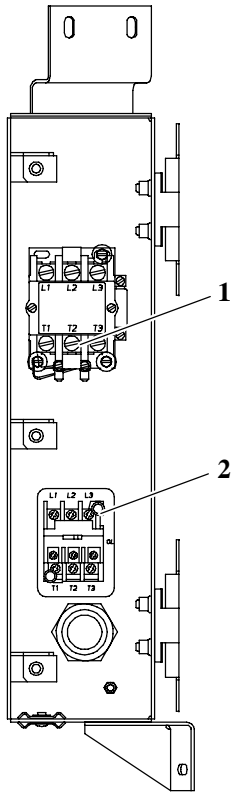


1. Ammeter
2. Manual Glow/Crank Switch
3. Buzzer
4. Starter Solenoid Relay (SSR) and Glow Plug Relay (GPR)
5. Fuses - F1 (80A), F3 (25A), F4 (15A), F5 (7.5A) F6, F9 (5A)
6. Relays, Run (RR), Diesel Electric (DER), Speed (SR) Unloader Front (UFR), Unloader Rear (URR), Heat (HR1, HR2, HR3 & HR4), Defrost (DR), Fault (FR), Out-of-Range (OR), Auto Restart (ARR), Fuel Heater (FHR)
7. Diode, Block (DB1, DB2 & DB3)

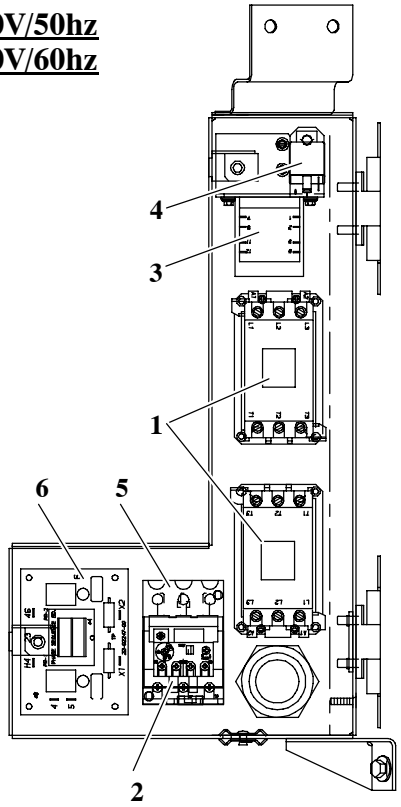
Figure 1-11. Relay Module



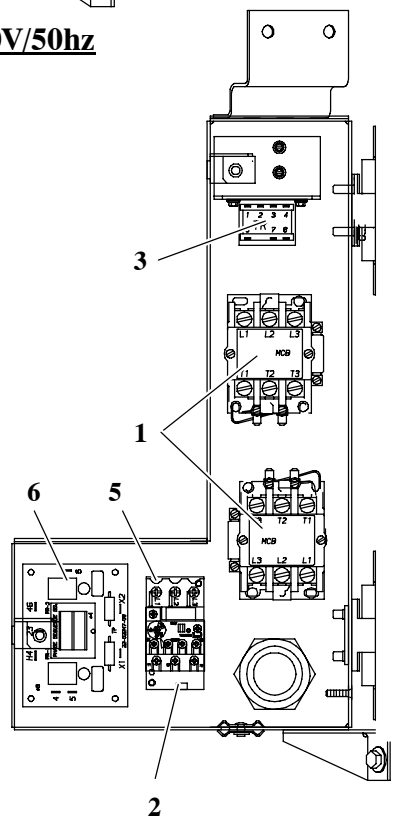
200V/50hz
230V/60hz



380V/50hz



PHASE REVERSAL 200V/50hz
230V/60hz



PHASE REVERSAL 380V/50hz

1. Motor Contactor (MC)
2. Motor Overload (MOL)
3. Transformer (TR)
4. Motor Contactor Relay (MCR)
5. Overload (OL)
6. Phase Reversal Circuit Board

Figure 1-12. Standby Electric Box

1.2 ENGINE DATA

Engine Models	CT4-134TV (V2203TV)	CT4-134DI (V2203DI)	CT4-114TV (V1903)	CT4-91TVO (V1505)
Used on	Ultra	Ultra XL/Ultima	Extra	Optima
Displacement	2.2 liters (134 in^3)	2.2 liters (134 in^3)	1.8 liters (113 in^3)	1.5 liters (91.4 in^3)
No. Cylinders	4	4	4	4
Horsepower	34 hp @1900 rpm 25 hp @ 1350 rpm	33 hp@1900 rpm 35 hp@2200 rpm	24 hp @1700 rpm 20 hp @1350 rpm	24.5 hp @ 2200 rpm 20 hp @ 1650 rpm
Weight	189.5 kg (417.8 lbs)			110 kg (242.5 lbs)
Coolant Capacity	7.6 liters (2 gallons)			
Thermostat	Starts to open 157 to 162°F (69 to 72°C) fully open 185°F (85°C)	Starts to open 177 to 182°F (81 to 83°C) fully open 203°F (95°C)		
Oil Capacity with Filter	14 liters (15 quarts)			13.2 liters (14 quarts)
Injection Setting	140 to 150 kg/cm^2 (1991 to 2133 psi)			
Fuel	Winter: Diesel No. 1 Summer: Diesel No. 2			
Firing Order	1–3–4–2	1–3–4–2	1–3–4–2	1–3–4–2
Glow Plug Amperage	7.0 amps per plug at 10.5 vdc (nominal)			
Valve Clearance (Cold) (Intake and Exhaust)	0.0071 to 0.0087 inch (0.18 to 0.22 mm)			

a. Lubrication System

Oil Pressure:

40 to 60 psig (2.8 to 4.2 kg/cm^2)
(Engine in high speed)

Oil Pressure Safety Switch Setting Closes:

15 (± 3) psig (1.05 kg/cm^2)

Lube Oil Viscosity:

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

Oil Change Intervals:

First 400 hours, thereafter as listed below.

CAUTION

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

ENGINE	API Class CD (Hours)	MOBIL DELVAC 1 (Hours)
TV	1500	3000
DI	2000	4000

1.3 COMPRESSOR DATA

Compressor Models	05G	05K
No. Cylinders	6	4
No. Unloaders	2	1
Weight	62 kg (137 lbs)	49 kg (108 lbs)
Oil Charge	2.8 L (6.0 pints)	2.6 L (5.5 pts)

APPROVED COMPRESSOR OIL		
Refrigerant	**05G**	**05K**
R-22	Zerol 150 (synthetic) P/N 07-00274	Suniso 3GS
R-404A	Mobil Arctic EAL 68	

1.4 REFRIGERATION SYSTEM DATA

a. Defrost Air Switch

Initiates Defrost:

1.40 (± .07) inch (35 ± 1.8 mm) WG

b. Defrost Timer

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

c. Defrost Thermostats

Opens: 50 ± 5°F (10 ± 3°C)
Closes: 40 ± 5°F (4.4 ± 3°C)

d. Expansion Valve Superheat

Setting at 0°F (–17.8°C) box temperature:

MODEL	SETTING
Ultima, Phoenix Ultra, Ultra XL, Extra	8 to 10°F (4.4 to 5.6°C)
Optima	5 to 8°F (2.8 to 4.5°C)

e. Fusible Plug Setting

208 to 220°F (97.8° to 104.4°C)

f. Head Pressure Control Switch (HP-2)

Phoenix Ultra, Extra & Optima:

Cutout: 350 ± 10 psig (24.6 ± 0.7 kg/cm2)

Cut-in: 290 ± 10 psig (20.4 ± 0.7 kg/cm2)

Ultima:

Cutout: 300 ± 10 psig (21.1 ± 0.7 kg/cm2)

Cut-in: 200 ± 10 psig (14.1 ± 0.7 kg/cm2)

g. High Pressure Switch (HP-1)

Prior to S/N EAD90304846:

Cutout: 428 ± 10 psig (30 ± 0.7 kg/cm2)

Cut-in: 320 ± 10 psig (22.5 ± 0.7 kg/cm2)

Starting with S/N EAD90304846:

Cutout: 465 ± 10 psig (32.7 ± 0.7 kg/cm2)

Cut-in: 350 ± 10 psig (24.6 ± 0.7 kg/cm2)

h. Refrigeration Charge

Refer to Table 1-1

i. Gearbox Oil

Mobil SHC 75–90W: 15oz

j. Fanshaft Oil

Mobil SHC 630: 3.2oz

k. Unit Weights (Approximate)

Ultima: 1665 lb. (755 kg)
Phoenix Ultra: 1610 lb. (730 kg)
Extra: 1610 lb. (730 kg)
Optima: 1435 lb (651 kg)

1.5 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 1-3.

The quench valve (R-22 Only) opens as required to maintain a 265 to 285°F (129 to 141°C) discharge temperature. Should this valve fail, the compressor discharge temperature sensor (CDT) will shut the unit down if center compressor head discharge temperature reaches 310°F (154°C) for 3 minutes or 350°F (177°C) . If ambient temperature sensor (ATS) is at 120°F (49°C) or higher, the CDT limits are increased to 340°F (171°C) for 3 minutes.

1.6 ENGINE SCREW THREADS

All threads used on the diesel engine are metric.

1.7 ENGINE AIR SYSTEM

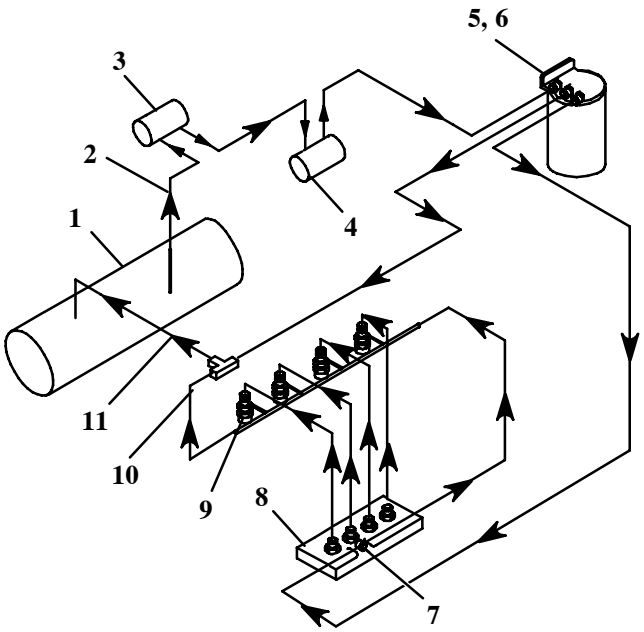
The air cleaner is put on the engine to prolong its life and performance by preventing dirt and grit from getting into the engine causing excessive wear on all operating parts. However, it is the responsibility of the operator to give the air cleaner equipment regular and constant attention in accordance with the instructions. (Refer to section 4.3.4)

Clean air is supplied to the engine through the air cleaner (See Figure 1-5). The air 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, the operation of the engine would be impaired.

Table 1-3. Safety Devices

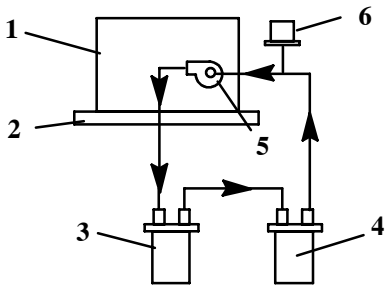
Unsafe Conditions	Safety Device	Device Setting
Low engine lubricating oil pressure	Oil pressure safety switch (OP) (microprocessor reset)	Opens below 15 ± 3 psig (2.1 ± 1.2 kg/cm2)
High engine cooling water temperature	Water temperature sensor (microprocessor reset)	Refer to section 1.11.3
Excessive current draw by glow plug circuit, control circuit or starter solenoid (SS)	Fuse (F1)	Opens at 80 amps
Excessive current draw by control circuit	Fuse (F3)	Opens at 25 amps
Excessive current draw by speed control solenoid, front or rear unloader	Fuse (F4)	Opens at 15 amps
Excessive current draw by SV3, auto restart or out-of-range lights	Fuse (F5)	Opens at 7 1/2 amps
Excessive current draw by microprocessor	Fuse (F9)	Opens at 5 amps
Excessive compressor discharge pressure	High pressure cutout switch (HP-1) automatic reset	Refer to section 1.4.g.
Excessive compressor discharge temperature	Compressor discharge temperature sensor (CDT) (microprocessor reset)	Refer to section 1.5
Excessive current draw by standby motor	Overload Protector (MOL)	Opens at 21.5 amps

1.8 LUBE OIL AND FUEL FLOW DIAGRAMS



1. Fuel Tank
2. Fuel Supply Line
3. Fuel Pump
4. Mechanical Lift Pump – Ultra
5. Fuel Filter
6. Fuel Warmer (Optional)
7. Fuel Bleed Valve
8. Injection Pump
9. Injector Nozzles
10. Fuel Leak-off Line
11. Fuel Return Line

Figure 1-13. Fuel System Diagram



1. Engine Block
2. Oil Pan
3. Full Flow Oil Filter
4. Bypass Oil Filter (Optional)
5. Engine Oil Connection
6. Oil Pressure Switch

Figure 1-14. Lube Oil Flow Diagram

1.9 COMPRESSOR UNLOADERS

This section contains two compressor unloader systems: the first one is hot gas bypass and the second is suction cutoff. They are easily distinguished from each other by observing the bottom side of the compressor cylinder head, it is either blank (hot gas bypass) or has a cover plate (suction cutoff). The unit operates the same with both unloader systems.

1.9.1 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 2 minutes once it is energized due to suction pressure.

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

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

a. Temperature Control Within 1.4°F (0.8°C) of Set Point

1. Cool light (CL) or heat light (HL) illuminated (depending on mode of operation).
2. If in low speed cooling, unloader relays (UFR, or UFR & URR) may energize to unload compressor banks. Refer to Table 1-4
3. The heat mode forces the rear unloader (UR) to a loaded condition (de-energized) for diesel operation. In low speed heating, front unloader relay (UFR) energizes to unload compressor bank.

Table 1-4. Unloading in Temperature Mode

SETPOINT BELOW 10°F (–12°C)	CYLINDER	SETPOINT ABOVE 10°F (–12°C)	CYLINDER
ULTIMA, PHOENIX ULTRA or EXTRA			
Cool High Speed	6	Cool High Speed	6
		Cool Low Speed	4
		Cool Low Speed	2
		Heat Low Speed	4
Cool Low Speed	6	Heat Low Speed	6
Cool Low Speed	4	Heat High Speed	6
OPTIMA			
Cool High Speed	4	Cool High Speed	4
		Cool Low Speed	2
		Heat Low Speed	2
		Heat Low Speed	4
Cool Low Speed	2	Heat High Speed	4

b. Perishable Cooling Unloader Control

Diesel

During perishable cooling the unloaders are energized when the temperature approaches setpoint. If a supply probe is present the unloaders are energized when the supply temperature decreases 5.4°F (3°C) below setpoint. It will stay unloaded until the supply temperature rises above setpoint. If a supply probe is not present the unloaders are energized when the return temperature decreases more than 9°F (5°C) above setpoint. It will stay unloaded until the return temperature rises more than 14.4°F (8°C) above setpoint. With software revision 2.10 or higher the return probe logic is disabled for ambient temperature higher than 90°F (32.2°C).

Standby

During perishable cooling the unloaders are energized when the control temperature reaches less than 2°F (1.1°C) above setpoint. The unloaders stay energized until the control temperature reaches 2.5°F (1.4°C) above setpoint.

c. Perishable Heating Unloader Control

Diesel

During perishable heating the front unloader is energized when the control temperature increases to 0.9°F (0.5°C) below setpoint. The unloader will stay energized until the control temperature decreases to 1.5°F (0.8°C) below setpoint.

Note: These switch points may vary slightly depending on the amount of overshoot around setpoint.

Standby

During perishable heating the unloaders are energized when the control temperature increases to 1.5°F (0.8°C) below setpoint. The unloaders will stay energized until the control temperature decreases to 2°F (1.1°C) below setpoint.

Note: During standby operation the unit may energize both the front and rear unloaders in heat(2 cylinders).

d. Frozen Unloader Control

Diesel

For units with UltraFreeze refer to section 1.13.

For units without UltraFreeze during frozen mode, heating is not allowed. The front unloader is energized when the control temperature decreases to 1.5°F (0.8°C) above setpoint. The unloader will stay energized until the control temperature reaches 2°F (1.1°C) above setpoint.

Note: During frozen mode only the front cylinder can be unloaded.

Standby

For units with UltraFreeze refer to section 1.13.

For units without UltraFreeze during frozen mode, heating is not allowed. The front unloader is energized when the control temperature decreases to 2°F (1.1°C) above setpoint. The unloader will stay energized until the control temperature reaches 2.5°F (1.4°C) above setpoint.

1.9.2 Suction Pressure Operation – Diesel Engine

The microprocessor will monitor suction pressure of the refrigeration system and control the unloaders to maintain a maximum operating pressure. A suction pressure transducer is used to signal the microprocessor when to load or unload the compressor.

When the compressor is fully loaded it is operating on 6 cylinders. When the front unloader UL1 is unloaded (energized), the unit operates on 4 cylinders. When UL1 and the rear unloader UL2 are unloaded (energized), the unit operates on 2 cylinders. The front unloader, UL1, always unloades before the rear unloader, UL2.

During the diesel heating and defrosting cycles, the rear unloader is locked out (loaded), forcing the compressor to always operate with at least four cylinders loaded.

a. R-22 Refrigeration System

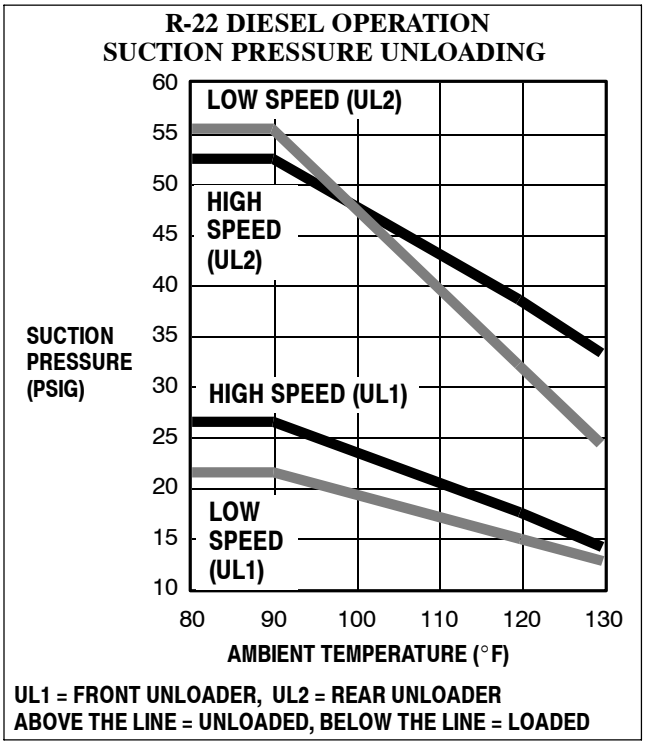
At ambient temperatures of 90°F (32.2°C) or below

When the system is operating in *high speed* and the suction pressure is greater than 53 psig, both unloaders are unloaded. As the suction pressure drops below 52 psig, the UL2 unloader is loaded. If the suction pressure drops below 26 psig, the UL1 unloader is loaded.

When the system is operating in *low speed* and the suction pressure is greater than 56 psig, both unloaders are unloaded. As the suction pressure drops below 55 psig, the UL2 unloader is loaded. If the suction pressure drops below 21 psig, the UL1 unloader is loaded.

At ambient temperatures of 90°F (32.2°C) or higher

At ambient temperatures of 90°F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



b. R-404A Refrigeration System

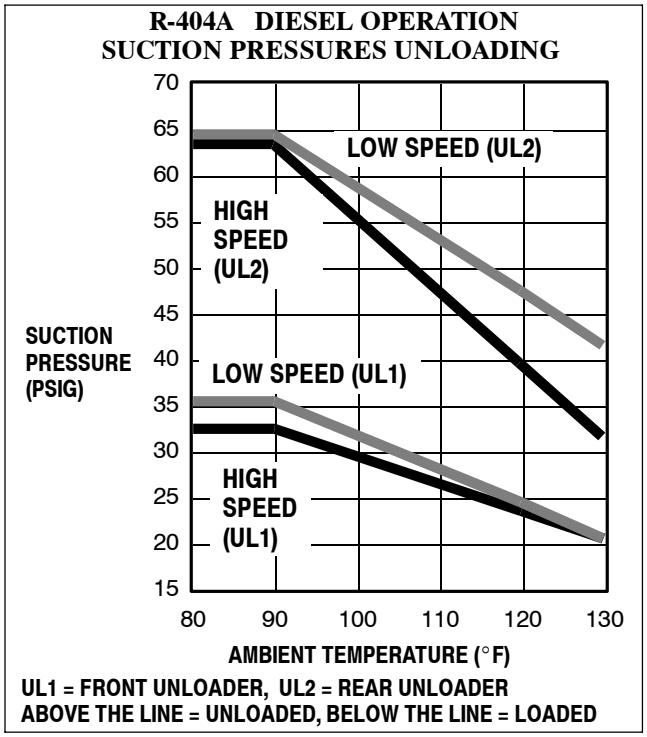
At ambient temperatures of 90°F (32.2°C) or below

When the system is operating in *high speed* and the suction pressure is greater than 64 psig, both unloaders are unloaded. As the suction pressure drops below 64 psig, the UL2 unloader is loaded. If the suction pressure drops below 33 psig, the UL1 unloader is loaded.

When the system is operating in *low speed* and the suction pressure is greater than 65 psig, both unloaders are unloaded. As the suction pressure drops below 64 psig, the UL2 unloader is loaded. If the suction pressure drops below 35 psig the UL1 unloader is loaded.

At ambient temperatures of 90°F (32.2°C) or higher

At ambient temperatures of 90°F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



1.9.3 Suction Pressure Operation – Standby

The microprocessor will monitor suction pressure of the refrigeration system and control the unloaders to maintain a maximum operating pressure. A suction pressure transducer is used to signal the microprocessor when to load or unload the compressor.

When the compressor is fully loaded it is operating on 6 cylinders. When the front unloader UL1 is unloaded (energized), the unit operates on 4 cylinders. When UL1 and the rear unloader UL2 are unloaded (energized), the unit operates on 2 cylinders. The front unloader, UL1, always unloades before the rear unloader, UL2.

During the heating and defrosting cycles, the lowest pressure unloader is *not* locked out (loaded). This will allow the compressor to fully unload in standby.

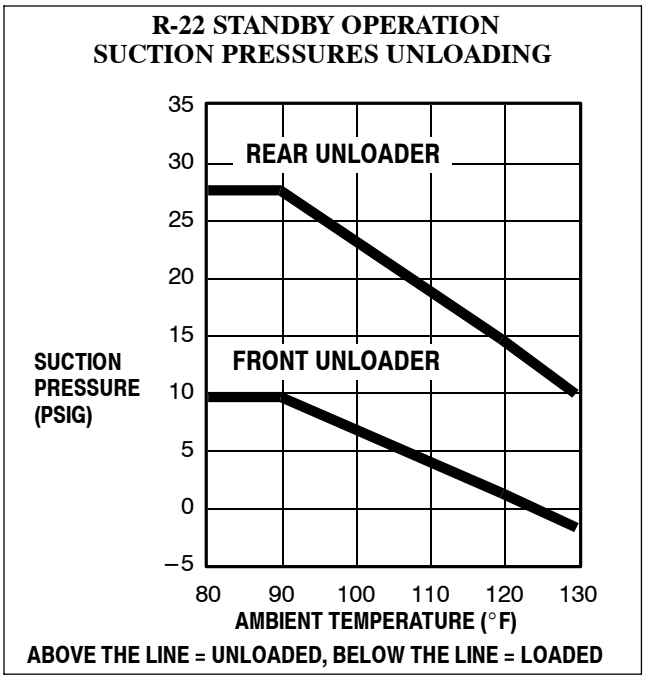
a. R-22 Refrigeration System

At ambient temperatures of 90°F (32.2°C) or below

When the system is operating and the suction pressure is greater than 29 psig, both unloaders are unloaded. As the suction pressure drops below 28 psig, the UL2 unloader is loaded. If the suction pressure drops below 10 psig, the the UL1 unloader is loaded.

At ambient temperatures of 90°F (32.2°C) or higher

At ambient temperatures of 90°F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



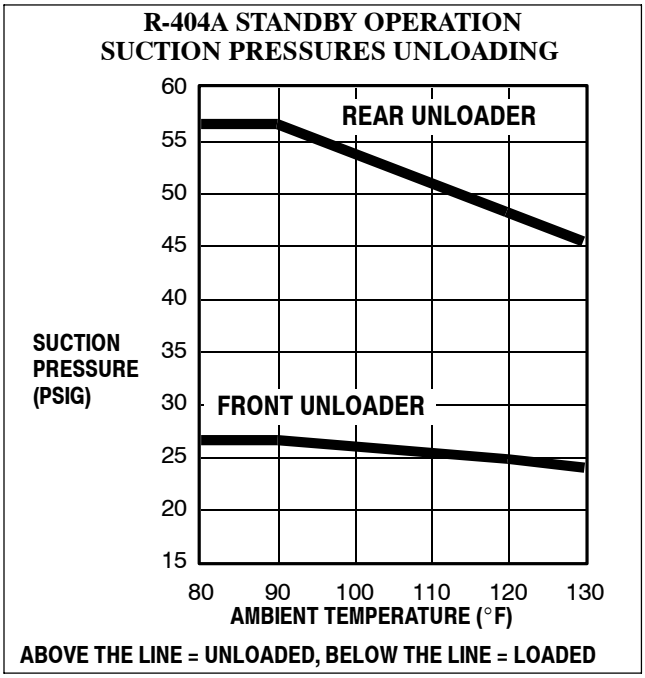
b. R-404A Refrigeration System

At ambient temperatures of 90°F (32.2°C) or below

When the system is operating and the suction pressure is greater than 57 psig, both unloaders are unloaded. As the suction pressure drops below 56 psig, the UL2 unloader is loaded. If the suction pressure drops below 26 psig, the the UL1 unloader is loaded.

At ambient temperatures of 90°F (32.2°C) or higher

At ambient temperatures of 90°F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



1.9.4 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.

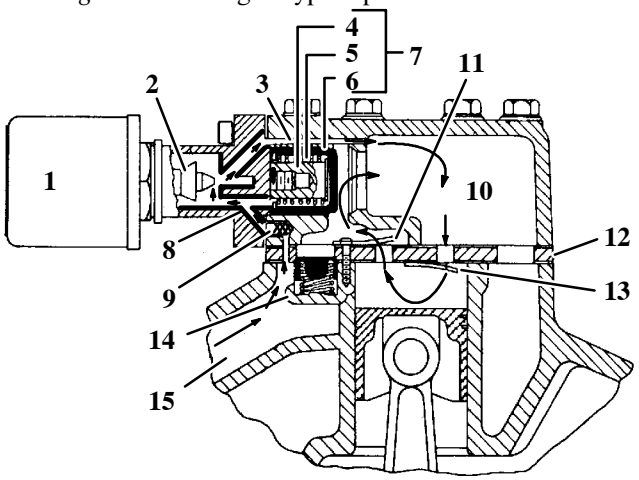
With the solenoid valve (1) *energized* the solenoid valve stem (2) will *open* the gas bypass port (3).

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 Hot Gas Bypass

c. Loaded Operation

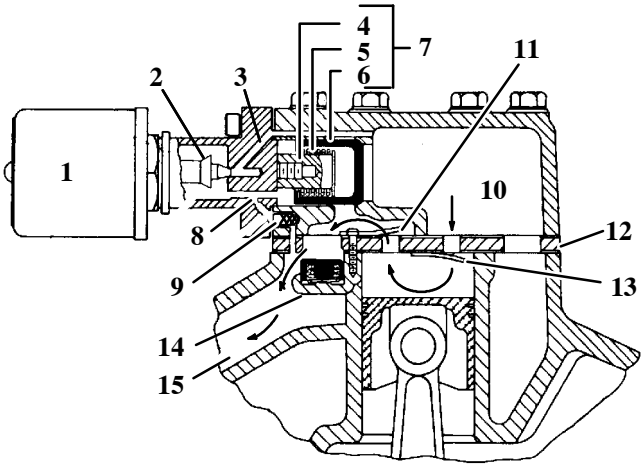
Discharge pressure bleeds from the discharge manifold (Figure 1-16, item 15) through the strainer (9) and (8) bleed orifice to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

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 Hot Gas Bypass

1.9.5 Suction Cutoff Unloader

a. Major Working Parts

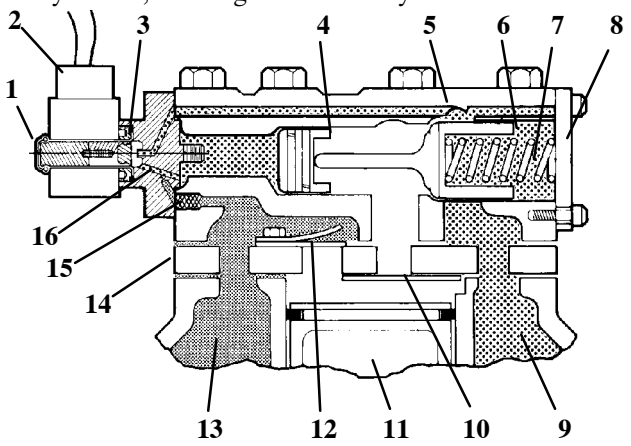
1. Solenoid and valve system
2. Unloader piston assembly
3. Spring and cover plate

b. Unloaded Operation

When the unloader valve solenoid energizes, the capacity control valve port opens (item 3, Figure 1-17). This allows the discharge gas behind the unloader piston assembly (item 4) to vent back to the suction side. The unloader valve spring (item 7) at this point, can move the unloader valve body to the left, blocking the unloader suction port. The cylinder bank is now isolated from the compressor suction manifold to unload these two cylinders. No refrigerant is allowed into the cylinders and no compression takes place.

c. Loaded Operation

When the unloader valve solenoid de-energizes, the capacity control valve port closes (item 3, Figure 1-18). This allows discharge pressure to build-up behind the unloader piston assembly. The high pressure will compress the unloader valve spring, opening the unloader suction port. Suction gas can now be drawn into the cylinders, running the bank fully loaded.

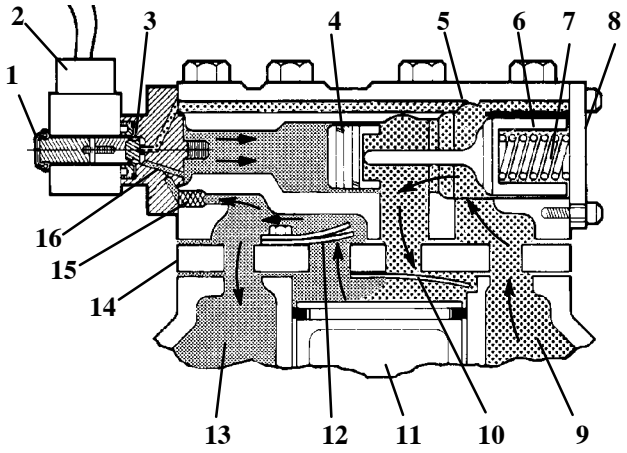


SUCTION PRESSURE

DISCHARGE PRESSURE

1. Solenoid Valve
2. Coil
3. Capacity Control Valve (Open)
4. Unloader Piston
5. Unloader Head
6. Body
7. Spring
8. Cover Plate
9. Suction Manifold
10. Suction Valve
11. Piston
12. Discharge Valve
13. Discharge Manifold
14. Valve Plate
15. Strainer
16. Bleed Orifice

Figure 1-17. Compressor Cylinder Head (Unloaded) Suction Cutoff



SUCTION PRESSURE

DISCHARGE PRESSURE

1. Solenoid Valve
2. Coil
3. Capacity Control Valve (Closed)
4. Unloader Piston
5. Unloader Head
6. Body
7. Spring
8. Cover Plate
9. Suction Manifold
10. Suction Valve
11. Piston
12. Discharge Valve
13. Discharge Manifold
14. Valve Plate
15. Strainer
16. Bleed Orifice

Figure 1-18. Compressor Cylinder Head (Loaded) Suction Cutoff

1.10 MICROPROCESSOR CONTROLLER

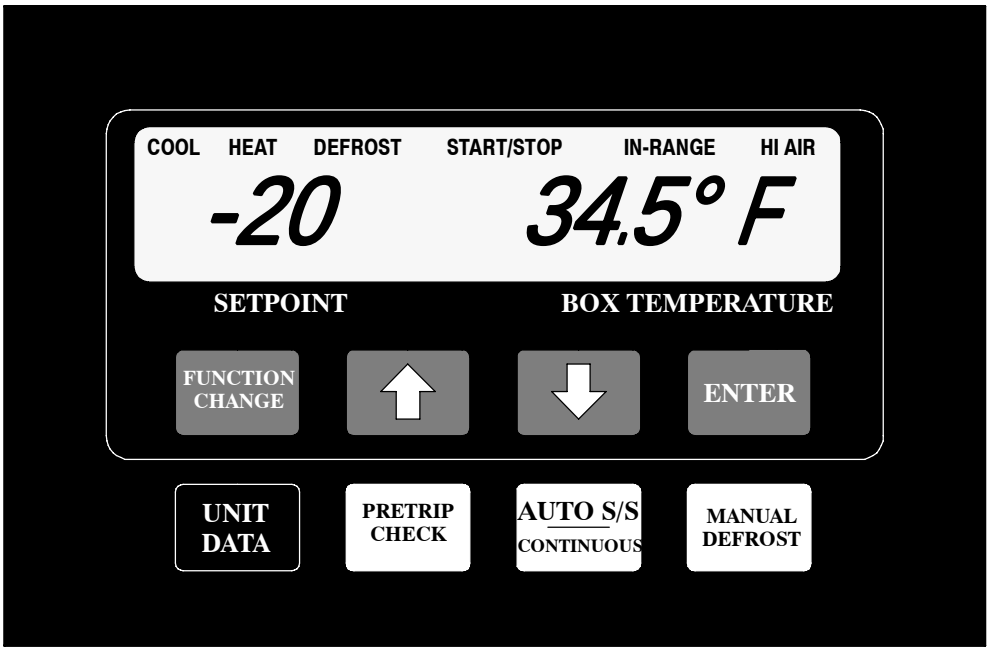


Figure 1-19. Microprocessor Control Panel

1.10.1 INTRODUCTION

The microprocessor controller is housed in the control panel on the lower roadside corner of the unit. This controller consists of 2 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 Display Board is mounted in the same control box as the processor board. The display board includes the LCD display, keypad and keypad interface.
3. The Relay Module contains replaceable relays, diode blocks and fuses along with the wiring harness.

The microprocessor is totally self-contained and does not contain any serviceable components.

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (see section 4.29) Should a problem develop with these component, contact your nearest Carrier Transicold dealer for replacement.

The Carrier Transicold microprocessor controller incorporates the following features:

a. Control supply or 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 supply or return air temperatures.

c. Digital readout and ability to select data. Refer to Table 1-5 for Function Code and Table 1-6 for Unit Data.

d. For alarm digital display identification refer to Table 1-7.

e. A pre-trip checkout of refrigeration unit operation. Refer to section 1.10.8

f. 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 5 seconds and then reset the micro.

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

g. A communication link to transmit unit operational data to a remote computer. Refer to section 1.10.12

1.10.2 KEYPAD

The keypad has 8 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 (Refer section 1.10.10).

Pretrip Check Key

The PRETRIP CHECK key is used to initiate a pretrip cycle, given that the proper conditions are met (Refer to section 1.10.8).

Auto Start/Stop Continuous Key

NOTE

With software revision 3.08 or 3.12 when configuration CNF11 is "ON" and setpoint is 32 to 42° F (0 to 5.5°C) the unit is locked into continuous run. Start/Stop Continuous key is disabled.

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 1.10.11).

To start the unit in manual start mode, the START/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 (See Section 1.10.5).

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 1.10.6).

1.10.3 SETPOINT

Setpoints of −22°F to +86°F (−30°C to +30°C) 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 will 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 being displayed is a non-entered value. Each time the UP/DOWN Arrow key is pressed, the 5 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 5 seconds of no keyboard activity, the display will revert back to the active setpoint.

1.10.4 DIGITAL DISPLAY

The digital display has 9 digits. The default display is setpoint on the left and controlled air temperature on the right. The readout is keypad selectable for Degrees C or Degrees F.

Also digital displays are provided to indicate the following modes: COOL, HEAT, DEFROST, IN-RANGE, HI AIR, START/STOP.

On each power-up, the unit will display a Display Test for 5 seconds then display the default reading.

1.10.5 FUNCTIONAL PARAMETERS

NOTE

If configuration CNF11 is "ON" functional parameters are lockout. The ability to change functional parameters from keypad are disabled.

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 will be 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 will be advanced one. If the function key is pressed and held for one second, the list will be advanced one item at a time. This list will be 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 5 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 5 seconds before reverting back to the default display. Each time a key is pressed, the 5 second delay will be reset. To select a different functional parameter the FUNCTION CHANGE key must be pressed first.

Code Vs English Messages

The description messages of the functional parameters, unit status and alarms can be displayed in English or Codes through this function selection. The two choices will be displayed as, ENGLISH or CODES. With this parameter set to CODES, all display descriptions will be 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 is 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 1.10.11. This feature must be selected before the 3 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 1.10.7. This parameter will not change due to the code vs English selection.

Table 1-5. Function Codes

CODE	ENGLISH	DATA
FN0	DEFR	Defrost Interval
FN1 ON	HIGH AIR	High Air Flow
FN1 OFF	NORM AIR	Norm Air Flow
FN2	OFF T	Off-time
FN3	ON T	On-time
FN4 A	REM PROBE	Controlling Probe – Return Air
FN4 B	SUP PROBE	Controlling Probe – Supply Air
FN5	Degrees F or C	Temperature Unit °C or °F
FN6 ON	TIME STRT	Maximum Off-time 30 Min.
FN6 OFF	TEMP STRT	Temperature Based Restarting
FN7	MOP STD	Future Expansion
FN8	2SET	Compartment 2 Setpoint
FN9	3SET	Compartment 3 Setpoint
FN10 ON	AUTO OP	Auto Start Operation
FN10 OFF	MAN OP	Manual Start Operation
FN11	T RANGE	Out-of-Range Tolerance
Code vs English = Code or English display format		
Manual Glow Override = Normal or Add 30sec		
Alarm Reset = Alarm Reset or No Alarms		

Defrost Interval

The defrost interval is displayed with the description DEFR or FN0. The data for the interval will be displayed with one decimal place and then the capital letter H for hours (i.e., DEFR 12.0H). The defrost intervals are 1.5, 3, 6 or 12 hours.

Airflow

The status of the speed control solenoid override is displayed as HIGH AIR or NORM AIR. The code display is FN1. The high air setting is "ON" and the NORM AIR setting is "OFF." If the display shows HIGH AIR, the unit is locked into high speed for setpoints above 10°F.

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 will be displayed with two digits and then the capital 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. With software revision less than 3.11 the on-times are 4 or 7 minutes. With software revision 3.11 or higher the on-time is 4 minutes. The data for the on-time will be displayed with two digits and then the capital letter M for minutes (i.e. ON T 4M).

Controlling Probe

The number of controlling probes is displayed with the following abbreviations: REM PROBE for a single probe (return air) control; SUP PROBE for a dual probe control (return and supply air). The code display is FN4. The 1-probe setting is "A" and the 2-probe setting is "B."

Standard Units Select

The standard unit select will control how all parameters are displayed. The two choices are DEGREES F and DEGREES C. This parameter also will control units that data is displayed in psig or bars (i.e, Degrees F or Degrees C). The code display is FN5. 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 FN6 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 STD – Future Expansion

This function is not used at this time. The display is FN7.

Compartment 2 Setpoint

Setpoints of –22°F (–30°C) to +86°F (+30°C) may be entered through this function for the second compartment. The setpoint function will be displayed with the abbreviated description 2SET. The code display is FN8. 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 being displayed is a non-entered value. Each time the UP key or the DOWN key is pressed, the 5 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 5 seconds of no keyboard activity, the display will revert back to the active setpoint. The update rate is once every 0.5 seconds if the UP or DOWN keys are held down.

Compartment 3 Setpoint

Setpoints of −22°F (−30°C) to +86°F (+30°C) may be entered through this function for the third compartment. The setpoint function will be displayed with the abbreviated description 3SET. The code display is FN9. The setpoint may be changed the same as the 2nd compartment.

Auto/Manual Start Operation

The selection for starting the unit are displayed AUTO OP (code FN10 ON) for auto start operation or MAN OP (code FN10 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 FN11. The selection are "A, B or C" 2, 3, or 4°C (3.6, 5.4, or 7.2°F) respectively.

When the out-of-range temperature is configured ON, 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 45 minutes. Also the unit will shut down.

When the out-of-range temperature is configured OFF, 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. Also the unit will continue to operate.

For set points below +10°F (−12.2°C) *frozen range* the unit is only considered out-of-range for temperatures above set point.

1.10.6 UNIT DATA

The UNIT DATA key can be used to display the unit operating data values. The data values will be displayed for 5 seconds and then the display will revert back to the normal 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 will be 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 will be advanced one. 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 will be 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 5 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 1-6. Unit Data Codes

CODE	ENGLISH	DATA
CD1	SUCT	Suction Pressure
CD2	ENG	Engine Hours
CD3	WT	Engine Temperature
CD4	RAS	Return Air Temperature
*CD5	SAS	Supply Air Temperature
*CD6	REM	Remote Air Temperature
CD7	ATS	Ambient Temperature
CD8	EVP	Future Expansion
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

* Codes 5 & 6 are variable. SAS is displayed when the SUP Probe Function is selected. REM is displayed when the REM Probe Function is selected.

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 −20 HG to 420 psig (−0.7 Bars to 29.4 Bars).

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 10°F to 266°F (−12°C to 130°C).

Return Air Temperature

The return air temperature is displayed with the description RAS 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 −36°F to 158°F (−38°C to 70°C).

Supply Air Temperature

The supply air temperature is displayed with the description SAS or CD5. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. SAS 85.0F). The display range is –36°F to 158°F (–38°C to 70°C). This unit data will be displayed only if the SUP PROBE is selected in the controlling probe functional parameter.

Remote Air Temperature

The remote air temperature is displayed with the description REM or CD6. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. REM 85.0F). The display range is –36°F to 158°F (–38°C to 70°C). This unit data will be displayed only if the REM PROBE is selected in the controlling probe functional parameter.

Ambient Temperature

The ambient temperature is displayed with the description ATS or CD7. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F, (i.e. ATS 85.0F) . The display range is –36°F to 158°F (–38°C to 70°C). If there is no sensor, then the display will read – – – for the data.

Evp – Future Expansion

This unit data is not used at this time. The Code display is CD8.

Compressor Discharge Temperature

The 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°F to 392°F (–40°C to 200°C). If there is no sensor, 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 capital 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 high enough to allow unit shut down in "Auto Start/Stop".

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 REV 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 3 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 3 digits of the serial number burned in to the Eprom. (i.e, SERH 001 or CD15 001).

Compartment 2 Air Temperature

The air temperature for the second compartment will be displayed with the abbreviated description 2RA on the left-hand side. 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 Air Temperature

The air temperature for the second compartment will be displayed with the abbreviated description 3RA on the left-hand side. 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.

1.10.7 ALARM DISPLAY

The fault light (FL) is turned on only for alarms that specify it. The default display will be overridden if a 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 1.10.5 for the procedure on resetting alarms.

Table 1-7. 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	✓Auto 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	RA SENSOR	✓Return Air Sensor
AL10	SA SENSOR	Supply Air Sensor
AL11	WT SEN-SOR	Coolant Temperature Sensor
AL12	HIGH CDT	✓High Discharge Temperature
AL13	CD SENSOR	Discharge Temperature Sensor
AL14	SBY MO-TOR	✓Motor Overload
AL15	FUSE BAD	✓Fuse
AL17	DISPLAY	Display
AL18	SERVICE 1	Maintenance Hour Meter 1
AL19	SERVICE 2	Maintenance Hour Meter 2
AL20	OUT RANGE	✓Main Compartment Out-of-range
AL21	2RA OUT	✓Remote Compartment 2 Out-of-range
AL22	3RA OUT	✓Remote Compartment 3 Out-of-range
AL23	CLUTCH	✓ Clutch Failure
✓ = 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 230 to 240°F (110 to 116°C) for 5 minutes or immediately if over 240°F (116°C). The fault light (FL) is turned on and 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 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 and engine will shut down.

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 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 (See Section 1.10.10).

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 1.10.11) 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.

Return Air Sensor Alarm

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

Supply Air Sensor Alarm

The supply air sensor alarm is displayed with the description SA SENSOR or AL10. This alarm is generated if the supply air sensor is open or shorted. This alarm will be disabled if the REM PROBE is selected in the controlling probe functional parameter.

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 and unit shuts down if the temperature is sensed above 310° F for 3 minutes. If the discharge temperature exceeds 350° F, the 3 minute timer will be overridden and the unit shut down immediately. If ambient temperature sensor (ATS) is at 120°F (49°C) or higher, the CDT limits are increased to 340°F (171°C) for 3 minutes. 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. The engine will shut down.

Display Alarm

When no communications exist between the main board and the display board for 8 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.

Out-of-Range Alarm

The out-of-range alarm is displayed with the description OUT RANGE or AL20. This alarm is generated when the main compartment is out-of-range refer to section 1.10.5. The fault light (FL) is turned on.

Remote Compartment 2 Out-of-range Alarm

The Code display is AL21. This alarm is generated when the remote compartment 2 is out-of-range refer to section 1.10.5. The fault light (FL) is turned on.

Remote Compartment 3 Out-of-range Alarm

The Code display is AL22. This alarm is generated when the remote compartment 3 is out-of-range refer to section 1.10.5. The fault light (FL) is turned on.

Clutch Alarm

The clutch alarm is displayed with the description CLUTCH or AL23. This alarm is generated if the clutch fails.

1.10.8 PRE-TRIP

The PRETRIP key is for checking unit operation and evaluating operation of all modes and indicating a failure when detected. The following details the sequence :

a. Unit operating and box temperature is below 40°F (4.4°C).

b. Operator presses the PRETRIP key. If the defrost thermostat (DTT) is closed, the controller will display "PPPP." If DTT is open, no response – end of test.

c. Controller displays "PPPP" Pre-trip mode is started.

d. After 30 seconds in high speed cool, unit cycles to low speed loaded cool.

e. After 30 seconds, unit cycles to low speed unloaded cool.

f. After 30 seconds, unit cycles to low speed unloaded heat.

g. After 30 seconds, unit cycles to low speed loaded heat.

h. After 30 seconds, unit cycles to high speed heat and displays coolant temperature.

i. After 30 seconds, unit cycles to high speed cool and displays defrost interval selected for 30 seconds, then unit cycles to defrost if DTT is closed.

j. After standard defrost cycle, Pre-trip is terminated and unit returns to normal operation.

1.10.9 HEAT/COOL MODE

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

The system is configured for cooling mode for engine start and during the oil pressure delay.

Hot gas heating is applied by energizing the HR1 and HR2 relays which will energize the hot gas solenoids. These relays will also control the remote heat and cool lights.

For units with UltraFreeze refer to section 1.13.

For units without UltraFreeze heating is locked out of operation at setpoint temperatures less than *+10°*F *(−12°C)* except during defrost.

Default Mode

For units with UltraFreeze refer to section 1.13.

When in frozen range (setpoint at or *below +10°*F), unit shall default to low speed loaded if a loss of control (bad sensor) is detected. Since electric driven units have no low speed, the default in the frozen range shall be high speed cooling unloaded. When in perishable range (setpoint *above +10°*F), the unit shall shut down. The proper alarm indication shall be displayed when this mode is active.

1.10.10 DEFROST CYCLE

Defrost is an independent cycle overriding cooling and heating functions to de-ice the evaporator as required. The controller displays "DF" during defrost mode on the right hand temperature display. The left hand display will continue to display the setpoint.

a. Defrost Timer Initiation

A defrost timer initiation is a keyboard selection (Refer to Section 1.10.5). The defrost timer is reset to zero whenever a defrost cycle is initiated. The controller holds in memory the last entered defrost interval.

b. Defrost Air Switch Initiation

An external defrost signal (DA) may be supplied as a set of normally open switch contacts closing to initiate the defrost cycle.

c. Manual Defrost Initiation

The defrost cycle may be initiated by pushing the MANUAL DEFROST key.

d. Defrost Function

The defrost mode is initiated upon expiration of the defrost timing interval with the presence of a signal from the defrost termination thermostat (DTT). It may also be initiated by the presence of a momentary manual defrost signal. Defrost may also be initiated by an external defrost signal from a device such as an air switch. The defrost mode terminates when the defrost termination thermostat (DTT) opens indicating the defrost cycle is complete. The defrost timer runs only when the DTT is closed. The defrost interval timer resets to zero when defrost is initiated by any means. The timer does not accumulate time during defrost mode, during standby off cycles or auto-start off cycles.

A defrost output is energized during defrost mode to de-energize the clutch to prevent hot air circulation to the load.

In addition, the heating outputs (SR, HR1 & HR2) are enabled to apply high-speed heat for hot gas heating.

The compressor operates at maximum capacity on diesel and diesel/electric units during defrost. The suction pressure signal can force the unloaders to be unloaded.

e. Fail safe Defrost Termination

Should the defrost cycle not complete within 45 minutes or if the external defrost signal does not clear at defrost termination, the defrost cycle is terminated. The internal timer is reset for 1.5 hours and the external defrost signal is ignored for defrost initiation. The manual defrost switch will override this mode and start a new 45 minute cycle. When defrost override is active, the appropriate alarm will be indicated. If the run relay is de-energized during defrost, defrost will be terminated.

f. Defrost Termination at Low Speed

The defrost terminates with HR1 and speed relay de-energizing. HR2 will turn off 2 seconds later. The defrost output will de-energize 5 seconds after HR1 to engage the clutch. If the temperature control requires high speed, it will energize 2 seconds after defrost relay is de-energized.

1.10.11 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 restarting when the engine coolant temperature drops below 34° F (1°C). A restart will also be initiated if the battery voltage falls below 11.0 Vdc. A restart will also be initiated if box temperature is more than 11°F (6°C) from set point.

NOTE

With software 3.11 or higher the unit will remain in low speed for 10 minutes after engine start-up when: Auto Start/Stop is at any setpoint or Continuous Run setpoint is below 10°F (−12°C).

a. Start/Stop – Continuous

NOTE

With software 3.08 or 3.12 when configuration CNF11 is "ON" and setpoint is 32 to 42° F (0 to 5.5°C) the unit is locked into continuous run. Start/Stop Continuous key is disabled.

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 ARL light will be on to indicate the start/stop mode has been selected.

c. Auto Start Failure

If the unit fails to start, shuts down on a safety, or fails to run for the minimum run time, three consecutive times, the "Auto Start/Failure" 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 5 seconds energize the glow plug relay (GPR) to supply power to the glow plugs, unit with buzzer will sound for 5 seconds than the starter is energized. On initial power-up, the control will delay 5 seconds before the starting sequence begins. If the required glow time is zero, the control will energize the starter after a 5 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 will be 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 is checked to determine if the engine is running and the alternator auxiliary has failed. For the second and third start attempts the glow time is increased by 5 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.

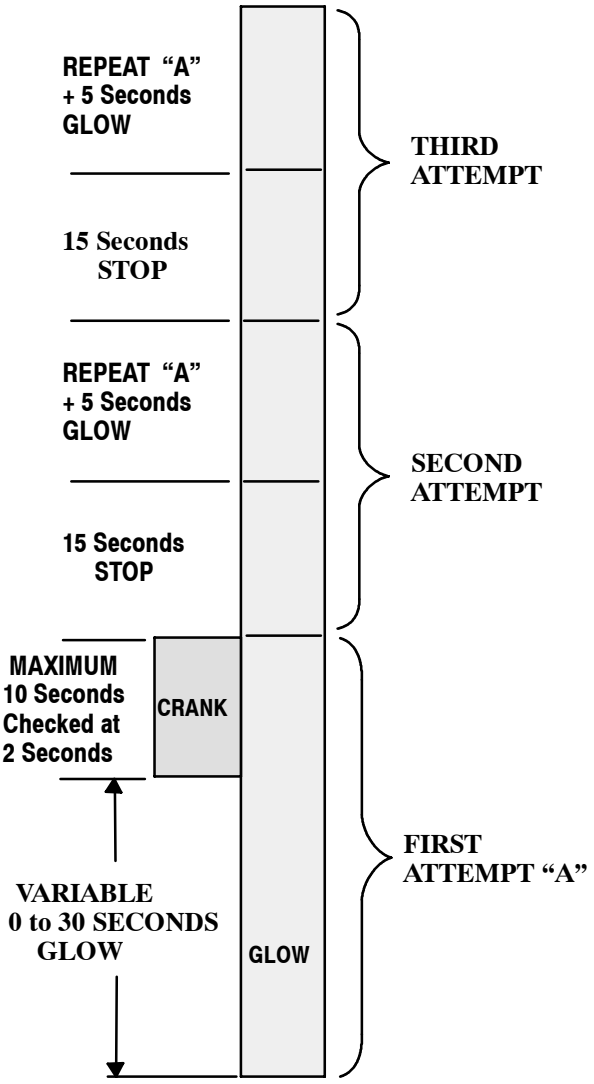


Figure 1-20. Auto Start Sequence

f. Variable Glow Time

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

Engine Coolant Temperature Glow Time		
Ambient Temperature	**Glow Time in Seconds**	
	TV	**DI**
Less than 32°F (0°C)	15	55
33°F to 50°F (1°C to 10°C)	10	40
51°F to 77°F (11°C to 25°C)	5	25
Greater than 78°F (26°C)	0	10

The second and third start attempts have a glow time that is 5 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 assume a temperature of less than 32°F (0°C) for the glow timing.

g. Minimum On Time

The engine is allowed to turn off only after a minimum of 4 or 7 minutes of run time with software revision less than 3.11. With software revision 3.11 or higher the on-time is 4 minutes.

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

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

The unit will shut down when the box temperature is within ±0.5°F (±0.3°C) of setpoint for setpoints in the Perishable range or +0.5°F (+0.3) above setpoint for setpoints in the Frozen range.

h. Minimum Off-Time

Keypad provision is provided 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 ±3.6°F (±2.0°C) of setpoint for the Perishable range or above +3.6°F (+2.0°C) of setpoint for the Frozen range.

The minimum off-time is overridden if the temperature is more than ±11°F (±6°C) from setpoint.

i. Battery Voltage

Provisions are made to sense when the battery is good. A good battery is defined as having 13.4v at 75°F. This condition is used to allow shut- off of the diesel engine.

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

Table 1-8. 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 the auto mode.

k. Maximum Off-Time

Provision for 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.

1.10.12 Remote Monitoring - DataTrak (Optional)

The microprocessor controller is equipped with a RS232 communication port. This port can be used to communicate unit operating data to a mobile satellite transmitter. This information will then be relayed back to the office via a modem to a computer.

There are presently three (3) protocols supported. The protocol for the QualComm transmitter, the protocol for the HUGHES transmitter, and Carrier Communication Protocol. The microprocessor will power up and transmit a HUGHES protocol packet and continue to transmit a packet every hour. The microprocessor will transmit in the Carrier, QualComm protocol if a data packet is requested.

1.11 SWITCHES AND CONTROLS

1.11.1 Introduction

Components required for monitoring and controlling the diesel engine – refrigeration system are located in the control box door and relay module. The water temperature sensor is located on top of the engine.

1.11.2 Control Box Door and Relay Module (See Figure 1-10 and Figure 1-11)

a. Gauges

1. Ammeter Gauge (A)

The d-c 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. The microprocessor performs a self-test (all segments of display are illuminated). Then Set Point and Box Temperature are displayed.

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) – Model NDM

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.

1.11.3 Location of Engine Safety Devices

a. Oil Pressure Safety Switch (OP)

This switch, set to open below 15 $\pm$ 3 psig (1.0 $\pm$ 0.2 kg/cm^2), will automatically stop the engine upon loss of oil pressure. See Figure 1-6 for location.

b. Water Temperature Sensor (WTS)

This sensor senses engine water temperature. The microprocessor will stop the unit when this temperature exceeds 230°F (110°C). If ambient temperature sensor (ATS) is at 120°F (49°C) or higher, the WTS limits are increased to 230 to 240°F for 5 minutes or immediately over 240°F (116°C). The sensor is located near the thermostat housing in the cylinder head.

1.12 ULTRAFRESH 2 TEMPERATURE CONTROL

UltraFresh 2 temperature control algorithm is a method of producing a reduced capacity state between heat and cool modes. This is done by combining a null pulse with either heat or cool. The capacity in this band can vary by adjusting the duty cycle of the null portion of operation. During this null operation heat and cool valves are opened simultaneously to reduce heating or cooling capacity.

UltraFresh 2 temperature control uses both supply and return air sensors to achieve control. If both probes are present and neither is defective or out of range the selected probe is the active probe. The controlling probe

will switch depending on if the unit has pulled down to setpoint yet. During pulldown the controlling temperature is from the active probe. When not in pulldown mode the controlling temperature is supply air plus an integrator error which is based on the selected controlling (active) probe Again the 60°F exception occurs. When not in pulldown mode and the setpoint is >= 60°F the active probe is used for control and integration .

There are three possible modes for UltraFresh 2 control. These are heat, cool and null. To enter COOL the control temperature must be greater than or equal to 1°C above setpoint. To exit cool and enter NULL the control temperature must be less than 0.8°C above setpoint. To exit NULL and enter HEAT the control temperature must be more than or equal to 1°C below setpoint and to exit heat and enter NULL the control temperature must be less than 0.8° below setpoint. (See Figure 1-21).

Null mode operates with a pulse, which combines cooling or heating with a null valve combination over a 10 second period. The null valve portion of the period is defined as HR1, HR3, and HR4 de-energized and HR2 energized. The calculated pulse percentage determines the type of pulse needed and the percentage of the 10 second period to pulse. At the end of each period the type of pulse and percentage is updated.

When in the null mode: The HEAT and COOL LCD's on the microprocessor display will blank out. The heat and cool lights (on light bar) will flash back and forth every 10 seconds or less.

UltraFresh 2 only operates when: Setpoint is in the perishable range above10°F (−12°C) and the unit is set for continuous run operation.

If ambient is <= 90°F (32°C) and the unit is in cool/diesel mode, with a setpoint > 10°F (−12°C) and the supply air probe is present/valid, and supply temperature is <= (setpoint − 3°C) energize the unloaders. Once supply temperature is > setpoint, (after having been unloaded), allow the normal temperature control algorithm to control the unloaders. If the supply air probe is not present/not valid, then use the return air temperature and energize the unloader solenoids at (setpoint − 5°C), allowing a 3°C band above setpoint before de-energizing the unloaders.

There is a delay of 10 seconds between de-energizing one unloader to de-energizing the other unloader under all operating conditions excluding engine starting.

1.13 ULTRA FREEZE TEMPERATURE CONTROL WITH SOFTWARE 3.11 OR HIGHER

For frozen setpoints, a modified Ultra Fresh 2 temperature control is used to keep the unit from over cooling. Ultra Freeze operates the same as Ultra Fresh 2 except as noted in this section. Ultra Freeze control will be used anytime a frozen setpoint is selected in both diesel and standby units, in both continuous and start/stop operation. When in standard multi-temp temperature control Ultra Freeze is used to control the main compartment if it has a frozen setpoint selected. Ultra Freeze operates independently of the setting of CNF-15.

If Ultra Freeze is active the Ultra Fresh 2 unloader cooling logic is not invoked.

a. Ultra Freeze Offset

In continuous run a −3°F offset is added which will force the unit to control to 3°F below setpoint. When the unit demands high speed cool and the high speed is delayed the unit will be allowed to run 6 cylinder low speed cool.

b. Ultra Freeze Start/Stop

In start/stop operation the unit's control will not have the 3°F offset and will control to setpoint by cycling the unit on and off according to the standard frozen mode start/stop startup and shutdown logic. The exception to this is when a low battery voltage or low engine coolant temperature defeats the normal shutdown logic, then the Ultra Freeze logic will control to the 3°F below setpoint offset.

c. Ultra Freeze Main Compartment Heat Mode

The main compartment is limited to 2 cylinder low speed heat. If either or both of the remote compartments are enabled and the main compartment goes to heat mode the remotes are immediately forced to null mode, no heat or cool.

d. Ultra Freeze Main Compartment / Remotes Control

When the main compartment is either heating or cooling The remote compartments can override both the speed and unloaders. If a remote goes to cooling the unloaders will be de-energized. If the remote then requests high speed the unit will go to high speed with no delays. If a remote goes to heat mode the unloaders will be controlled by the main compartment, (unless another remote is cooling), however the unit will go to high speed.

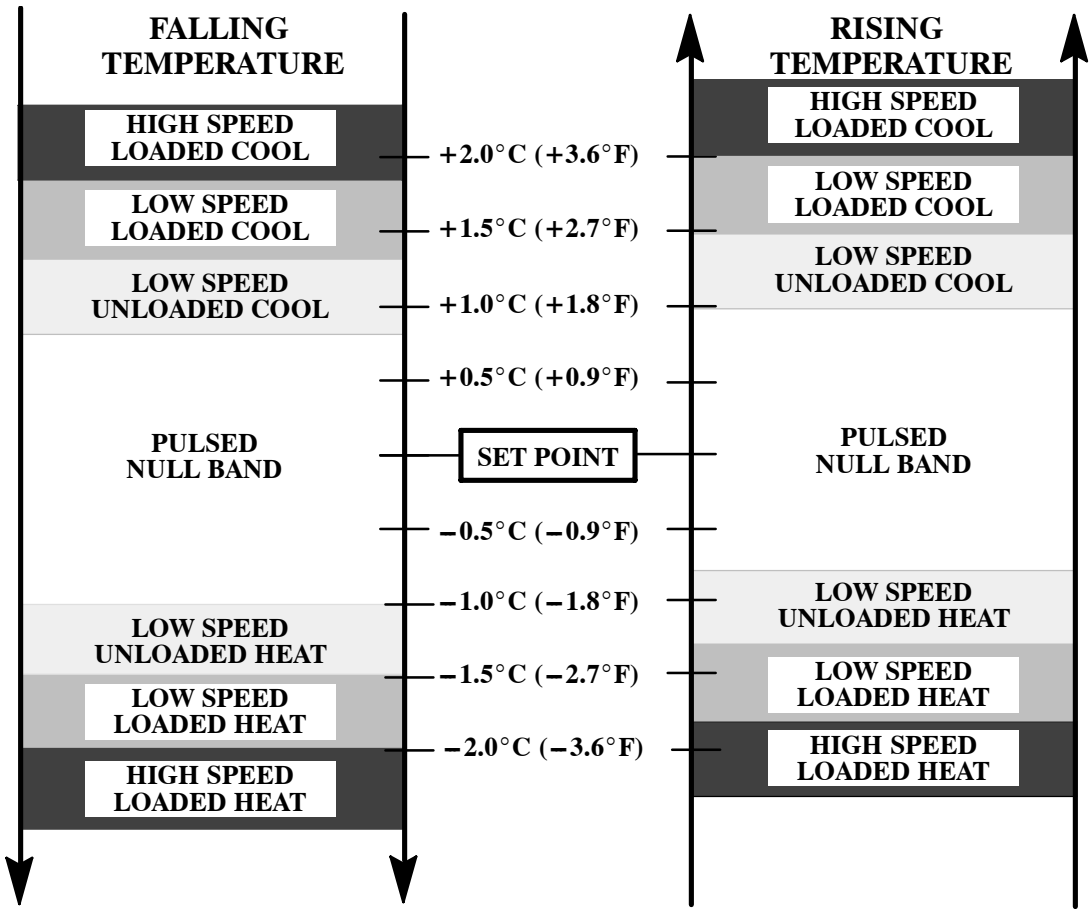


Figure 1-21 . UltraFresh 2 Temperature Control Operating Sequence

1.14 DATALINK MODULE (OPTIONAL)

1.14.1 Brief Description

WARNING

Do not attempt to service the DataLink module, breaking the warranty seal will void the warranty.

CAUTION

Remove DataLink module and unplug all wire harness connectors before performing any arc welding on any part of the unit.

Do not remove wire harness from module unless you are grounded to the unit frame with a static safe wrist strap.

Carrier Transicold has developed a recorder "DataLink" it is a self-contained module which consists of:

- Microprocessor
- Program memory
- Data memory
- Internally battery backed real time clock
- 5 thermistor inputs
- Fuel Level inputs
- Door open/closed switch
- Four status LED's
- Software ports
- Electronic backup power pack

This recorder eliminates the mechanical recorder and paper chart, and replaces it with a custom-designed module (see Figure 1-22) that interfaces with the controller module and the Datalink Toolbox PC based software program.

a. Operate as a stand alone device or as part of a network.

b. Log data at 2, 15, 30, 60 or 120 minute intervals.

c. Log DataLink alarms.

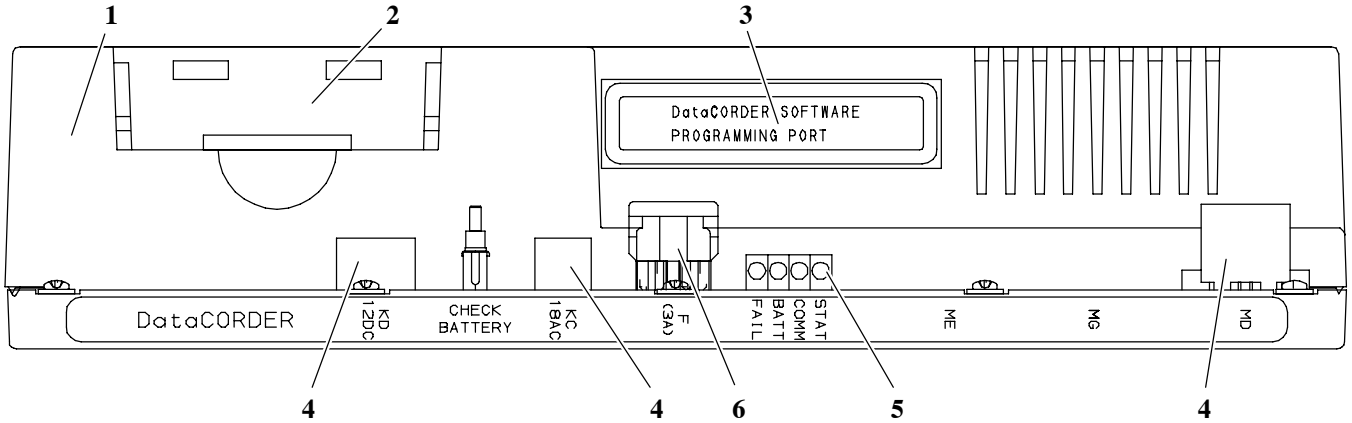
d. Can be custom configured to record up to 13 different sensors.

e. Record DataLink/Network generated events as follows:

- Main Setpoint Change
- Defrost Initiation
- Defrost Termination
- Pre-Trip Initiation
- Pre-Trip Termination
- Alarm Activity
- Controller Software Upgrade
- Controller Replacement
- Trailer ID Change
- Trip Start
- Trip Comment
- Unit Start/Stop
- Controller Configuration Change
- Function Parameter Change
- Controller System Mode Change (diesel/elect)
- Control Mode Change
- In-Range Indicator
- RTC Battery Replaced (Internal Battery)
- Remote 1 Setpoint Change
- Remote 2 Setpoint Change
- DataLink Alarm Activity
- Power off
- Power on
- Data Retrieval
- RTC Modification
- DataLink Software Upgrade
- Network Failure
- Network Recovery
- Door Opened/Closed
- Fuel Level Low/Normal

f. Download files contain the following information:

- Description Header
- DataLink Header
- Memory Configuration
- Current Values
- Alarm Table
- Time and Date
- Selected Event Data
- Recorded Sensor Values



1. DataLink Module
2. Backup Power Pack
3. Software Port
4. Connector
5. Status LED's
6. Fuse

Figure 1-22. DataLink Module

1.14.2 DataLink Flash (Programming) Cards

The programming cards are used for loading software into the DataLink. This is the same concept as using a floppy diskette to load software into a personal computer.

Operational Software:

This is the software that makes the DataLink module do what it does. Wake the unit up at a specified time, request information from other modules in the unit, take readings from probes, etc.

1.14.3 Functions

a. Memory Card Operations

The DataLink will support the download of code via a memory card using the software port. See Figure 1-22.

b. DataLink Power-Up

The DataLink may power up in any of 3 ways; normal DC power, by the RTC (Real Time Clock) because a logging interval has expired, or by plugging the computer cable into the downloader port.

If the DataLink has woken up because the logging interval is up, the DataLink will log the appropriate data and power-off when it is through. It will continue to log data for the next hour (2 minute interval setting) or 8 hour (all other setting). The data line will wake up on standby power, during a start/stop off cycle, electric standby off cycle, or following a unit safety shut down or turning unit switch off.

c. DataLink Diagnostics

The DataLink start up diagnostics processing will occur each time there is a power up or after a hardware reset. This processing will test the DataLink hardware for proper operation. If any critical test fails, then the fault LED will flash the test code three times to indicate what test failed. If any of these test fails, the module must be replaced.

CODE	TEST
1	Memory Test 1
2	Memory Test 2
3	Timer Test 1
4	Timer Test 2
5	Timer Test 3
6	Converter Test 1

d. Trip Start Processing

For the user to initiate a Trip Start: press the PRETRIP CHECK key on the control panel or use the DataLink Tool Box program to initiate Trip Start.

e. Data Recording Mode

DataLink can have up to 5 thermistor, 1 fuel level sensor and 1 door open/closed switch.

1.14.4 Status LED's

The DataLink contains four status LEDs. These are as follows:

- Battery Status (Yellow)
- Communication (Green)
- Fault/Alarm (Red)
- Status/Power/Executing Code (Yellow)

Batt – Battery Status LED:

The Battery status LED flashes once every 2 seconds when the battery voltage is greater than or equal to 6.0V. It will be on solid when the battery voltage is less than 6.0V but greater than or equal to 1.0V. It will be off when the battery voltage is less than 1.0V.

Comm – Communication LED:

The Communication LED will normally be off. A couple of blinks every minute shows DataLink is communicating with micro.

Fail – Fault/Alarm LED:

The Fault/Alarm LED indicates if a hardware fault or alarm has occurred in the DataLink. If a hardware fault occurs, the LED will flash the fault code three times, then the processor will reset. The fault codes and their code numbers are defined below. Fault codes will only be displayed on power up. If the DataLink powers up properly, then this LED will indicate an alarm condition that has been detected. The alarm LED should turn on when the alarm is detected, and off when the alarm goes away.

If an alarm occurs, then the LED will be on solid until the alarm goes away.

The out of range values are as follows:

Thermistor Inputs:

Low limit = −58.0°F (−50°C)
High limit = 158°F (70°C)

Stat – Status/Power LED:

The Status/Power LED indicates if the DataLink is powered up. The LED will be off when power is off or the DataLink is in a sleep mode running off the battery. The LED will pulse at a once every 2 second rate.

1.14.5 Message Trip Comment

DataLink has the capability to allow the user to enter comments directly into DataLink. The comments have a maximum length of 78 characters. Only one comment can be recorded per day. In the event that multiple comments are entered, then only the last will be saved.

1.14.6 DataLink Communications

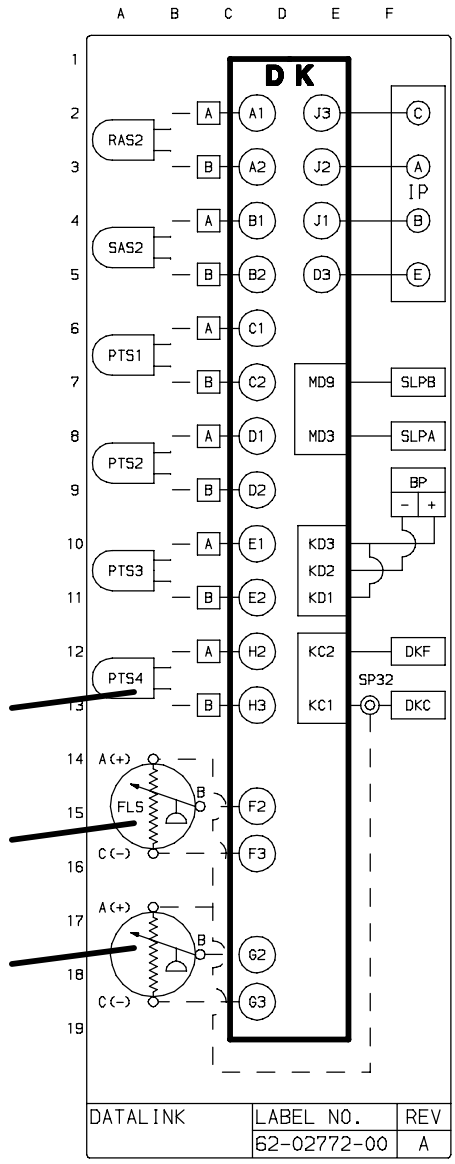
a. DataLink Retrieval – Interrogation

Data retrieval from the DataLink can be accomplished with a IBM compatible computer with appropriate cable and software.

The Toolbox software for a computer is supplied on a 3.5 inch floppy disk. This software allows downloading, screen view of the data, and printing.

ZONE	SYMBOL	DESCRIPTION
F9	BP	BATTERY PACK-7.2VDC NICAD
D1	DK	DATALINK MODULE
F12,F13	DKC/F	DATALINK CONNECTOR
A15	FLS	FUEL SENSOR (OPT.)
F2/5	IP	INTERROGATOR PORT
A6,8 10,12	PTS	PULP TEMPERATURE SENSOR (OPT.)
A2	RAS	RETURN AIR SENSOR (OPT.)
A4	SAS	SUPPLY AIR SENSOR (OPT.)
F7,8	SLP	SERIAL PORT
E13	SP	SPLICE POINT

◎ INDICATES SOLDERED SPLICE POINT
——— INDICATES WIRES IN SYSTEM
(1) COMPONENT CONNECTION NUMBER OR LETTER
— — INDICATES STANDARD OPTIONS



Door Switch

Fuel Level Sensor

Spare Voltage Sensor

Figure 1-23. DataLink Electrical Schematic

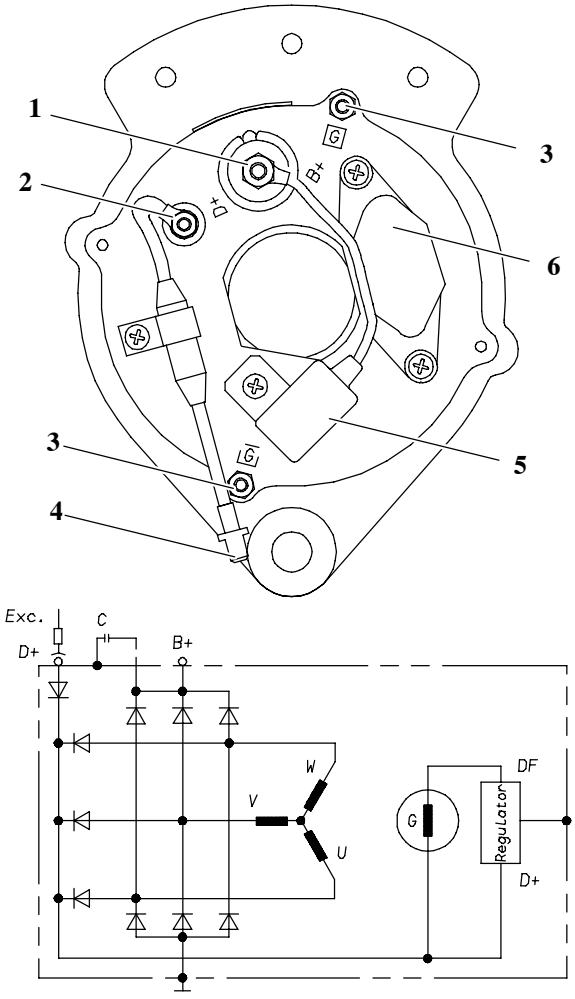
1.15 BATTERY CHARGING ALTERNATOR

1.15.1 Alternator Operation

CAUTION

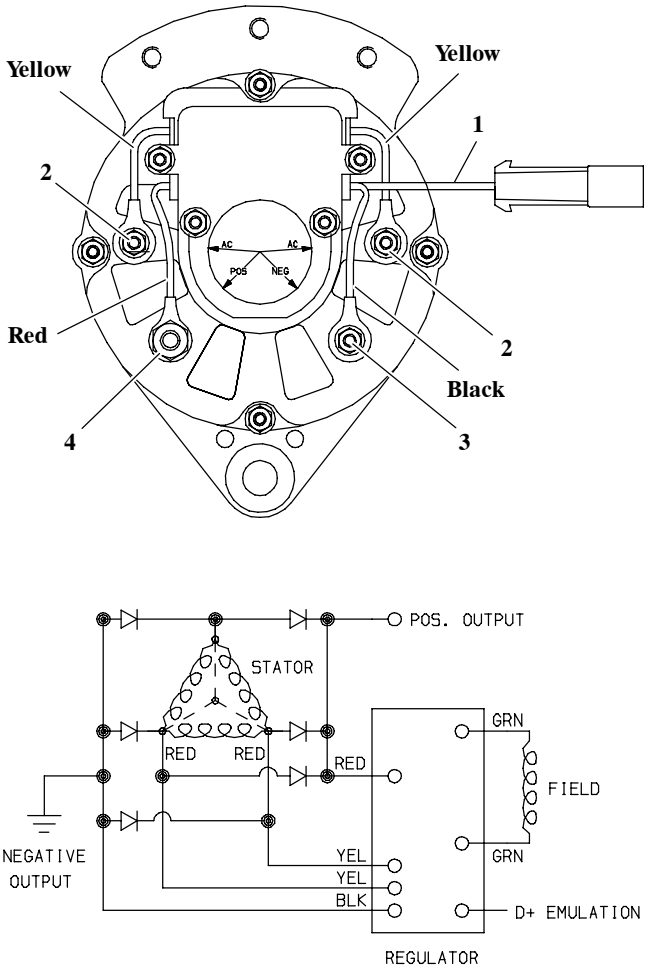
Observe proper polarity when installing battery, negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the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

The alternator converts mechanical and magnetic energy to alternating current (A.C.) 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 A.C. energy through a three phase, full-wave rectifier system. Six silicon rectifier diodes are used.



1. Positive Output(B+)
2. 12vdc Terminal (D+)
3. Ground Terminal
4. Excitation Input
5. Suppression Capacitor
6. Regulator, Brush Holder & Brushes

Figure 1-24. Alternator and Regulator P/N 30-00393-00



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

Figure 1-25. Alternator and Regulator P/N 30-00409-02

1.15.2 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 system voltage level and switches the voltage applied to the field in order to maintain proper system voltage.

1.16 REFRIGERANT CIRCUIT DURING COOLING (See Figures 1-20, 1-21 or 1-22)

When cooling, the unit operates as a vapor compression refrigeration system. The main components of the system are the (1) reciprocating compressor, (2) air-cooled condenser, (3) expansion valve, and (4) direct expansion evaporator.

The compressor raises the pressure and the temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air over the outside of the condenser tubes. The tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air. This removal of heat causes the refrigerant to liquefy; thus liquid refrigerant leaves the condenser and flows through the solenoid valve SV-1 (normally open) and to the receiver.

The receiver stores the additional charge necessary for low ambient operation and for the heating and defrost modes. The receiver is equipped with a fusible plug which melts if the refrigerant temperature is abnormally high and releases the refrigerant charge.

The refrigerant leaves the receiver and flows through the 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; and the electrically controlled liquid line solenoid valve (SV-2) which starts or stops the flow of liquid refrigerant.

In R-404A units the refrigerant flows to the "Liquid/suction" heat exchanger. Here the liquid is further reduced in temperature by giving off some of its heat to the suction gas.

The liquid then flows to an externally equalized thermostatic expansion valve 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 refrigerant pressure drop caused by the expansion valve is accompanied by a drop in temperature; thus, the low pressure, low temperature fluid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fan. The evaporator tubes have aluminum fins to increase heat transfer; therefore heat is removed from the air circulated over the evaporator. This cold air is circulated throughout the trailer 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. In R-22 units this low temperature, low pressure vapor returns to the compressor.

In R-404A units this low temperature, low pressure vapor passes through the "suction line/liquid line" heat exchanger where it absorbs more heat from the high pressure/high temperature liquid and then returns to the compressor.

The quench valve (R-22 Only) opens as required to maintain a 265 to 285°F (129 to 141°C) maximum discharge temperature.

NOTE

On Optima the quench valve is before SV2 and on Phoenix Ultra it is after SV2.

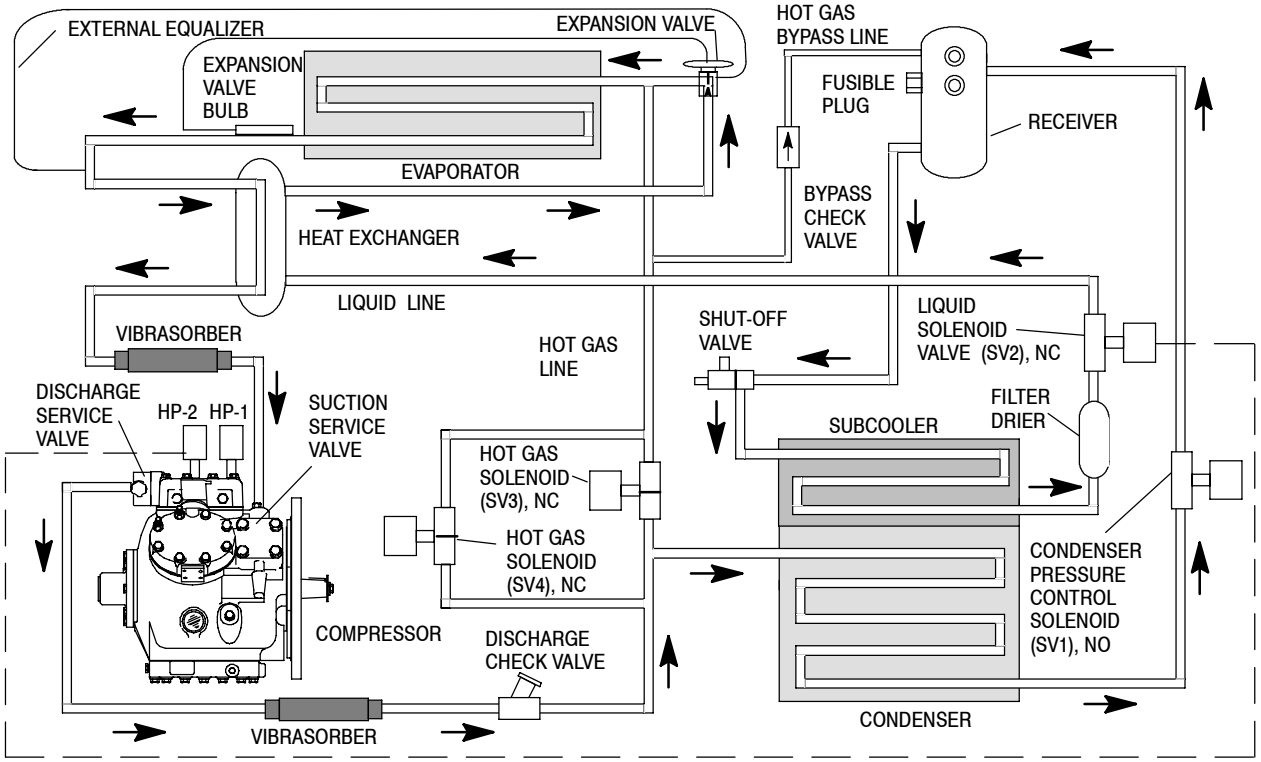


Figure 1-26. R-404A Refrigerant Circuit – Cooling

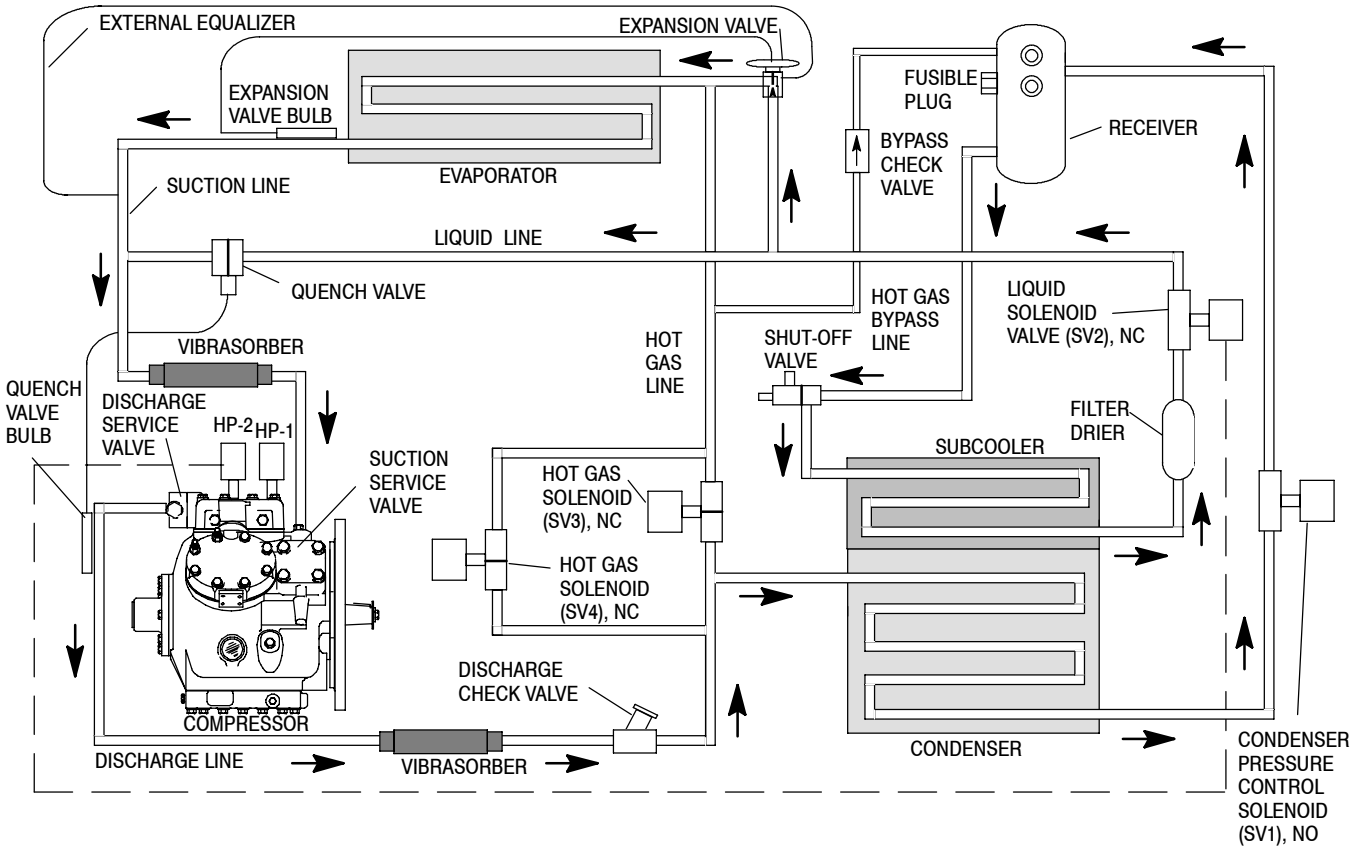


Figure 1-27. Phoenix Ultra – R-22 Refrigerant Circuit – Cooling

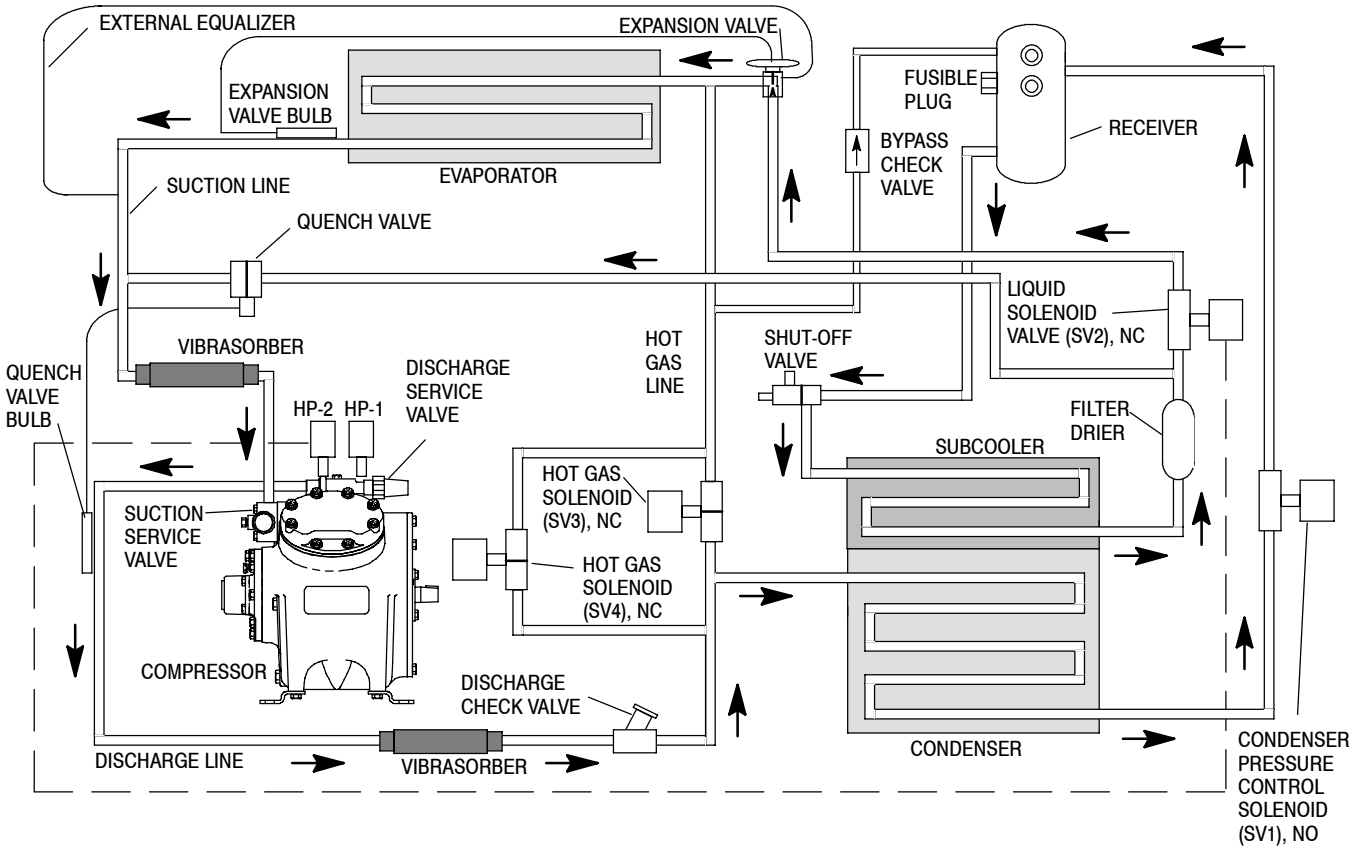


Figure 1-28. Optima – R-22 Refrigerant Circuit – Cooling

1.17 REFRIGERANT CIRCUIT DURING HEATING AND DEFROSTING (See Figures 1-23, 1-24 or 1-25)

For units with UltraFreeze refer to section 1.13.

For units without UltraFreeze the unit will only heat when the controller is set above +10°F (−12.2°C) as the heat relays are electronically locked out with set points below +10°F (−12.2°C).

When vapor refrigerant 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 is used as the source of heat during the heating cycle.

The quench valve (R-22 Only) opens as required to maintain a 265 to 285°F (129 to 141°C) maximum discharge temperature.

1.17.1 Heating and Defrost

NOTES

1. Solenoid valve (SV-2) remains open during heating or defrosting to allow additional refrigerant to be metered into the hot gas cycle (through the expansion valve) providing additional heating capacity until de-energized by head pressure control switch HP-2.
2. SV-3 on Ultima's, will not open when the ambient temperature exceeds 80°F (26.7°C).
3. SV-3 will open after a 60 second delay, if the engine is in high speed and the difference between ambient and discharge temperatures exceeds 100°F (55.5°C). If the difference between ambient and discharge temperatures goes below 50°F (27.8°C) SV-3 will close.

When the controller calls for heating, hot gas solenoid valve (SV-4) opens and the condenser pressure control solenoid valve (SV-1) closes. The condenser coil then fills with refrigerant, and hot gas from the compressor enters the evaporator. Also the liquid line solenoid valve (SV-2) will remain energized (valve open) as the head pressure control switch (HP-2) will remain closed until the compressor discharge pressure increases to cut-out setting (refer to section 1.4).

Switch HP-2 opens to de-energize the liquid line solenoid valve (SV-2) and the valve closes to stop the flow of refrigerant to the expansion valve.

When the compressor discharge pressure falls to cut-in setting (refer to section 1.4), pressure switch (HP-2) closes and in turn energizes the normally closed liquid solenoid valve (SV-2) which opens, allowing refrigerant from the receiver to enter the evaporator through the expansion valve.

When in engine operation and the discharge pressure exceeds pressure settings detailed in section 1.4, pressure cutout switch (HP-1) opens to de-energize the run relay coil (RR). When the RR coil is de-energized, the RR contacts open stopping the engine. The function of the hot gas bypass line is to raise the receiver pressure when the ambient temperature is low (below 0°F = −17.8°C) so that refrigerant flows from the receiver to the evaporator when needed.

1.17.2 Defrost with Greater Than 100°F (37.8°C) Ambient

a. Diesel Engine Operation

Units utilizing the new wiring harness & HR4 relay will initiate a pump down cycle during defrost above 100°F ambient temperature.(See Figure 1-11)

Units with older wiring harness, will not have HR4 and no pump down cycle.

If the ambient is greater than 100°F (37.8°C) the following stages are performed for defrost (Refer to Table 1-9). The first stage (Pump Down) runs for a minimum of thirty seconds and then checks the suction pressure. When the suction pressure is less than 10 PSIG, it will continue to stage 2. The total time in stage one cannot be greater than 330 seconds. If 330 seconds is reached stage two (Defrost Begins) will automatically be entered regardless of suction pressure. Stage 2 is defrost. Stage 3 (Defrost Termination) is the termination of defrost. When defrost is terminated SV4 will remain energized for 15 seconds.

b. Electric Standby Motor Operation

On electric standby motor operation HR4 relay is used to initiate a pump down cycle in heat or defrost.

Table 1-9. Stages for Defrost with Greater Than 100 °F (37.8°C) Ambient

STAGE	SV1 (HR1)	SV2 (HR4)	SV3 (HR3)	SV4 (HR2)	UR	UF	SPEED	CLH (DR)
1	OPEN (De-energ)	CLOSED (Energ)	CLOSED (De-energ)	CLOSED (De-energ)	Energ	Energ	De-energ	Energ (De-energ)
2	CLOSED (Energ)	HP2 Control (Energ)	CLOSED (De-energ)	OPEN (Energ)	De-energ	Energ	Energ	De-energ (Energ)
3	OPEN (De-energ)	OPEN (De-energ)	CLOSED (De-energ)	OPEN (Energ)	De-energ	Energ	De-energ	Energ (De-energ)

De-energ = De-energized Energ = Energized

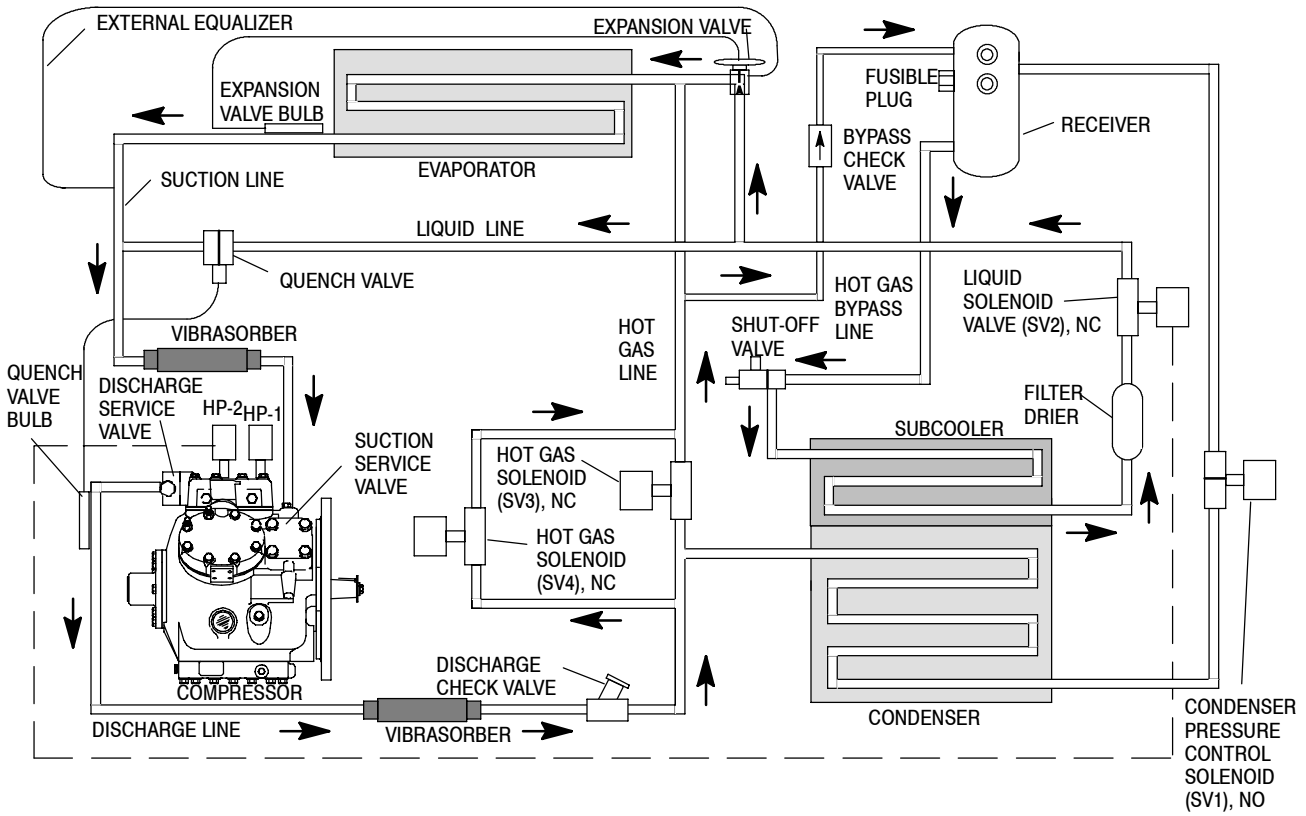


Figure 1-29. Phoenix Ultra – R-22 Refrigerant Circuit – Heating and Defrosting

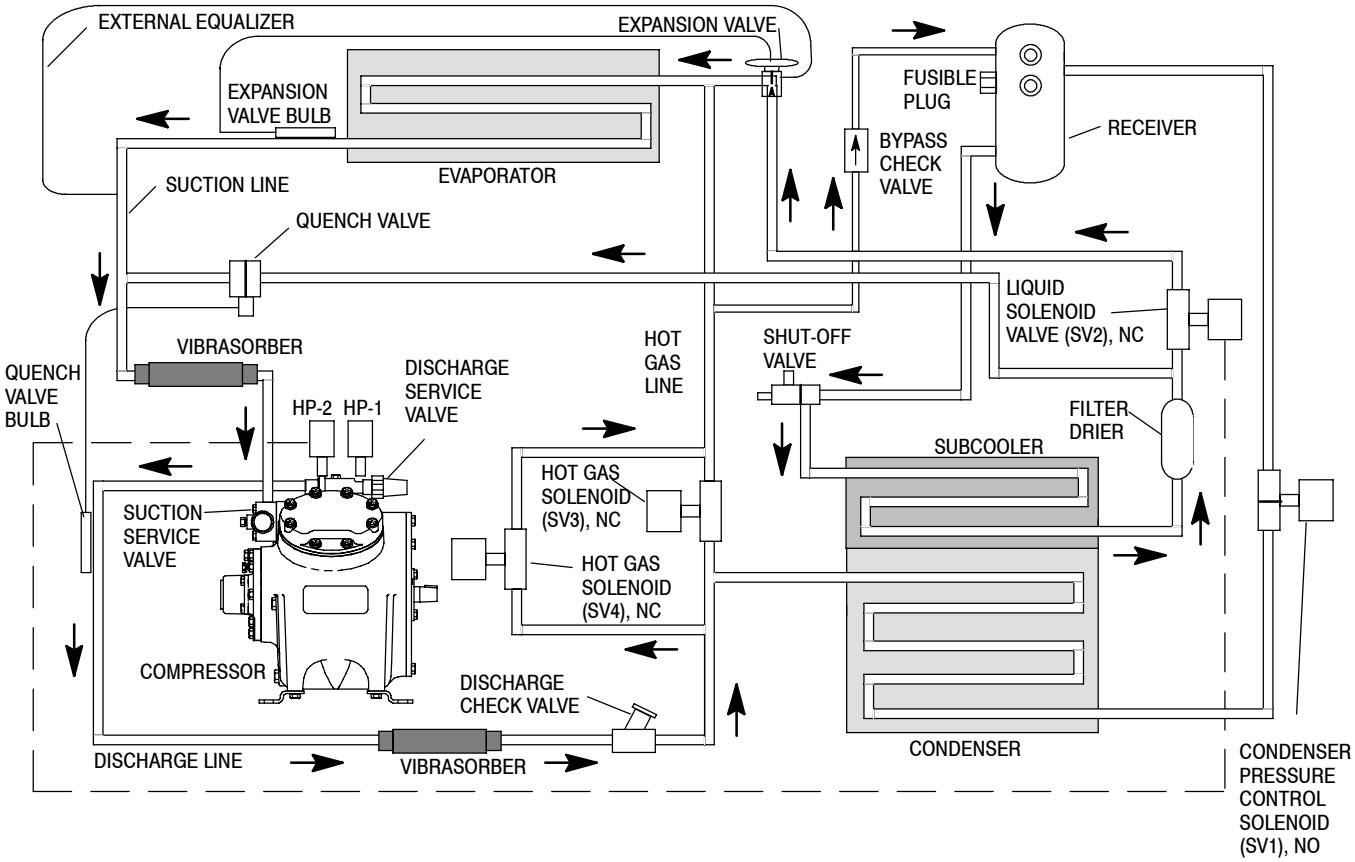


Figure 1-30. Optima – R-22 Refrigerant Circuit – Heating and Defrosting

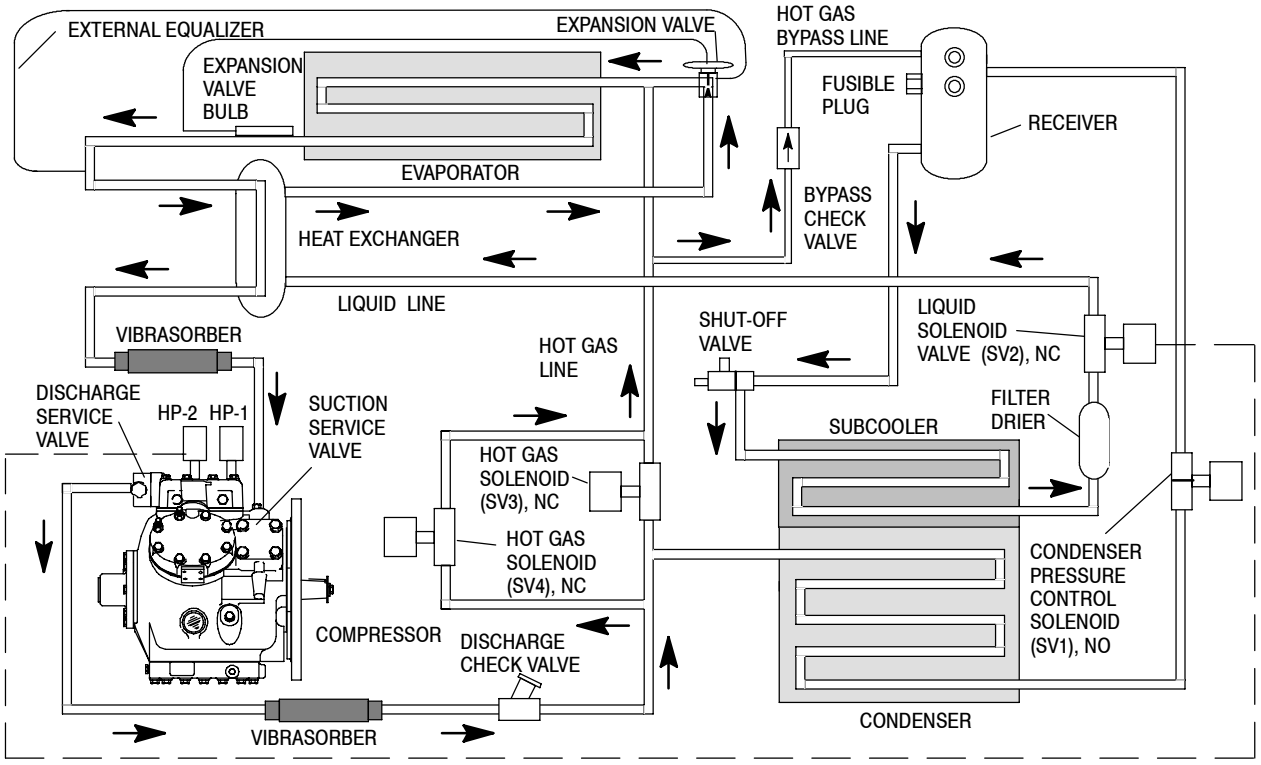


Figure 1-31. R-404A Refrigerant Circuit – Heating and Defrosting

SECTION 2

OPERATION

2.1 PRE-TRIP INSPECTION

a. Before Starting Engine

1. Drain water and sediment from fuel tank sump. Then fill tank with diesel fuel. (Refer to section 1.2)
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 belt or replace.
7. Check battery terminals for cleanliness and tightness. Clean and coat with a mineral type grease (such as Vaseline).
8. Check condenser/evaporator fan shaft bearing for excessive play.
9. Check engine air cleaner for cleanliness and condition of air cleaner hose.
10. Check oil level in compressor sight glass.
11. Check defrost drain pan hoses. (Should be clear of debris.)
12. Check defrost air switch tubes and connections for breaks or air leaks.

b. After Starting Refrigeration Unit

1. Check water temperature. (Should be 160 to 180°F = 71 to 82°C.)
2. Check ammeter. (Should indicate +2 to +10 amps after start-up.)
3. Check engine speed. (Refer to section 4.3.3)
4. Listen for abnormal noises. (Refer to section 3.3.7)
5. Check compressor oil level. (Refer to section 4.13)
6. Observe any signs of lube or fuel oil leaks.
7. Check radiator hoses for leaks.
8. Check refrigerant level. (Refer to section 4.10.f)
9. Feel filter-drier. Excessive temperature drop across drier indicates restriction. (Refer to section 4.16)
10. Check clutch/gearbox for excessive noise. On Ultima clutch is on fanshaft.
11. Start microprocessor Pre-trip Inspection. (Refer to Section 1.10.8)

2.2 STARTING AND STOPPING INSTRUCTIONS - ENGINE DRIVE

WARNING

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

NOTES

1. Whenever starting the 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 79°F (26°C). In order to prolong engine life, the microprocessor will prevent operation in high speed until coolant temperature reaches this temperature.
2. With software 3.11 or higher the unit will remain in low speed for 10 minutes after engine start-up when: Auto Start/Stop is at any setpoint or Continuous Run setpoint is below 10°F (−12°C).

2.2.1 AUTOMATIC START

a. Starting Instructions

1. Place the RUN-STOP switch in the RUN position. The microprocessor will perform a self-test (all display messages will appear in display window). Then setpoint and box temperature will be displayed.
2. The microprocessor will energize glow cycle (length of time depends on engine temperature). Units with buzzer will sound for 5 seconds before starting the engine.
3. To change the setpoint press the UP or DOWN arrow key and ENTER key.
4. 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 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.
2. Press the AUTO S/S−CONTINUOUS key (if necessary) to erase START/STOP 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 Continuous Run

Table 2-1. Manual Glow Time

Ambient Temperature	Glow Time in Seconds For	
	TV	DI
Less than 32°F (0°C)	15	55
33°F to 50°F (1°C to 10°C)	10	40
51°F to 77°F (11°C to 25°C)	5	25
Greater than 78°F (26°C)	0	10

b. Stopping Instructions

Place RUN-STOP switch in the STOP position to stop unit.

2.3 STARTING AND STOPPING INSTRUCTIONS - STANDBY MOTOR

WARNING

Make sure the power plugs are clean and dry before connecting to any power receptacle.

Beware of unannounced starting of fans and V-belts caused by thermostatic cycling of unit during standby operation.

a. Starting Instructions

1. Place the Run/Stop Switch in the STOP (0) position.
2. Plug in the power plug.
3. Place the Engine/Standby Switch in the STANDBY position.
4. Place the Run/Stop Switch in the RUN (I) position. Units with buzzer will sound for 5 seconds before starting.
5. Check for proper motor rotation. Condenser air must be drawn into unit. To reverse rotation, stop unit, disconnect power cord and change polarity of plug.

b. Stopping Instructions

WARNING

When changing from standby operation, first turn the unit OFF, turn OFF main power and remove power plug.

1. Place the Run/Stop Switch in the STOP (0) position.

2.4 CONTROL CIRCUIT OPERATION - ENGINE DRIVE

2.4.1 Introduction

NOTE

The schematic in this manual has map coordinates added to the margins. For example, to locate the ammeter (A) on the schematic, it would follow the component designation by the designation (I2). This would indicate that it is closest to lines I and 2 on the schematic. These locations have been added to the legend.

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

Connections to these boards are made through 3 multiple-pin plug connectors HC, HC2, & MP. The address system (example 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.

2.4.2 Cooling

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

The controller automatically selects the mode(s) necessary to maintain box temperature at set point. The modes are shown in Table 2-2.

For units with UltraFresh 2 refer to section 1.12.

If the unit is in high speed loaded 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.

When the unit is running in high speed loaded cool and with the evaporator coil temperature below 40°F (4.4°C) to close at least one defrost termination thermostat, a pre-trip may be initiated by depressing the PRETRIP

key. The operator now may verify the pre-trip sequence. (Refer to Section 1.10.8)

As the trailer temperature falls toward set point, the microprocessor will place the unit in low speed loaded cool. The temperature at which this occurs is not fixed but depends upon the rate at which the trailer temperature is approaching set point.

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.

As the trailer temperature falls closer to set point, the controller will shift the operation from low speed loaded cool to low speed unloaded cool to further reduce cooling capacity. To do this, the microprocessor will pull terminals X2 or X2 & X3 low, completing the ground path for the unloader relays (UFR & URR). The coils energizes to close the UFR & URR contacts. One or both unloaders (UF and UR) may energize to unload the compressor (Refer to Section 1.9).

For setpoints above 10°F (−12°C) and with decreasing temperature, the unit will shift to low speed unloaded heat.

For units with UltraFreeze refer to section 1.13.

For units without UltraFreeze setpoints below 10°F (−12°C) heating is locked out. Therefore, it is possible for the box temperature to fall below setpoint in the frozen range.

Unit will remain in various stages of heating until the box temperature increases enough to place the unit in the low speed unloaded cool mode. As the box temperature increases, the unit will shift to low speed loaded cool , and then to high speed cool mode (speed relay energizes).

2.4.3 Heating

NOTES

1. SV-3 will open after a 60 second delay, if the engine is in high speed and the difference between ambient and discharge temperatures exceeds 100°F (55.5°C). If the difference between ambient and discharge temperatures goes below 50°F (27.8°C) SV-3 will close.
2. SV-3 on Ultima's, will not open when the ambient temperature exceeds 80°F (26.7°C).
3. Whenever the unit shifts to heat or defrost, HR1 and HR2 energize simultaneously. When switching from heat (or defrost) to cool, HR1 de-energizes 2 seconds before HR2. This allows time for SV-1 to open and clear the condenser of liquid before SV4 closes. This will eliminate any high pressure buildup which could occur. During this time, only on the remote light bar, the heat and cool lights will be on together. The heat and cool display on the control panel change immediately.

Refer to section 1.17 for description on heating cycle.

For units with UltraFreeze refer to section 1.13.

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

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

(a) Low Speed Unloaded Heating, (b) Low Speed Loaded Heating, (c) High Speed Loaded Heating

The controller will shift the unit into low speed unloaded heat when the trailer temperature falls below set point (compressor in four cylinder heating). The microprocessor pulls terminals N1, X1 and X2 low to complete the ground paths for the heat relays (HR1 and HR2) and unloader front relay (UFR). When these relays energize, several things happen. This opens the (N.C.) contacts to the cool light and solenoid valve (SV2). SV2 now operates in conjunction with the head pressure control switch (HP2). (Refer to section 1.17)

Also, HR1 closes a set of normally open contacts to energize solenoid valve SV1 to close the condenser outlet line.

When the unloader front relay (UFR) energizes, a set of N.O. contacts (UFR) close to energize the compressor front unloader (UF). Compressor will be in four cylinder heating.

Energizing HR2 closes two sets of N.O. contacts. Solenoid SV4 energizes and opens to allow hot refrigerant vapor to enter the evaporator (section 1.17). The other set of HR2 contacts supply power to the heat light on light bar.

If more heating capacity is required, the unit will shift to low speed loaded heating. The microprocessor will break the ground path to de-energize the front unloader relay, which in turn, de-energizes the compressor unloaders (compressor shifts from four cylinder to six cylinder operation).

NOTE

High speed heat is locked out for 5 minutes after switching from cool to heat.

When maximum heating capacity is required, the unit will shift to high speed loaded heat. The microprocessor energizes the HR1, HR2, and speed relay (SR) coils. Terminals N1, X1 and N3 will be pulled low. The only change from the low speed loaded heat mode is that the speed relay is now energized. SR contacts close to energize the speed control solenoid (SCS). The engine will be in high speed.

2.4.4 Defrost

Refer to sections 1.10.10 and 1.17 for the heat and defrost cycle.

NOTE

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

The defrost mode may be initiated by three different ways if the evaporator coil is below 35°F (1.7°C). (Refer to section 1.4)

Method one to initiate defrost is by pressing 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 1.10.2). The manual defrost key and defrost timer are part of the microprocessor and are not shown on the schematic.

The third means of defrost initiation is by the defrost air switch (DA). The switch is an air pressure differential switch which measures air pressure differential across the evaporator coil and initiates the defrost cycle when the air pressure differential increases enough to close the DA contacts, such as would happen when excessive frost builds up on the evaporator coil surface.

When the defrost air switch contacts close, there is a 12 vdc potential to terminal K1 on the microprocessor. The microprocessor looks for voltage at terminal K2. Voltage at K2 indicates that at least one defrost termination thermostat is closed. The unit will shift to the defrost mode if voltage is present at K2.

If both defrost thermostats (klixons) are open (no voltage at K2), defrost cannot be initiated by any means.

In defrost the microprocessor pulls terminals N1, 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. This closes the N.O. defrost relay contacts to energize the defrost light on the remote light bar. The defrost and heat display will also be illuminated.

Also N.C. defrost relay contacts open to de-energize the clutch (CLH) to stop the evaporator and condenser fans. On Ultima the clutch stop only the evaporator fans.

The unit will remain in defrost until both defrost termination thermostats open to remove voltage from the defrost relay. If the thermostats fail to open in 45 minutes, the microprocessor will terminate defrost and shift between normal control and defrost at 1 1/2 hour intervals. This will also occur if the defrost air switch is stuck closed.

If the problem corrects itself, (thermostats opens for example), the unit will automatically resume its normal functions).

The defrost termination starts with HR1 and speed relay de-energizing. HR2 will turn off 2 seconds later. The defrost output will de-energize 5 seconds after HR1. If the temperature control requires high speed, it will energize 2 seconds after defrost relay is de-energized.

2.5 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.

With software 3.11 or higher and units with UltraFresh 2 refer to section 1.12.

2.5.1 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: Electric Standby can operate in the Start/Stop mode or the Continuous Run mode.

During Start/Stop operation, (Perishable Range) the unit will operate in 3 modes: A) "Cool" cycle B) "Off" cycle C) "Heat" cycle

During Start/Stop operation, (Frozen Range) the unit will operate in 2 modes: A) "Cool" cycle B) "Off" cycle

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. The microprocessor automatically locks out heating for entered setpoints below –12.2°C (10°F). Therefore, it is possible for the box temperature to fall below setpoint in the frozen range.

2. Minimum "ON" time (5 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 +/– 0.3°C (0.5°F)

Frozen Range Setpoints + 0.3°C (0.5°F)

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.

2.5.2 Standby Cool

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

First the microprocessor will energize (ARR), this will close a set of N.O. (ARR) contacts, energizing the Auto Restart Light (ARL) on the light bar, indicating to the operator that the unit is in the START/STOP mode and may start at any time. After a 5 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 Power Light (PL) on the light bar indicating to the operator that the unit is in the standby mode of operation, and also 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.

2.5.3 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.

When the unit is "OFF," the microprocessor keeps (ARR) energized. The unit will remain off for at least 5 minutes before restarting. If after 5 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.

2.5.4 Standby Defrost

Standby defrost operates the same as engine drive defrost refer to section 2.4.4.

Table 2-2. Relay Operation

Mode	DER	GPR	RR	SSR	SR	Perishable		Frozen		HR1	HR2	HR3	HR4	DR	OR	ARR	FR
						UFR	URR	UFR	URR[5]								
Off	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Glow	O	I	I	O	O	I	I	I	I	O	O	O	O	O	I or O	I or O	I or O
Start	O	I	I	I	O	I	I	I	I	O	O	O	O	O	I or O	I or O	I or O
High Speed Cooling	O	O	I	O	I	I or O[1]	I or O[1]	I or O[1]	O[1]	O	O	O	O	O	I or O	I or O	I or O
Low Speed Cooling	O	O	I	O	O	I	I or O[1]	I or O[1]	O[1]	O	O	O	O	O	I or O	I or O	I or O
Off Cycle	O	O	O	O	O	O	O	O	O	O	O	O	O	O	I or O	I or O	I or O
Low Speed Heating	O	O	I	O	O	I or O[1]	O[4]	N/A	N/A	I	I	I or O[2]	I	O	I or O	I or O	I or O
High Speed Heating	O	O	I	O	I	O[1]	O[4]	N/A	N/A	I	I	I[3]	I	O	I or O	I or O	I or O
Defrost	O	O	I	O	I	O[1]	O[4]	O[1]	O[4]	I	I	I[3]	I	I	I or O	I or O	I or O
High Ambient Defrost Stage 1	O	O	I	O	O	I	I	I	I	O	O	O	I	O	I or O	I or O	I or O
UltraFresh 2	O	O	I	O	O	O[1]	O[1]	N/A	N/A	O/I	O/I	O	O/I	O	O	O	I or O
UltraFreeze	O	O	I	O	O	N/A	N/A	O	O	O/I	O/I	O	O/I	O	O	I or O	I or O
STANDBY MOTOR OPERATION																	
Cooling	I	O	I	O	O	O[1]	O[1]	O[1]	O[1]	O	O	O	O	O	I or O	O	O
Cooling Unloaded	I	O	I	O	O	I	I	I	I	O	O	O	O	O	I or O	O	O
Off Cycle	O	O	O	O	O	O	O	O	O	O	O	O	O	O	I or O	O	O
Heating	I	O	I	O	O	O[1]	O[4]	N/A	N/A	I	I	I[3]	I	O	I or O	O	O
Heating Unloaded	I	O	I	O	O	I	O[4]	N/A	N/A	I	I	I or O[2]	I	O	I or O	O	O
Defrost	I	O	I	O	O	O[1]	O[4]	O[1]	O[4]	I	I	I[3]	I	I	I or O	O	O
High Ambient Defrost Stage 1	I	O	I	O	O	I	I	I	I	O	O	O	I	O	I or O	O	O
UltraFresh 2	I	O	I	O	O	O[1]	O[1]	N/A	N/A	O/I	O/I	O	O/I	O	O	O	I or O
UltraFreeze	I	O	I	O	O	N/A	N/A	O	O	O/I	O/I	O	O/I	O	O	I or O	I or O

I = Output is ON
O = Output is OFF
[1] Sequence shown is thermostat control selection. This may be overridden by suction pressure.
[2]Output will only energize in high speed heat, but will remain energized if unit goes to low speed heat.
[3]Certain conditions must be met before output is energized.
[4]Suction pressure will not override this unloader in heat.
[5] No (URR) rear unloader on model NDA-93/94B Optima.

SECTION 3

TROUBLESHOOTING

CAUTION

Under no circumstances should anyone attempt to service the microprocessor!(see section 4.29) 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 Fuel solenoid defective Fuel pump (FP) malfunction	Check 4.2 Drain Sump Re-place Check Engine Manual 4.3.7 Engine Manual 4.2
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 Fuel solenoid defective Fuel pump (FP) malfunction	Check Check Check Engine Replace Engine Manual Engine Manual 4.3.4 1.5 Engine Manual 4.2
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 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 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
Fuel 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 sensor (WTS) defective Fuel solenoid defective Run-Stop switch defective	Check Tighten Replace Replace Replace Engine Manual 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 4.4 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	4.4 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	4.4 Replace 4.4 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	4.12 4.12
Refrigeration system	Defrost cycle did not terminate Abnormal pressure Solenoid valve malfunction Clutch Failure (Ultima)	3.3.5 3.3.6 3.3.11 4.24
3.3.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor valves defective Unloader malfunction	4.12 4.14
Refrigeration system	Abnormal pressure Unloader malfunction Expansion valve malfunction No or restricted evaporator airflow Clutch Failure (Ultima)	3.3.6 4.14 3.3.10 3.3.9 4.24
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.3.3 3.1
3.3.3 Unit Operates Long or Continuously in Cooling		
Trailer	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	4.12
3.3.4 Unit Will Not Heat or Has Insufficient Heating		
Refrigeration	Head pressure control switch (HP-2) defective Abnormal pressure Temperature controller malfunction Solenoid valve malfunction 1/4” check valve (bypass) defective Clutch Failure (Ultima)	4.17 3.3.6 3.3.8 3.3.11 4.15 4.24
Compressor	Compressor drive defective Compressor defective	4.12 4.12
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.3.3 3.1

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.5 Defrost Cycle Malfunction		
Will not initiate defrost automatically	Defrost air switch (DA) out of calibration Defrost thermostats (DTT) open or defective Defrost air switch (DA) defective Loose terminal connections Air sensing tubes defective or disconnected	4.22 4.21 4.21 & 4.22 Tighten Check
Will not initiate defrost manually	Microprocessor defective Loose terminal connections Defrost thermostats (DTT) open or defective Glow/Crank switch defective	Replace Tighten Replace Replace
Initiates but does not defrost	Solenoid valve malfunction Defrost relay (DR) defective Clutch/Gearbox defective	3.3.11 Replace Replace
Frequent defrost	Defrost air switch (DA) out of adjustment Wet load	4.21 & 4.22 Normal
Does not terminate or cycles on defrost	Defrost thermostats (DTT) shorted closed Head pressure control switch (HP-2) defective Low refrigerant charge Defrost air switch (DA) out of adjustment	4.21 4.17 4.11 4.21 & 4.22
3.3.6 Abnormal Pressure **3.3.6.1 Cooling**		
High discharge pressure	Quench valve malfunction Condenser coil dirty Condenser fan defective V-belt broken or loose Discharge check valve restricted Noncondensibles or refrigerant overcharge Solenoid valve (SV-1) malfunction	Replace 4.26 4.23 4.4 4.15 Replace 4.20
Low discharge pressure	Compressor valves(s) worn or broken	4.12
High suction pressure	Compressor valves(s) worn or broken Compressor gasket(s) defective	4.12 4.12
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 Solenoid valve (SV-2) defective Clutch Failure (Ultima)	Open Open 4.16 4.11 3.3.10 3.3.9 4.21 4.19 4.24
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective	4.12

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.6.2 Heating		
High discharge pressure	Solenoid valves (SV-1, SV-3 and SV-4) malfunction Condenser fan defective V-belts broken or loose Noncondensibles in system Head pressure control switch (HP-2) defective (closed)	3.3.11 4.23 4.4 Check 4.17
Low discharge pressure	Compressor valve(s) worn or broken Head pressure control switch (HP-2) defective(open) Solenoid valve (SV-1) malfunction Low refrigerant charge	4.12 4.17 3.3.11 4.11
Low suction pressure	Refrigerant shortage Solenoid (SV-1) open Defective HP-2	4.11 3.3.11 4.17
3.3.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	Tighten 4.12 4.12 3.3.10 4.13
Condenser or evaporator fan	Loose or striking shroud Bearings defective Bent shaft	Check 4.23 4.23
Clutch/Gearbox	Defective	Replace
V-belts	Cracked or worn	4.4
3.3.8 Control System Malfunction		
Will not control	Sensor defective Relay(s) defective Microprocessor controller malfunction	4.31 Check 4.29
3.3.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil Dirty coil	4.21 4.25
No or partial evaporator air flow	V-belt broken or loose Clutch/Gearbox defective Evaporator fan loose or defective Evaporator fan rotating backwards Evaporator air flow blocked in trailer (box)	4.4 Replace 4.23 4.4 Check

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	4.8/4.11 Clean 4.9 4.27 4.27 Replace Replace 4.27
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	4.27 Open 4.9 Clean 4.27
Fluctuating suction pressure	Improper bulb location or installation Low superheat setting	4.27 4.27
High superheat	Broken capillary	4.27
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 4.19 4.19 4.19 4.19 4.19 4.19
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 Internal Motor Overload (MOL) open Improper power supply Oil pressure switch (OPS) open Selector switch (SSW) defective Phase sequence defective	Replace Replace motor Check Check Replace 4.28
Standby motor starts, then stops	Internal Motor Overload (MOL) open High amperage draw	Check Check
Fans rotating backwards	Motor incorrectly wired	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.

CAUTION

Unit uses R404A and POE oil. The use of inert gas brazing procedures is mandatory for all Carrier Transicold refrigeration units; otherwise compressor failure will occur. For more information Refer to Technical Procedure 98-50553-00 Inert Gas Brazing.

NOTE

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

4.1 MAINTENANCE SCHEDULE

For the most reliable operation and for maximum life, your unit requires regular maintenance. This includes oil and filter changes, fuel and air filter replacement, coolant replacement and pretrip inspections. Maintenance should be performed according to the following schedule:

SYSTEM	OPERATION	REFERENCE SECTION
a. Daily Maintenance		
	Pre-Trip Inspection – before starting Pre-Trip Inspection – after starting Check Engine Hours	2.1 2.1 Check
b. Every 2000 Hour Maintenance (Normal Operating Conditions)		
Unit	1. Check unit mounting bolts 2. Check engine and compressor mount bolts 3. Check door latches & hinges 4. Check muffler and exhaust pipes 5. Check gauges, switches and electrical connections 6. Check all belt tensions 7. Check controL box 8. Check gearbox and fanshaft for oil leaks 9. Check fanshaft and gearbox bearings 10. Check clutch air gap and adjust as required.	 4.4
Engine	1. Check oil/filter change interval (refer to section **f.**of this table) 2. Check for oil leaks 3. Check low oil pressure safety 4. Clean crankcase breather	4.3.2 1.5 4.3.5
Fuel System	1. Drain fuel tank sump 2. Clean fuel pump strainer 3. Change fuel filter(s) 4. Check fuel heater (optional) 5. Check for fuel leaks 6. Check fuel lines for chafing	– – – 4.3.6 4.3.6 – – – Check/Replace

b. Every 2000 Hour Maintenance – Normal Operating Conditions (Continued)		
Cooling System	1. Check antifreeze using a refractometer (CTD P/N 07–00435–00) 2. Clean radiator/condenser fin surface 3. Check hoses and connections 4. Check water pump 5. Check water temperature sensor functions	4.3.1 4.3.1 and 4.26 Check/Replace 1.2
Exhaust System	1. Check mounting hardware 2. Check muffler and exhaust pipes	
Air Intake System	1. Check and reset air filter indicator (optional) 2. Check air cleaner – clean or replace as required	 4.3.4
Starting System	1. Check battery 2. Clean battery connections and cable ends 3. Check battery hold down clamps 4. Check starter operation 5. Check glow plug operation	Check/Replace Check/Replace 4.3.7
Charging System	1. Check alternator mounting bolts 2. Check alternator brushes 3. Check alternator output	 1.15
Refrigeration System	1. Check air switch & calibrate 2. Check & clean evaporator 3. Check compressor oil level 4. Check refrigerant level 5. Check operating refrigerant pressure 6. Check all sensor calibrations 7. Check defrost drains 8. Check manual defrost operation 9. Check Compressor drive coupling	4.15 4.25 4.13 4.8 Check
c. Every 3000 Hour Maintenance (Normal Operating Conditions)		
Perform complete 2000 hour Preventive Maintenance and the following:		
Engine	1. Check oil/filter change interval (refer to section **f.**of this table)	Engine Service Guide
d. Every 6000 Hour Maintenance (Normal Operating Conditions)		
Cooling System	1. Drain and flush cooling system **(12,000 hours with Extended Life Coolant)**	Engine Service Guide
e. Every 10,000 Hour Maintenance		
Perform complete 2000 and 3000 hour Preventive Maintenance and the following:		
Engine	1. Check oil/filter change interval (refer to section **f.**of this table)	Engine Service Guide
Fuel System	2. Clean and adjust injector nozzles.	Engine Service Guide

f. Oil Change Intervals			
Oil Type	**Without Bypass Filter**	**With Bypass Filter**	**With ESI Oil Filters**
Petroleum	2000 hours		2000 hours
Synthetic*	3000 hours	4000 hours	

* Mobil Delvac1 is the only approved synthetic oil. Maximum oil drain interval is two (2) years.

These maintenance schedules are based on the use of approved oils and regular Pretrip inspections of the unit. Failure to follow the recommended maintenance schedule may affect the life and reliability of the refrigeration unit.

4.2 PRIMING FUEL SYSTEM

4.2.1 Mechanical Fuel Pump

The mechanical fuel lift pump is mounted on the engine next to the injection pump. This pump has a manual plunger for priming the fuel system when the fuel tank has been run dry. (See Figure 4-1).

To prime the fuel system, use the following steps:

1. Turn the bleed valve (Red) counter-clockwise until fully opened.
2. Turn the top of the manual fuel pump plunger counter-clockwise to unlock it. **S–L–O–W–L–Y** (up/down once per second) pump the manual plunger until positive pressure (resistance) is felt. This may take up to 200 strokes. This will indicate fuel flow.
3. Continue to pump **S–L–O–W–L–Y** (up/down once per second) approximately 100 more strokes to fill the filter and bleed the air out of the lines.
4. Start engine. It may be necessary to continue to pump until the engine starts.
5. Depress and turn the top of the manual plunger clockwise to **lock in place.**
6. When engine is running smoothly, turn bleed valve clockwise until fully closed.

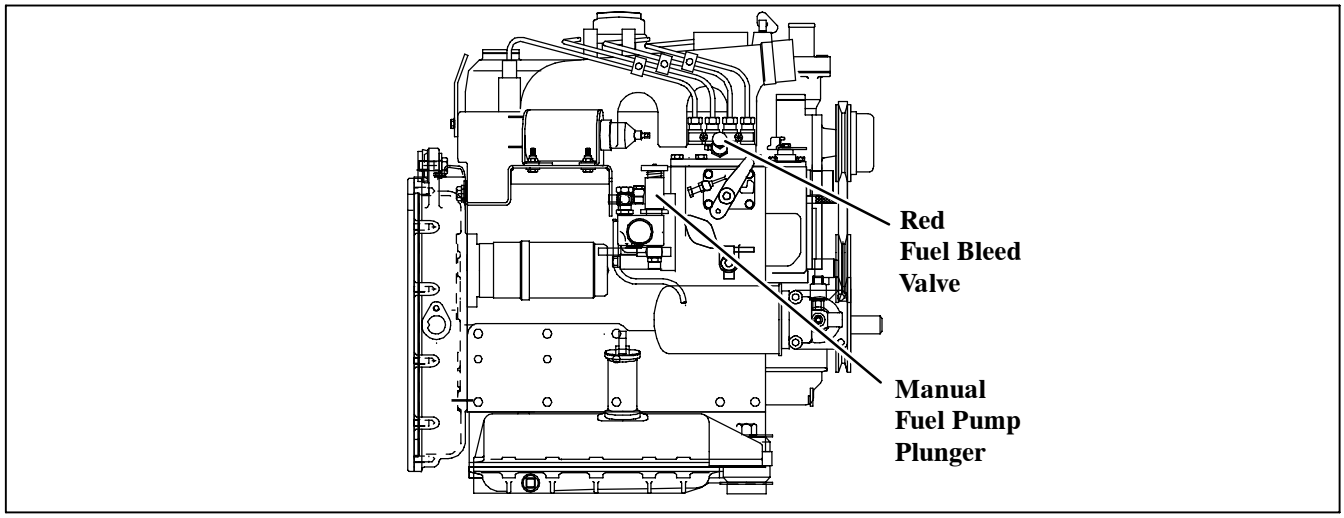


Figure 4-1. Priming Fuel Pump

4.2.2 Electric Fuel Pump

If the unit is equipped with an optional electric fuel pump, it will be mounted on the fuel tank mounting bracket.(Refer to Section 4.3.6) Use the following steps to bleed out the fuel system:

1. Open bleed valve located on top of the injection pump. (See section Figures 1–3 and 1–6 for location on all units.)
2. Place unit in Manual Start Mode. (Hold Glow/Crank Switch in the Glow position, then place the Start/Run–Off Switch in the Start/Run position. Continue holding the Glow/Crank switch until the Main Display lights up.) This will turn on the electric fuel pump.
3. Allow the electric pump to operate for 2–3 minutes.
4. Start engine.
5. When engine is running properly, turn bleed valve clockwise until fully closed.

4.3 ENGINE SERVICE AND COMPONENTS

4.3.1 Cooling System

Air flows through the condenser/radiator on Ultima. On all other models the air flows through the radiator by using the engine fan.

The radiator, externally and internally, must be clean for adequate cooling. The water pump V-belt must be adjusted periodically to provide maximum air flow. (Refer to section 4.4.2)

Do the following to service the cooling system:

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 meeting GM specifications GM 6038M or equal.

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

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

c. Install hose and fill system with clean, untreated water to which three to five percent 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 Note and refer to section 1.2) NEVER POUR COLD WATER INTO A HOT ENGINE, however hot water can always be added to a cold engine.

4.3.2 Lube Oil Filters

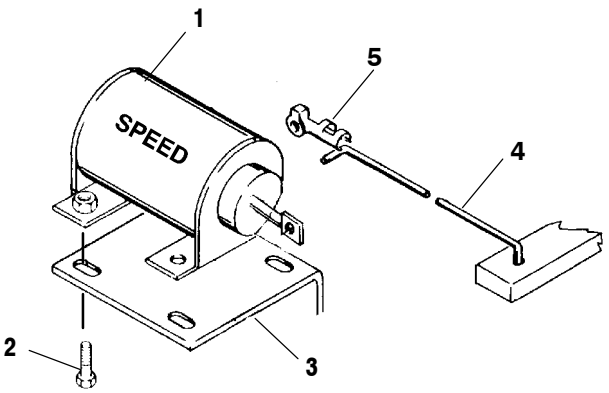
After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil. Lightly oil gasket on filter before installing.

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) and add lube oil. (Refer to section 1.2) Warm up engine and check for leaks.

4.3.3 Servicing the Speed Control Solenoid and Linkage



1. Solenoid
2. Bolt
3. Solenoid Bracket
4. Linkage (Speed)
5. Clip

Figure 4-2. Speed Control Solenoid

a. Disconnect wiring to solenoid. Disconnect linkage arm (item 6, Figure 4-2) from solenoid. Remove mounting hardware from solenoid and then remove solenoid.

b. Install replacement solenoid and mounting hardware. Do not tighten at this time.

c. Attach linkage to solenoid and install the clip to the linkage rod.

d. Hold the speed lever against the low speed stop and check the RPM (Refer to Table 1-1). Adjust the low speed stop screw if necessary.

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

f. Hold the speed lever against the high speed stop and check the RPM (Refer to Table 1-1). Adjust the high speed stop screw if necessary.

g. Energize the speed solenoid. Push the solenoid so that the speed arm rests against the high speed stop screw and tighten solenoid mounting bolts. Connect wiring to solenoid.

LE (Low Emission) DI engines are delivered with a tamper resistant high-speed adjustment screw on the engine. High-speed adjustments are made using the slotted holes in the solenoid mounting bracket and 86-03027-00 speed solenoid adjusting bracket with solenoid adjusting bolt and lockout (on the bracket).

4.3.4 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.*

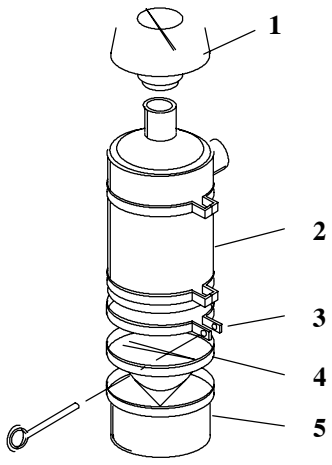
b. Air Cleaner Service Indicator

The air cleaner indicator is connected to the engine air intake manifold and 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)

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

d. Service Procedure (Oil Type)



1. Air Inlet Hood
2. Air Cleaner Body
3. Clamp
4. Inner Cup(Oil bath)
5. Oil or Dust Cup

Figure 4-3 Air Filter

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 to carry 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 cup 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. (Refer to section 1.2)

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:

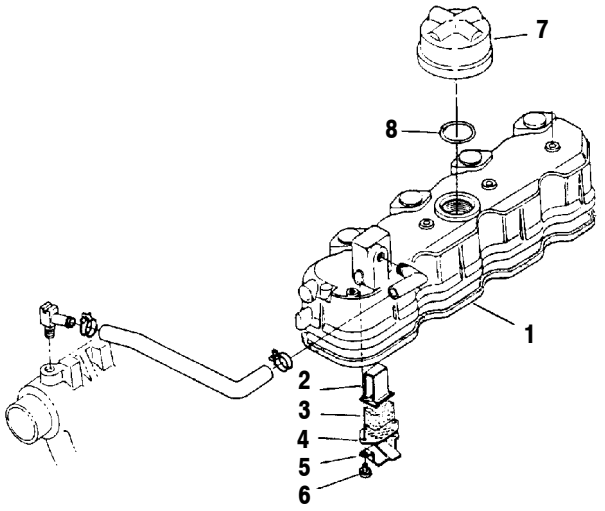
(a) Remove oil cup. Check and clean center tube. *DO NOT USE GASOLINE*.

(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.

4.3.5 Engine Crankcase Breather

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

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

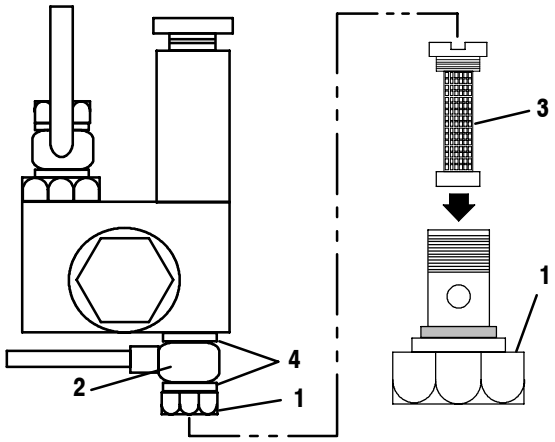
Figure 4-4. Engine Crankcase Breather

4.3.6 Servicing Fuel Pump

a. Mechanical Pump (See Figure 4-5)

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 4-5).
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 install reverse steps 1 through 3.



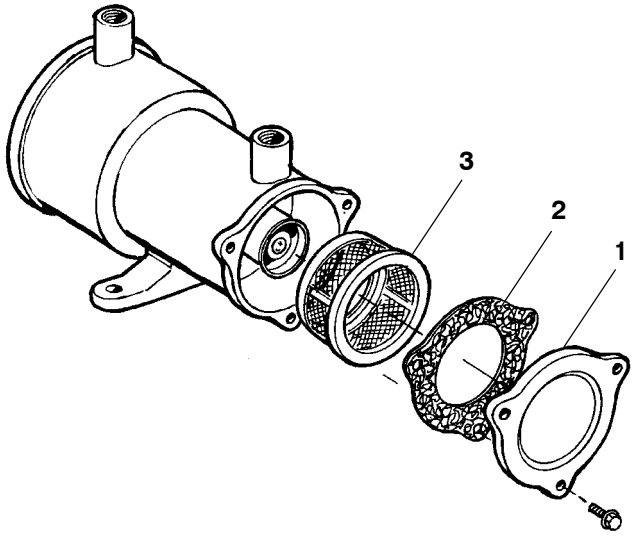
1. Nut
2. Banjo
3. Filter
4. Copper Rings

Figure 4-5. Mechanical Fuel Pump

b. Electric Pump (See Figure 4-6)

To Check or Replace Filter

1. Remove 3 screws from cover (item 1, Figure 4-6).
2. Remove cover, gasket and filter.
3. Wash filter in cleaning solvent and blow out with air pressure. Clean cover.
4. To Install reverse above steps.



1. Cover
2. Gasket
3. Filter

Figure 4-6. Electric Fuel Pump (Optional)

4.3.7 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 14 to 18 ft-lb (1.9 to 2.5 mkg).

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 7 to 10 amps 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.

4.4 SERVICING AND ADJUSTING V-BELTS

WARNING

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

4.4.1 Belt Tension Gauge

It is recommended using a belt tension gauge (tester) P/N 07-00253, shown in Figure 4-7 whenever V-belts are adjusted or replaced.

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

The belt tension gauge can be used to adjust all belts. The readings which we specify for Carrier Transicold units are applicable only for our belts and application, as the tension is dependent on the size of the belt and distance between sheaves. When using this gauge, it should be placed as close as possible to the midpoint between two sheaves. (See Figure 4-8)

The V-belts must be kept in good condition with the proper tension to provide adequate air movement across the coils. Pre–tension new belt to tension indicated in chart below. Check and re–tension belt to final tension after 15 minute break–in.

Table 4-1. Belt Tension (See Figure 4-7)

BELTS	Pre Tension	Tension
Water pump to Crankshaft	35/40	35/40
Clutch/Gearbox to Fan shaft	140/150	70/80
Clutch/Gearbox to Compressor	140/150	70/80
Clutch/Gearbox to Alternator	60/70	40/50
Standby Motor to Clutch	140/150	70/80

Figure 4-7 Belt Tension Gauge (Part No. 07-00253)

4.4.2 Water Pump V-Belt

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)

4.4.3 Alternator V-Belt

a. Make sure negative battery terminal is disconnected and remove old belt.

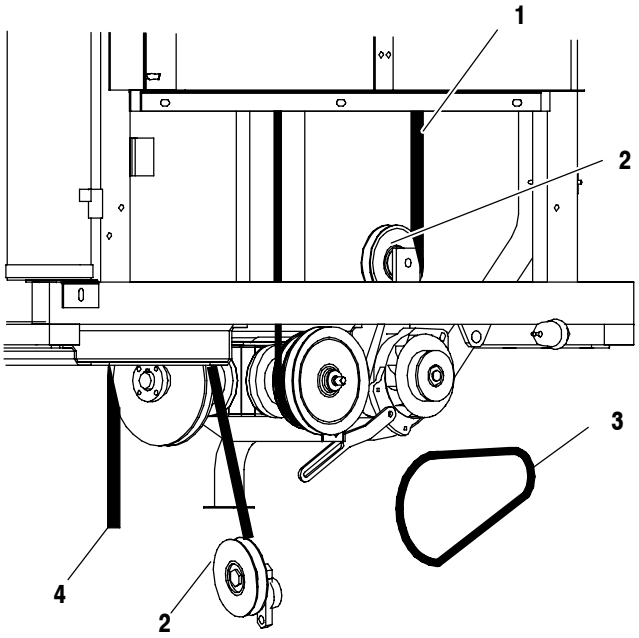
b. Place V-belt on alternator sheave and then install alternator with two bolts loosely in position.

c. Check the center alignment of the Clutch/Gearbox 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.

d. 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.

NOTE

Belt must be checked and retensioned, if necessary, after a brief run-in period.



1. Evaporator/Condenser Fan V-Belt
2. Idler Pulley
3. Alternator V-Belt
4. Drive V-Belt

Figure 4-8. V-Belt Arrangement

4.4.4 Driveshaft to Clutch/Gearbox and Clutch/Gearbox To Evaporator/Condenser Fans

a. Clutch/Gearbox to Fan Shaft V-Belt

To Replace V-belt:

1. Disconnect negative battery cable and remove V-belt guard.
2. Loosen idler pulley.
3. Remove old belt and replace with new belt. (See Figure 4-8)
4. Using a belt tension gauge (Figure 4-7) on the belt, rotate idler pulley so that the gauge reads the correct tension (Refer to Table 4-1).
5. Tighten idler, carriage bolt, and bolts.

NOTE
Both belts must be checked and retensioned, if necessary, after a brief run-in period. (see step 6)

6. Operate unit in high speed for 5 to 10 minutes. Repeat steps 4 and 5.
7. Replace belt guard.

b. Driveshaft to Clutch/Gearbox V-Belt

1. Disconnect negative battery cable and remove V-belt guard and then loosen idler bolt.
2. Match mark adapter to engine flywheel (See Figure 4-9A) for ease of assembly.
3. Remove six bolts (5/16-18 x 1 lg) securing adapter drive sheave to engine flywheel, Figure 4-9A.
4. Insert 2 of the six bolts (5/16-18 x 1 lg) into the threaded holes (jacking holes) provided on engine adapter. Jack adapter from engine flywheel. Remove the 2 screws from adapter. Insert a pry bar between engine flywheel and adapter, Figure 4-9A and slide the adapter-sheave toward the compressor enough to change the V-belt as shown in Figure 4-9B. Replace V-belt.
5. Pry the adapter back toward the engine flywheel or use 5/16-18 x 2-1/2 lg bolts (3) in every other hole of adapter and take up evenly on the bolts until the 5/16-18 x 1 lg bolts will start in the engine flywheel. Apply thread sealer (Loctite #262) to the bolts used to secure adapter to flywheel. Take up on all bolts evenly and then torque to a value of 28 ft-lb (3.87 mkg).
6. Place V-belt on the Clutch/Gearbox sheave and adjust belt tension as indicated in Table 4-1. Install V-belt guard. DO NOT START UNIT UNTIL V-BELT GUARD IS INSTALLED.
7. Start unit and run for 10 minutes to allow for belt stretch.
8. Turn unit off and recheck belt tension.

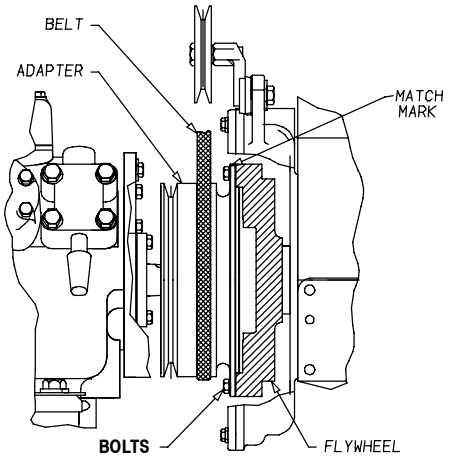


Figure A

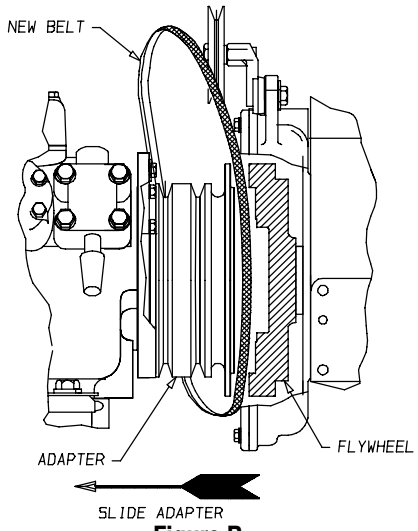


Figure B

Figure 4-9. Removing V-Belt from Engine Adapter Drive Sheave (NDA or NDX)

4.4.5 Standby Motor V-belts (NDM)

NOTE

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

a. Remove V-belt guard.

b. Remove 6 bolts on rear face of clutch flange (See Figure 4-10).

c. Slide clutch flange forward inside clutch sheave.

d. Remove and replace V-belt through opening.

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

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

g. Turn unit off and recheck belt tension.

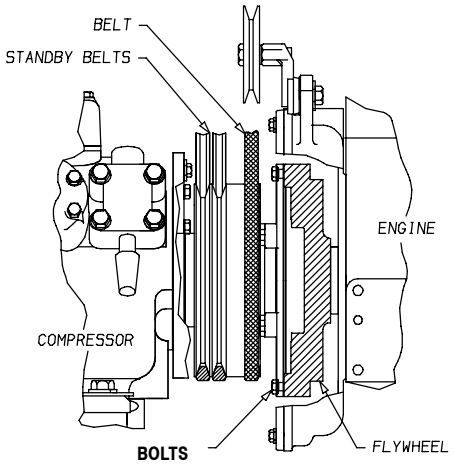


Figure A

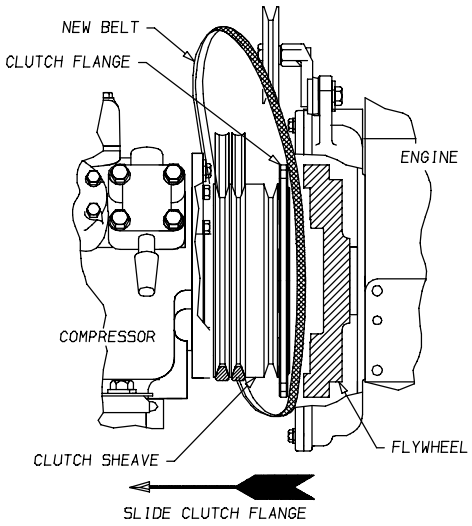


Figure B

Figure 4-10. Removing V-Belt from Clutch (NDM)

4.5 SERVICING STANDBY CLUTCH (NDM)

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. Unplug unit from external electrical outlet and disconnect battery.

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

c. Block up engine.

d. Remove clutch V-belts as outlined in section 4.4.5.

e. Pump down the unit.

f. Remove suction and discharge service valve.

g. Attach sling or other device to the compressor.

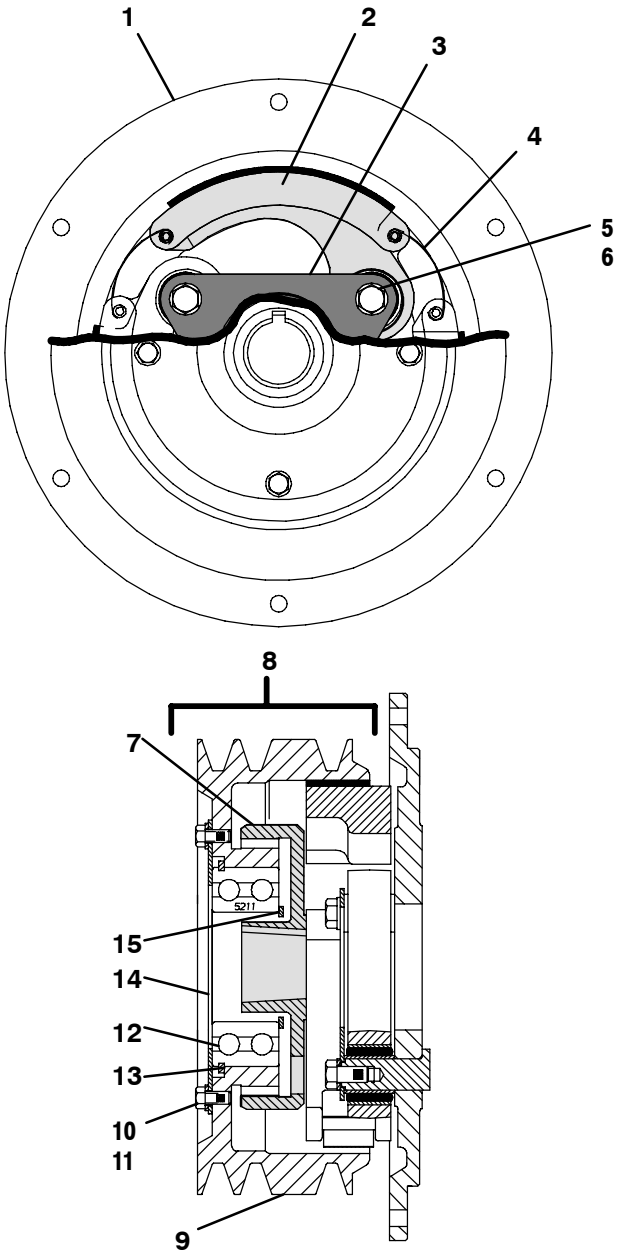
h. Slide compressor enough to remove clutch.

i. Remove (6) 5/16-18 capscrews from rotor assembly (Item 2, Figure 4-11).

j. Using 3 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.

k. After replacing necessary parts, reassembly by reversing above steps. Install snap ring, painted side **must** face away from bearing.

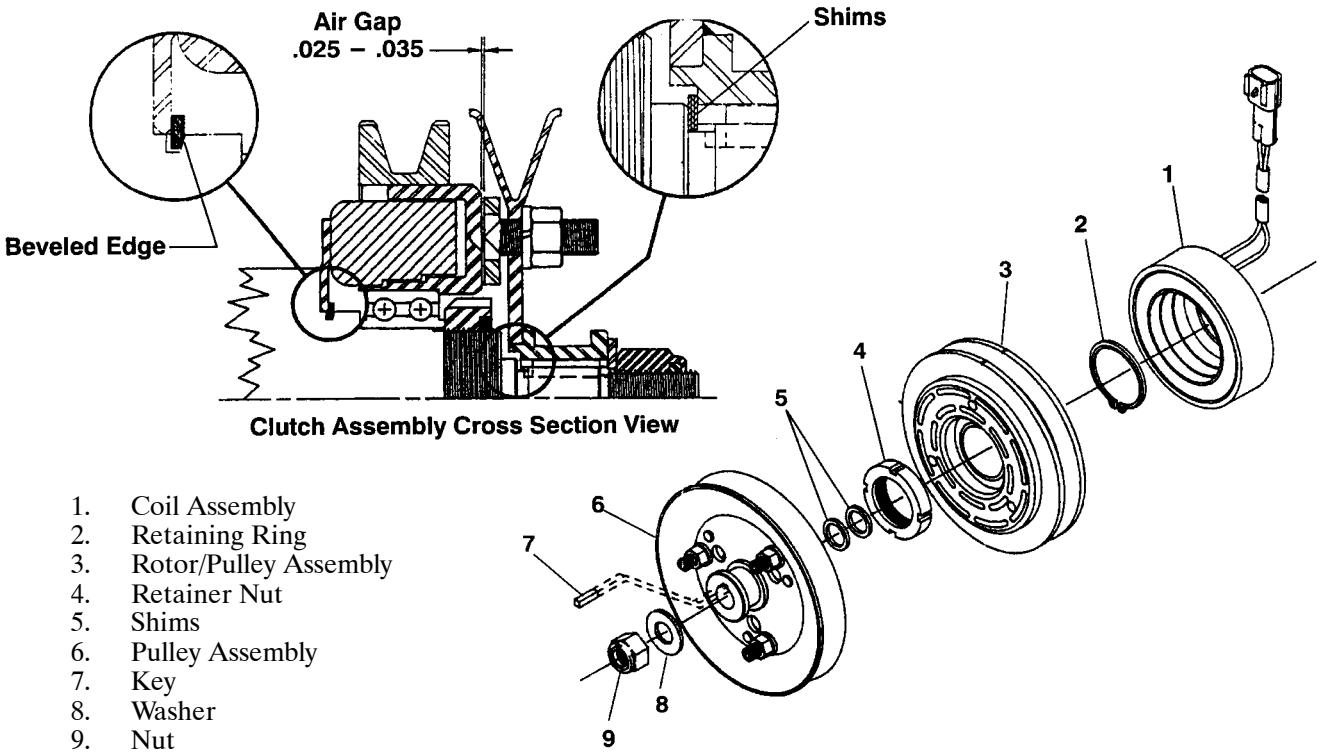
l. Start unit and check operation.



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 4-11. Standby Clutch Assembly (NDM)

4.6 GEARBOX CLUTCH



1. Coil Assembly
2. Retaining Ring
3. Rotor/Pulley Assembly
4. Retainer Nut
5. Shims
6. Pulley Assembly
7. Key
8. Washer
9. Nut

Figure 4-12. Gearbox Clutch

a. Clutch Removal

1. Disconnect electrical input.
2. Remove armature/pulley assembly (Figure 4-12, 6)
   a. Remove shaft nut (9) and washer (8).
   b. Using a standard 2– or 3–jaw gear puller, pull the armature (6) off the shaft. Apply the puller jaws to the pulley hub, not the rim of the pulley. **NOTE: The armature pulley has been loctited to the shaft.**
   c. Remove the shaft key (7) and shims (5).
3. Remove rotor/pulley assembly (3)
   a. Remove bearing retainer nut (4) using removal tool CTD P/N 07–00303–01.
   b. Slide rotor/pulley assembly (3) from gearbox housing.
4. Remove the field coil assembly (1)
   a. Remove field coil assembly retaining ring (2).
   b. Remove field coil assembly (1) from gearbox.

b. Clutch Installation

1. Install field coil assembly (1)
   a. Place field coil assembly (1) on pilot diameter of gearbox. Align slot in field coil assembly with locator pin in gearbox housing.
   b. Install field coil retaining ring (2). **IMPORTANT: The retaining ring's beveled or tapered edge must face away from the gearbox to obtain proper retention force.**
2. Install rotor/pulley assembly (3)
   a. Slide rotor/pulley onto gearbox housing. **DO NOT POUND** on rotor assembly; rock back and forth gently with hand pressure until unit slides on.
   b. Install bearing retainer nut (4). Tighten nut to 65 lb-ft. Rotor should spin free without noise.
3. Install armature/pulley assembly (6)
   a. Slide armature assembly (6) onto gearbox shaft. Measure air gap between armature face and rotor face using a wire type feeler gauge. Three access holes are provided in the pulley face.
   b. If the air gap is less than 0.050 in., remove armature assembly and add shim(s) (5) to shaft as shown in Figure 4-12. Use only new shims.
   c. Repeat steps a. and b. until an average air gap of 0.025 to 0.035 in. is obtained.
   d. Install a new key (7) in shaft.
   e. Apply Loctite #609 to shaft and pulley hub bore. Slide armature/pulley onto gearbox shaft.
   f. Install washer (8) and lock nut (9). NOTE: two types of locking nuts may be used –
   - Standard nylon locknut uses flat washer and requires 65-70 ft/lbs. torque.
   - Upset thread type with integral washer DOES NOT use a separate washer and requires 55-60 ft/lbs. torque - DO NOT over-tighten this type.

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. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

a. Pumping the Unit Down

To service the filter-drier, liquid line solenoid valve (SV-2), expansion valve, quench 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 1 psig (0.1 kg/cm^2).
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. Evacuate and dehydrate the low side. (Refer to section 4.9).
10. Start the unit in cooling and check for noncondensibles.
11. Check the refrigerant charge. (Refer to section 4.10.f)

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

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

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

c. If system is without refrigerant, charge system with refrigerant to build up pressure between 30 to 50 psig (2.1 to 3.5 kg/cm^2). Remove refrigerant drum and leak check all connections.

NOTE

Connect the refrigerant drum intended for your 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.

d. 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^{3}H volume displacement, 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 60°F (15.6°C) to speed evaporation of moisture. If ambient temperature is lower than 60°F (15.6°C), ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise system temperature.

4.9.3 Procedure for Evacuation and Dehydrating System

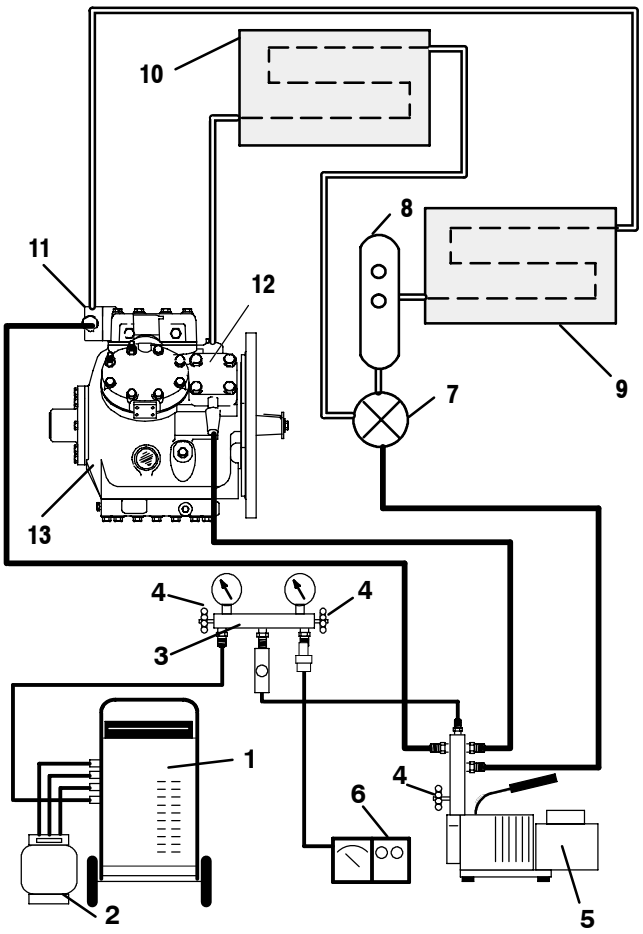
a. Remove refrigerant using a refrigerant recovery system.

b. The recommended method to evacuate and dehydrate the system is to connect three evacuation hoses (Do not use standard service hoses, as they are

not suited for evacuation purposes.) as shown in Figure 4-13 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 if necessary.

d. Midseat the refrigerant system service valves.



1. Refrigerant Recovery Unit
2. Refrigerant Cylinder
3. Evacuation Manifold
4. Valve
5. Vacuum Pump
6. Vacuum Gauge
7. King Valve
8. Receiver
9. Condenser
10. Evaporator
11. Discharge Valve
12. Suction Valve
13. Compressor

Figure 4-13. Vacuum Pump Connection

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

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

g. Remove refrigerant using a refrigerant recovery system.

h. Repeat steps e through g one time.

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)

4.10 ADDING REFRIGERANT TO SYSTEM (FULL CHARGE)

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

b. Place drum of refrigerant on scale and connect charging line from drum to king valve. Purge charging line at outlet valve.

c. Note weight of drum and refrigerant.

d. Open liquid valve on drum. 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 drum weight (scale) indicates that the correct charge has been added, close liquid line valve on drum and backseat the king valve.

f. Start unit in cooling mode. Run approximately ten minutes. Partially block off air flow to condenser coil so discharge pressure rises to 230 psig (16 kg/cm^2).

Refrigerant should appear at center line of lower receiver sight glass. If charge is inadequate, add refrigerant charge (per section 4.11).

4.11 ADDING REFRIGERANT TO SYSTEM (PARTIAL CHARGE) - R-22 ONLY

CAUTION

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

a. Place drum of refrigerant on scale and note weight. Backseat suction service valve and connect charging line between suction valve port and drum. Open VAPOR valve on drum and purge charging line.

b. Run the unit in cooling for ten minutes and then partially block off air flow to condenser coil so discharge pressure will rise 10 psig (0.7 kg/cm2). Refrigerant should appear at center line of the lower receiver sight glass . If charge is inadequate, add refrigerant charge with condenser coil still blocked.

c. Open suction service valve three turns. Add charge until level appears at center line of the lower receiver sight glass.

d. Backseat (close) suction service valve. Close vapor valve on refrigerant drum, noting weight. Vent charging line and replace all caps.

e. Start unit and check for noncondensibles.

4.12 REPLACING THE COMPRESSOR

If compressor is inoperative and unit still has refrigerant pressure, remove the refrigerant. (Refer to section 4.7.b.).

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

a. Disconnect negative battery cable.

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

c. Disconnect wiring to unloader valve assemblies, compressor discharge temperature sensor (CDT), suction pressure transducer and the wiring to the high pressure cutout switches (HP-1 and HP-2). Identify wiring and switches if necessary. (See Figure 4-15)

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

e. Block up engine.

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

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.

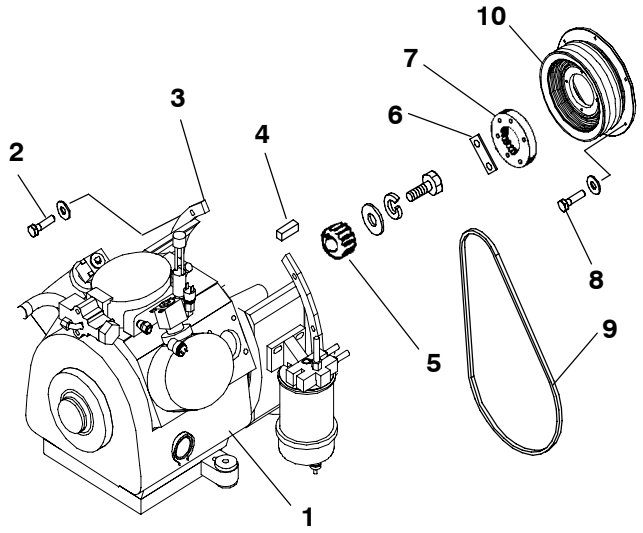
k. Slide compressor enough to clear nylon drive gear (or clutch housing on model NDM), Figure 4-14, and remove compressor from unit.

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)



1. Compressor
2. Bolts
3. Spacer
4. Key
5. Compressor Drive Gear
6. Locking Tab
7. Nylon Drive Gear
8. Drive Sheave Bolts
9. V-Belt
10. Engine Adapter Drive Sheave

Figure 4-14. Compressor Drive Assembly

n. Remove the complete high pressure switch assembly (HP-1 and HP-2) (See Figure 4-15) 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).

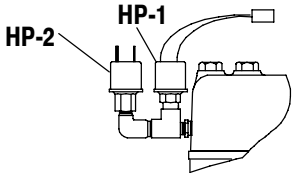


Figure 4-15. Pressure Switches HP-1 and HP-2

o. Install compressor in unit by reversing step 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. Refer to section 4.33.1 driver gear installation.

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 (section 4.11.b.)

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 the Oil Level in the 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 4-16).

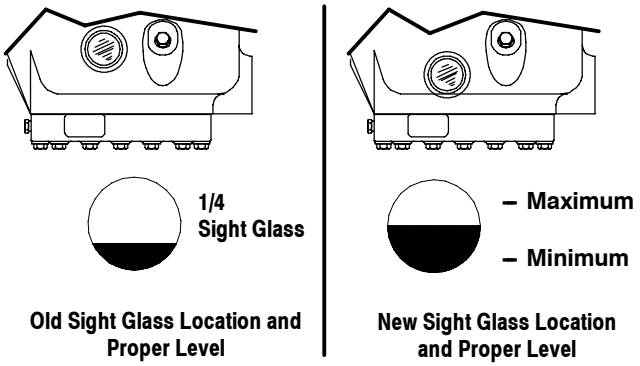


Figure 4-16. Oil Level in Sight Glass

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 oil fill (item4, Figure 4-17). 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 oil fill (item4, Figure 4-17). Purge the oil hose at oil pump. Add oil as necessary (Refer to section 1.3).

2. Closed System Method

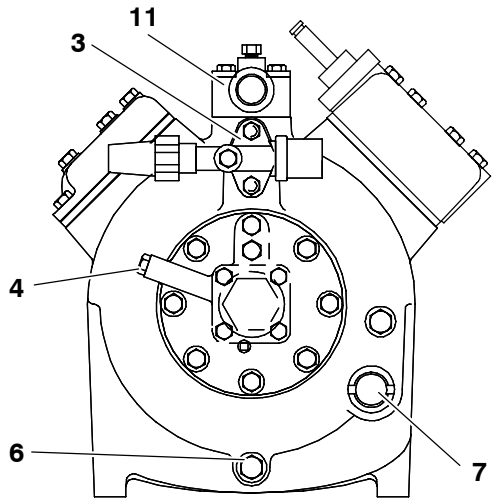
In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

CAUTION

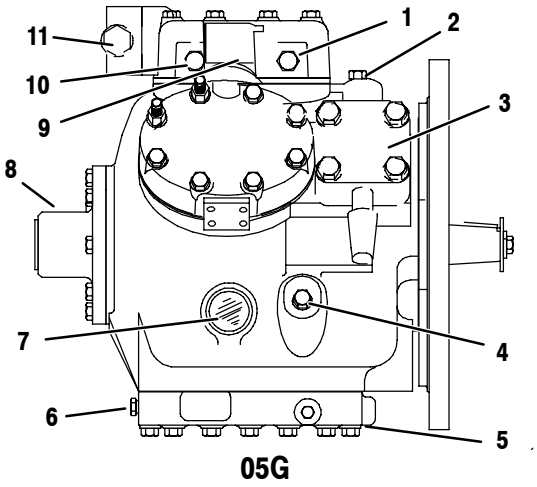
Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times. Otherwise air and moisture will be drawn into the compressor.

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 (Refer to section 1.3).



05K



05G

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 4-17. Compressor

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) through the suction service valve flange cavity or by removing the oil fill plug (See Figure 4-17)

d. To remove oil from the compressor:

1. Close suction service valve (frontseat) and pump unit down to 2 to 4 psig (0.1 to 0.3 kg/cm^2). Frontseat discharge service valve and slowly bleed remaining refrigerant.
2. Remove the oil drain plug from the compressor and drain the proper amount of oil. 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.

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 1.9)

This section contains two compressor unloader systems: hot gas bypass and suction cutoff. They are easily distinguished from each other by observing the bottom side of the compressor cylinder head, it is either blank (hot gas bypass) or has a cover plate (suction cutoff). The unit operates the same with ether unloader systems.

a. Checkout Procedure

1. Connect manifold gauges to the compressor suction and discharge service valves and start unit in cooling with the trailer temperature at least 5°F (2.8°C) above set point and 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^2) will 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^2) 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 out compressor loading. Suction pressure will drop with this test.

NOTE

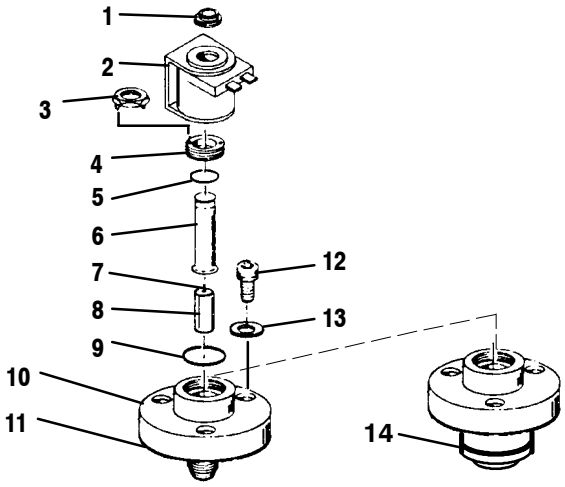
If either unloader coil energizes and the suction pressure does not change, the unloader assembly must be checked.

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 4-18)
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, 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 4-18. Unloader Solenoid Valve

c. Replacing Solenoid Valve Internal Parts (See Figure 4-18)

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 4-18) 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 4.12.p through 4.12.w.)
8. Start unit and check unloader operation (Refer to section 4.14.a).

d. Replacing the Suction Cutoff Unloader

WARNING

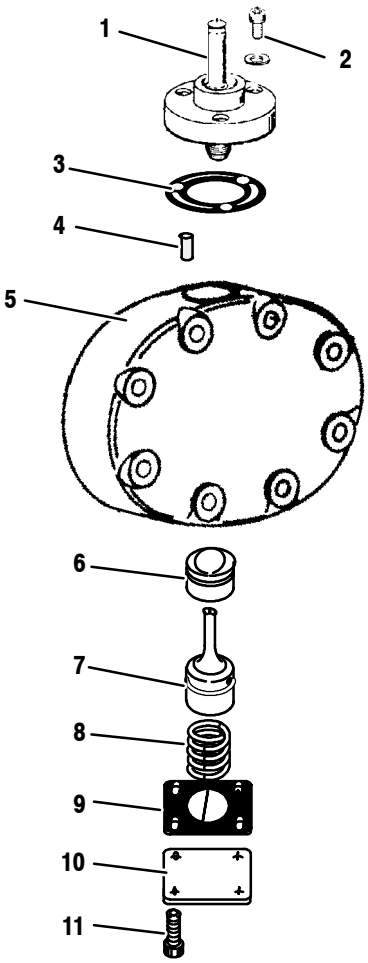
Make sure power to unit is OFF and negative battery cable is disconnected before servicing the compressor unloader.

1. Close off suction and discharge service valve to trap most of the refrigerant in the unit (this will prevent moisture from entering the system and save most of the refrigerant charge).
2. *Slowly* release compressor pressure through the service valve gauge ports.
3. Remove cylinder head and unloader from compressor. Have on hand valve plate gasket, cylinder head gasket, suction and discharge service valve gaskets.
4. Proceed to step 11 if not rebuilding unloader at this time.

CAUTION

Care must be exercised when handling valve body and enclosing tube as a dent in the enclosing tube could mean failure to unload the compressor.

5. Remove valve body and enclosing tube assembly and gasket. (Items 1, 2, and 3, Figure 4-19).
6. Remove cover and gasket (items 9,10 & 11) from bottom of cylinder head. Then remove spring and valve body (items 7 and 8).
7. From the top of the cylinder head, push piston (item 6) out of piston cavity.
8. On the replacement piston, place ring seal in position on piston by positioning in place (using two thumbs). Make sure seal is firmly in place.
9. From bottom of cylinder head, insert seal and piston in cylinder head. Using piston driver, push piston into cylinder head cavity.
10. Re-assemble rest of unloader.
11. Install new valve plate gasket and cylinder head gasket before installing cylinder head.
12. After installing cylinder head, torque bolts to a value of 35 to 40 ft/lb (4.84 to 5.53 mkg).
13. Place unloader coil and snap cap on unloader valve enclosing tube.



1. Valve Body and Enclosing Tube
2. Bolt and Gaskets
3. Gasket
4. Strainer
5. Cylinder Head
6. Piston and Ring Seal
7. Valve Body
8. Spring
9. Cover Gasket
10. Cover
11. Bolts

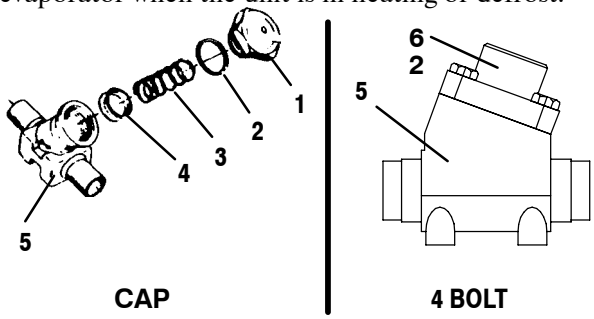
Figure 4-19. Compressor Unloader Valve – Suction Cutoff

14. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (75.9 cm = 29.90 inches Hg vacuum). Turn off valves on both lines to pump.
15. Fully backseat (open) both suction and discharge service valves.
16. Remove vacuum pump lines.
17. Start unit and check refrigerant charge. (Refer to section 4.10.f)
18. Check system for wetness. Change filter-drier if necessary. (Refer to section 4.16)
19. Check compressor oil level per section 4.13.a. Add oil if necessary. (Refer to section 4.13.b.)

4.15 SERVICING THE CHECK VALVE - SERVICEABLE TYPE

The check valve allows the hot gas to travel in one direction only.

The function of the condenser coil bypass is to raise the receiver pressure when the ambient temperature is low so that refrigerant can flow from the receiver to the evaporator when the unit is in heating or defrost.



1. Cap
2. Copper Washer
3. Spring
4. Brass/Teflon Seat
5. Body
6. Cover

Figure 4-20. Check Valve – Serviceable Type

a. To replace check valve, store the refrigerant into an evacuated container. (Refer to section 4.7)

b. Replace necessary parts.

c. Evacuate and dehydrate unit. (Refer to section 4.9)

d. Add refrigerant charge. (Refer to section 4.10)

4.16 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 4.11.b)

4.17 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCHES

4.17.1 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 switches are located on the top cylinder head. (See Figure 4-17)

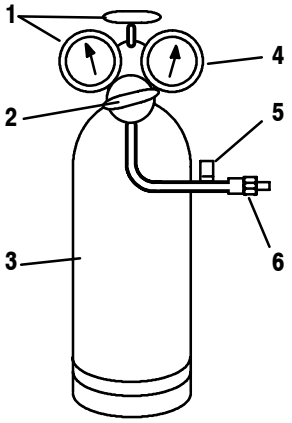
d. Install new cutout switch after verifying switch settings. (Refer to section 4.17.2)

e. Evacuate and dehydrate the compressor. (Refer to section 4.12.p through 4.12.w)

4.17.2 Checking High Pressure Switch (HP-1 or HP-2)

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 2350 psi (165 kg/cm^2). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 4-21)



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

Figure 4-21. Typical Setup for Testing High Pressure Switch

a. Remove switch as outlined in section 4.17.1.

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 4-21)

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

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

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

4.18 REPLACING RECEIVER SIGHT GLASS ASSEMBLY

NOTE

There are two types of receiver sight glasses. One is the floating ball type (P/N 14-00111), and the second is the prism type (P/N 14-50023-00); 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.

4.19 SERVICING SOLENOID VALVES

4.19.1 Solenoid Valves - Alco SV2/SV4 on Ultima, Ultra & Extra SV2/SV3/SV4 on Optima

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.

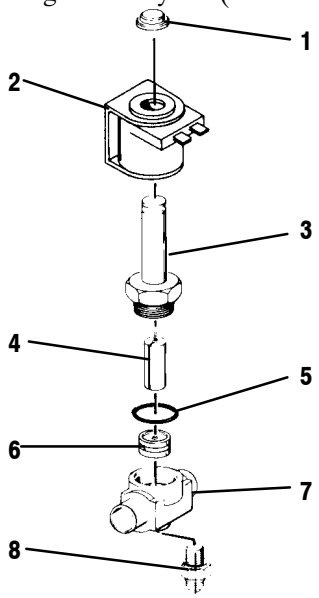
1. Disconnect leads, remove coil retainer and coil assembly.
2. Verify coil type, voltage and frequency. This information appears on the coil housing.
3. Place new coil over enclosing tube, retainer and connect wiring.

b. Replacing Solenoid Valve Internal Parts (See Figure 4-22)

The liquid line solenoid valve (SV2) 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.f.
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 4-22. Solenoid Valves – Alco

4.19.2 Solenoid Valve - Sporlan SV1/SV3 on Ultima, Ultra & Extra SV1 on Optima

a. Replacing the Coil

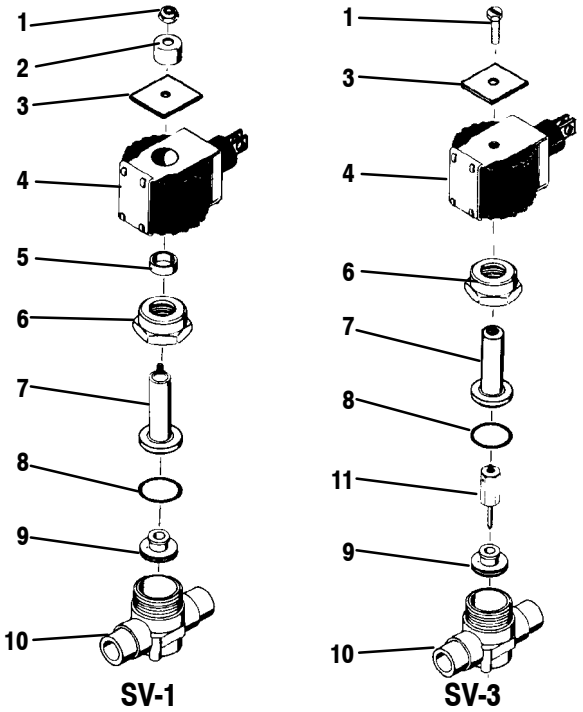
NOTE

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

1. Remove top locknut, spacer cup and nameplate (SV1). For SV3, remove screw and nameplate.
2. Disconnect wiring and remove coil.
3. Replace coil by reversing steps 1 and 2.

b. Replacing Internal Components (See Figure 4-23)

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 (SV1). For SV3, remove screw and nameplate.
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. For SV3 install stem and plunger (item 11, Figure 4-23)
8. 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.



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

Figure 4-23. Solenoid Valves – Sporlan

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

10. Dehydrate and evacuate the system. (Refer to section 4.9) Charge unit with refrigerant per sections 4.10 and 4.11.

11. Start unit and check operation. (Refer to section 2)

4.20 SOLENOID VALVE SV-1 CHECKOUT PROCEDURE

To obtain proper heating and defrost, the normally open (N.O.) SV-1 solenoid valve must energize and close tightly during the heat and defrost cycles. If the valve does not close tightly due to physical damage, foreign material or wear, refrigerant leakage through the valve can reduce heating capacity.

a. During normal heat or defrost cycles the following conditions will be observed when the valve is operating properly:

(1) Receiver refrigerant level will drop quickly at the initiation of heating or defrost mode.

(2) Suction pressure will rise slowly to 90–100 psig (6.3 to 7.0 kg/cm^2).

(3) Discharge pressure will drop quickly, but begin to rise to a minimum of 250 psig (17.5 kg/cm^2) within 15 to 20 minutes.

b. If suction and discharge pressures remain low and the receiver level does not drop, the valve may be inoperative and can be checked by the following method.

(1) Verify the solenoid coil has proper voltage and is energized in heating and defrosting.

(2) Connect a discharge pressure gauge to the compressor discharge service valve and connect a gauge to the liquid line valve (king valve) leaving the receiver tank.

(3) With the trailer temperature at 35°F (1.7°C) or lower, operate the unit in high speed cool and remove or disconnect the “hot” wire leading to the SV-1 coil.

(4) With a separate 12 vdc positive voltage, energize SV-1 with the unit in high speed cooling and observe the discharge and receiver pressures. If the valve is closing properly, compressor discharge pressure will begin to rise and the receiver pressure will remain the same or begin to drop slowly. If the valve is not seating properly, both discharge and receiver pressure will rise slowly or remain the same.

Operate the unit until discharge pressure reaches 200 psig (14 kg/cm^2) and disconnect jumper wire to SV-1 valve. Discharge and receiver pressure should be within 5 to 15 psig (0.4 to 1.0 kg/cm^2) of each other.

4.21 CHECKING DEFROST OR HEATING CYCLE

NOTE

The evaporator temperature must be 35°F (1.7°C) (approximately 40°F = 4.4°C box temperature) or lower, before any checks can be made.

a. Hot Gas Solenoid Valve (SV-1,SV-3 & SV-4) Heating and Defrosting

1. Connect a discharge pressure gauge to the King valve and another gauge to the compressor discharge service valve. Connect a gauge to the compressor suction service valve.

2. Start unit with controller set at least 10°F = 5.5°C below indicated box temperature to obtain high speed cooling. Press the MANUAL DEFROST key to initiate defrost. (Box temperature must be below 40°F = 4.4°C.) The hot gas solenoid valve (SV4) will energize and the hot gas line will be hot to touch on either side of the valve. The condenser pressure control solenoid (SV1) closes and suction pressure will rise approximately 10 to 15 psig (0.70 to 1.05 kg/cm^2) after 5 minutes on unit operation. Refer to section 4.20 if unit does not heat properly.

3. SV-3 will open after a 60 second delay, if the engine is in high speed and the difference between ambient and discharge temperatures exceeds 100°F (55.6°C).If the difference between ambient and discharge temperatures goes below 50°F (27.8°C) SV-3 will close. The unit will remain in defrost until coil temperature increases to 50°F (10°C) where the defrost thermostats open and the unit resumes automatic operation.

b. Defrost Air Switch (DA)

1. To check air switch, run unit in high speed cooling and jump across the air switch terminals. This will start the defrost cycle as it simulates the action of the defrost air switch. Bypassing the switch in this manner operates all components involved in defrost.

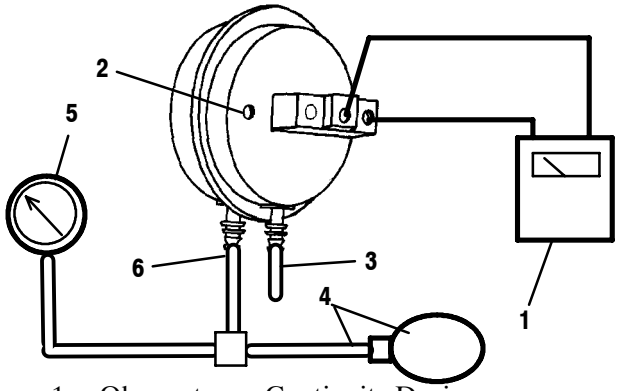
2. Unit should remain in defrost until evaporator coil temperature reaches 50°F (10°C). At this point the two defrost thermostats should open to terminate the defrost cycle. Replace the defrost thermostats if unit fails to terminate defrost.

3. If the above test indicates satisfactory operation, test defrost air switch (DA) settings using a Dwyer Magnehelic gauge (P/N 07-00177) or similar instrument. (Refer to section 4.22)

c. Solid State Defrost Timer

Refer to section 1.10.10 for description.

4.22 CHECKING CALIBRATION OF THE DEFROST AIR SWITCH



1. Ohmmeter or Continuity Device
2. Adjustment Screw (0.050 socket head size)
3. Low Side Connection
4. Pressure Line or Aspirator Bulb (P/N 07-00177-01)
5. Magnehelic Gauge (P/N 07-00177)
6. High Side Connection

Figure 4-24. Defrost Air Switch Test Setup

a. Make sure magnehelic gauge is in proper calibration.

NOTE

The magnehelic gauge may be used in any position, but must be re-zeroed if position of gauge is changed from vertical to horizontal or vice versa. USE ONLY IN POSITION FOR WHICH IT IS CALIBRATED.

b. With air switch in vertical position, connect high pressure side of magnehelic gauge to high side connection of air switch. (See Figure 4-24)

c. Install tee in pressure line to high side connection. Tee should be approximately half-way between gauge and air switch or an improper reading may result.

d. Attach an ohmmeter to the air switch electrical contacts to check switch action.

NOTE

Use a hand aspirator (P/N 07-00177-01), since blowing into tube by mouth may cause an incorrect reading.

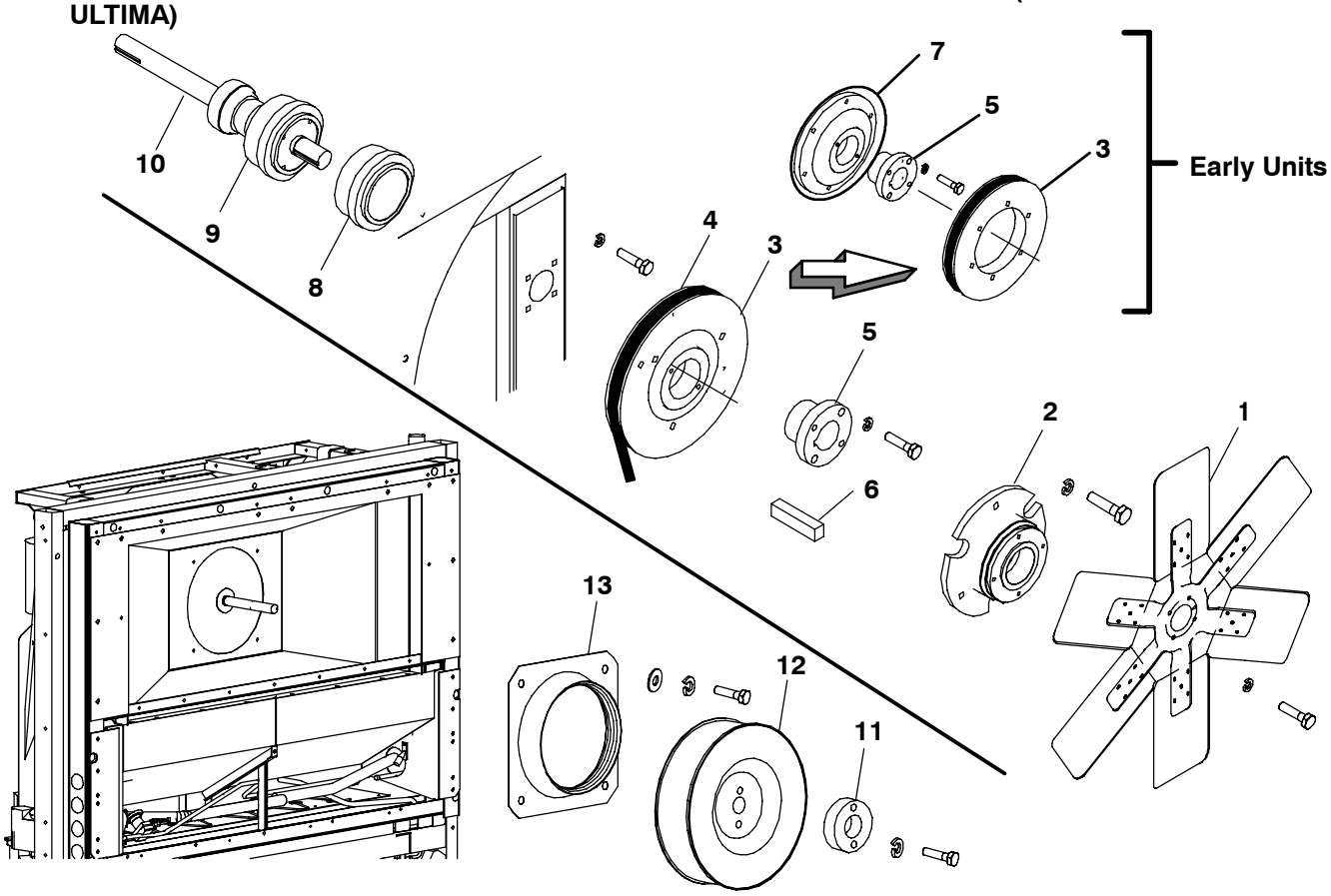
e. With the gauge reading at zero, apply air pressure very slowly to the air switch. An ohmmeter will indicate continuity when switch actuates.

f. Refer to section 1.3 for switch settings. If switch fails to actuate at correct gauge reading, adjust switch by turning adjusting screw clockwise to increase setting or counterclockwise to decrease setting.

g. Repeat checkout procedure until switch actuates at correct gauge reading.

h. After switch is adjusted, place a small amount of paint or glycerine on the adjusting screw so that vibration will not change switch setting.

4.23 REPLACING THE CONDENSER/ EVAPORATOR FAN SHAFT OR BEARING (ALL MODELS EXCEPT ULTIMA)



1. Condenser Fan
2. Adapter Condenser Fan
3. Sheave
4. V-Belt
5. Split Tapered Bushing
6. Key
7. Flange Condenser Fan
8. Gasket (Prior to S/N DAF90213555)
9. Bearing Housing
10. Shaft
11. Bushing
12. Blower Wheel
13. Venturi Ring

Figure 4-25. Evaporator/Condenser Fan Shaft Assembly (All Models Except Ultima)

WARNING
Beware of unannounced starting of the evaporator and condenser fan.

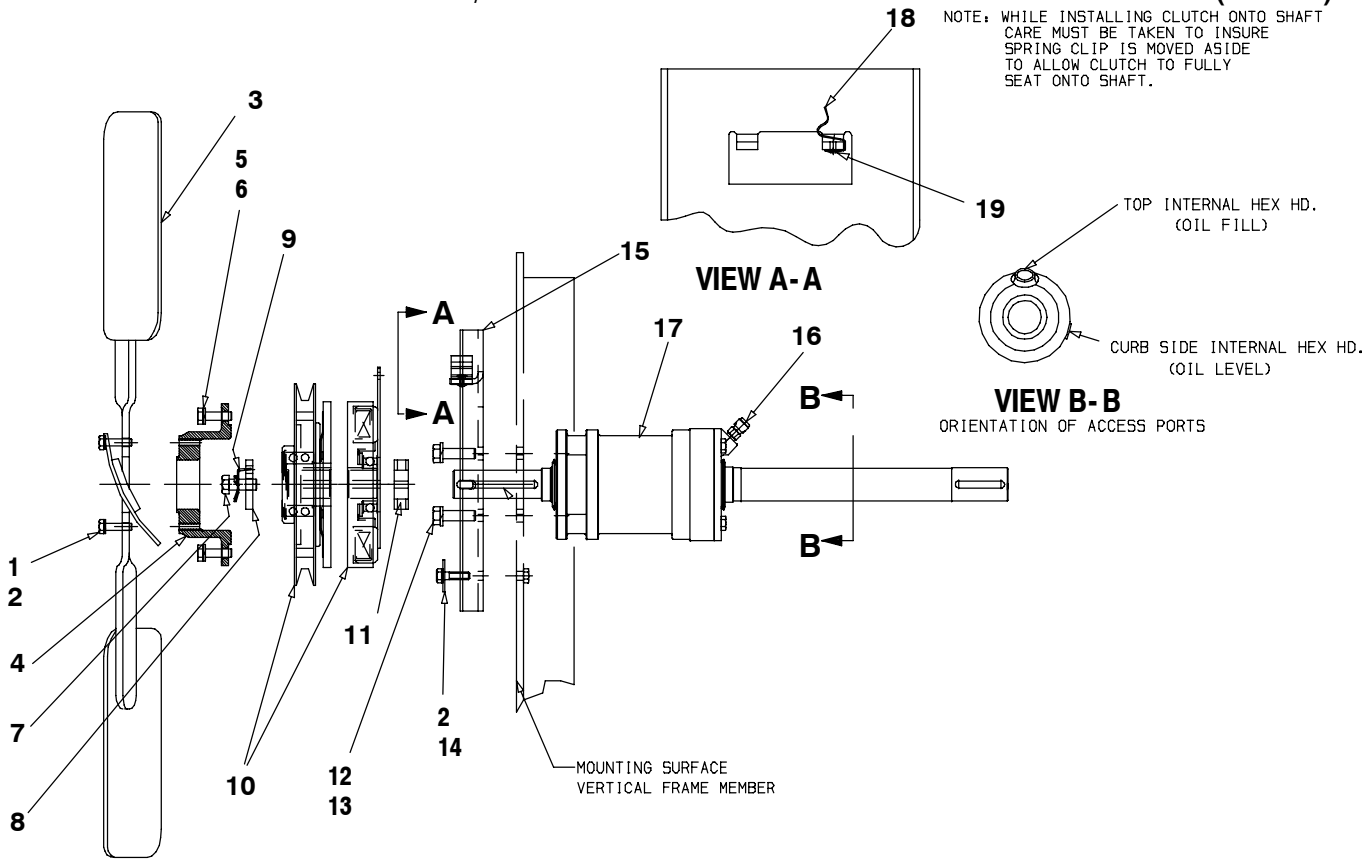
a. To Remove the Fan Shaft

1. Disconnect negative battery cable.
2. Remove 4 screws securing condenser fan (item 1, Figure 4-25) to adapter.
3. Remove V-Belt. (Refer to section 4.4.4.)
4. Remove 3 screws securing adapter (item 2).
5. Remove 3 screws securing sheave (item 3).
6. Remove tapered bushing (item 5) and flange (item 7) on early units.
7. Remove evaporator panels.
8. Remove two screws securing split tapered bushing, to blower wheel (items 12 and 13, Figure 4-25). Place the two screws in the threaded holes of the fan hub and use screws as jacking bolts to remove bushing from blower wheel.
9. Remove venturi ring (item 13, Figure 4-25) by removing 4 screws.
10. Remove 4 screws from the bearing housing (item 9, Figure 4-25).
11. Remove the shaft and bearing housing.
12. Install bearing housing assembly into unit by reversing steps 1 through 9 with a new gasket (item 8) or using caulk.
13. Locate the fan and key so that 1/3 of the condenser fan extends beyond the leaving edge of the fan shroud. Secure fan and hub to shaft.
14. Install evaporator fan venturi ring. Then install tapered hub and blower wheel loosely. Adjust blower wheel and tighten.
15. Install evaporator panels.

WARNING
Do not start unit without installing the evaporator panels as unit damage or body harm may result.

16. Start unit and check refrigeration cycle.

4.24 REPLACING THE CONDENSER/EVAPORATOR FAN SHAFT ASSEMBLY OR FAN CLUTCH (ULTIMA)



1. Screw Hex Head 1/4-20 X 1lg
2. Lock Washer 1/4
3. Condenser Fan
4. Adapter
5. Screw Hex Head 5/16-18 X 1lg
6. Lock Washer 5/16
7. Screw Hex Head 3/8-16 X 1lg
8. Special Washer
9. Retainer Washer
10. Clutch
11. Special Washer
12. Screw Hex Head 3/8-16 X 1.5lg
13. Lock Washer 3/8
14. Special Washer
15. Plate
16. Pressure Relief Valve
17. Bearing Housing
18. Clip
19. Screw Hex Head #10-32 X .25lg

Figure 4-26. Evaporator/Condenser Fan Shaft Assembly (Ultima)

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.

a. To Remove the Clutch (See Figure 4-26)

NOTE

The air gap between the clutch contact surfaces is non-adjustable. The original air gap is set to 0.020" and can wear up to 0.040" before replacement is needed.

1. Disconnect the negative battery cable.
2. Remove top 8 bolts (4 along top edge and 2 down each side) that hold fan shroud to condenser frame. Remove top frame cross member (6 bolts).
3. Loosen the fan belt idler and remove belt.
4. Pry top of shroud away from frame and hold it open by inserting any object about 3.50" deep between frame and shroud on each side (short pieces of 2 X 4's works well).
5. Remove the 4 screws securing the condenser fan (item 3, Figure 4-26) to the adapter (item 4) or skip this operation to remove the fan/adapter as one assembly.
6. Remove the 3 screws securing the adapter (/ fan).
7. Using an Allen wrench or 1/4" rod, slide it through the notch on either side of the backer plate (item 15) until it touches the washer behind the clutch. Slowly rotate the fan shaft while applying a slight pressure to the rod until the rod slips into one of the anti-rotation holes in the washer. With the rod in place, remove the bolt and washers (items 7, 8 & 9) which secure the clutch onto the shaft.
8. Remove the clutch pulley/armature from the shaft (be careful not to get the anti-seize compound on the clutch engagement surfaces if clutch is to be reused).
9. Unplug the wire connector to the clutch rotor/field assembly and remove from the shaft.

10. Install clutch on fan shaft assembly by reversing steps 1-7. Add a thin coating of anti-seize compound to new clutch bore. Do not get anti-seize compound on clutch contact surfaces. Be sure to align anti-rotation tang of rotor/field assembly (12 o'clock position) between the two backer plate supports while sliding it into position and also pull the tension clip (item 18) out of the way (about 1") to fully seat this clutch half. Orient retainer washer (9) so that bent tab is inserted into key way, then bend two tabs over the bolt. Clutch bolts torque is 25 to 30 ft/lbs.

b. To Remove the Fan shaft/bearing Assembly (See Figure 4-26)

1. First complete clutch removal refer to steps above.
2. Remove washer (item 11) from shaft (behind clutch).
3. Remove evaporator panels.
4. Remove two screws securing split tapered bushing, to blower wheel (items 12 and 13, Figure 4-25). Place the two screws in the threaded holes of the fan hub and use screws as jacking bolts to remove bushing from blower wheel.
5. Remove venturi ring (item 13, Figure 4-25) by removing 4 screws.
6. Remove clamp from rubber boot on the back of the fan shaft housing and remove the 6 bolts and ring securing the boot to the pod.
7. Remove 4 screws from the bearing housing (item 17).
8. Remove the shaft and bearing housing.
9. Install bearing housing assembly into the unit by reversing steps 1 through 8. Torque 45 to 50 in/lb the 6 bolts which hold the boot and ring to the pod.

WARNING
Do not start unit without installing the evaporator panels as unit damage or body harm may result.

10. Start unit and check refrigeration cycle.

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

It is recommended to clean the evaporator coil 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 (front of trailer).

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 and 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. (Refer to section 2)

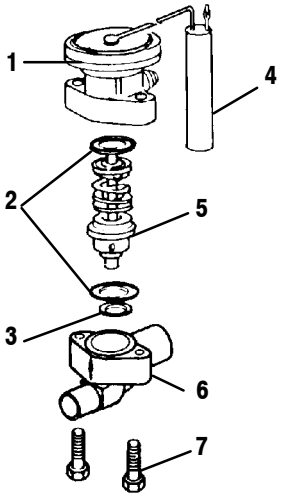
4.26 CONDENSER COIL CLEANING

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

4.27 THERMOSTATIC EXPANSION VALVE

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

a. Replacing Expansion Valve (All Models Except Ultima)



1. Power Assembly
2. Body Flange Gaskets
3. Seat Gasket
4. Bulb
5. Cage Assembly
6. Body Flange
7. Body Flange Screws

Figure 4-27. Thermostatic Expansion Valve

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

2. Remove insulation (Presstite) from expansion valve bulb and then remove bulb from suction line.
3. Loosen flare nut and disconnect equalizer line from expansion valve.
4. Remove flange screws and lift off power assembly. Then remove the cage assembly. Check for foreign material in valve body.
5. The thermal bulb is located below the center of the suction line (See Figure 4-28). This area must be clean to ensure positive bulb contact. Apply thermal mastic and strap thermal bulb to suction line and insulate both with Presstite.
6. Install new gaskets and insert cage assembly and install power assembly.
7. Fasten equalizer tube to expansion valve.
8. Evacuate by placing vacuum pump on suction service valve.
9. Open King valve and then check refrigerant level. (Refer to section 4.11.b)
10. Check superheat. (Refer to section 1.3.h)

b. Replacing Expansion Valve & Screen (Ultima)

1. Pump down the unit by closing the King valve. (Refer to section 4.7.a)
2. Remove insulation (Presstite) from expansion valve bulb and then remove bulb from suction line.
3. Remove Presstite from the expansion valve power head. Unscrew power head if only the element is being changed and replace by reversing steps 1 through 3.
4. Use a wet rag to keep TXV cool whenever brazing or unbrazing. Unbraze inlet, outlet and equalizer connection to valve body. Clean all tube stubs so new valve fits on easily.
5. Install new valve and screen, with cone of screen pointing into liquid line at inlet to the valve by reversing steps 1 through 4.
6. The thermal bulb is located below the center of the suction line (See Figure 4-28). This area must be clean to ensure positive bulb contact. Apply thermal mastic and strap thermal bulb to suction line and insulate both with Presstite.
7. Evacuate by placing vacuum pump on suction service valve.
8. Open King valve and then check refrigerant level. (Refer to section 4.11.b)
9. Check superheat. (Refer to section 1.3.h)

c. Checking Superheat

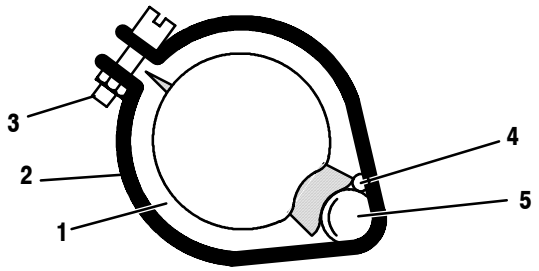
NOTE
It is not recommended adjusting expansion valves unless absolutely necessary.

Due to the time involved in adjusting the superheat, replace the valve rather than adjusting it.

d. To Measure Superheat

NOTE
The expansion valve and bulb location are shown in Figure 1-9.

1. Remove evaporator panel from rear of unit and then remove Presstite from expansion valve bulb and suction line.
2. Loosen one TX bulb clamp and make sure area under clamp (above TXV bulb) is clean.
3. Place thermocouple above (parallel) TXV bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 4-28.



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

Figure 4-28. Thermostatic Expansion Valve Bulb and Thermocouple

NOTE
When conducting this test the suction pressure must be 6 psig (0.4 kg/cm^2) below expansion valve maximum operating pressure (MOP). For example: R-22 units use an expansion valve with a 55 MOP. The recommended test pressure should be below 49 psig(3.44 kg/cm^2).

4. Connect an accurate gauge to the 1/4" port on the suction service valve.
5. Run unit until stabilized. Set controller 10°F (5.5°C) below box temperature.
6. From the temperature/pressure chart, determine the saturation temperature corresponding to the evaporator outlet pressure.
7. Note the temperature of the suction gas at the expansion valve bulb.

Subtract the saturation temperature determined in Step 6 from the average temperature measured in Step 7. The difference is the superheat of the suction gas.

4.28 SERVICING PHASE SEQUENCE – OPTIONAL

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 4-29)

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

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

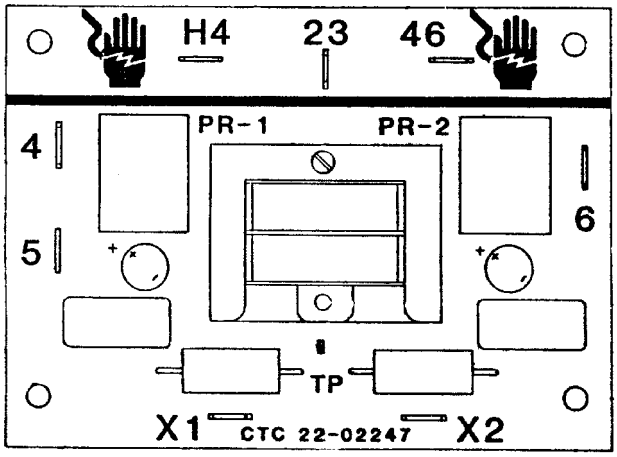


Figure 4-29. Phase Sequence Module

4.29 MICROPROCESSOR CONTROLLER

NOTE

The erasable, programmable, read only memory (EEPROM) 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 4-2. Connection Point Voltage

Connection Point	Approximate Voltage
CDT, RAS, SAS, 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 the processor would start 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 a good practice to remove both battery cables before welding on either the unit frame or the trailer to prevent possible damage to other components such as the alternator and voltage regulator.

a. Replacing Key Board

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

All replacement key boards are packaged with replacement O-Ring. The recommended torque for securing nuts or bolts is 15 inch-lbs.

b. Hour Meters

The hour meter can be set to any value via the serial port, if the meter has less then 5 hours on it. This allows a replacement microprocessor to be set to the same hours as the microprocessor it is replacing.

The microprocessor has 2 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.

4.30 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.

a. To reach the configuration fields:

1. Turn the Run/Stop switch to the Stop position.
2. 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.

CAUTION

Do not allow jumper wire to touch any ground.

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.

b. To change the configuration selection:

1. Bring the configuration to be changed onto the display. Press the ENTER key to allow change access to the displayed configuration.
2.. 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 5 seconds.)
3. Continue to scroll through the configuration list by pressing the FUNCTION key. Change any other configurations as required.
4. When finished turn the Run/Stop switch to the Stop position, then back to the Run position to start the unit.

Configuration		Description
CNF1	DI	DI Engine Glow Time
	TV	TV Engine Glow Time
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	OFF	MOP Disabled (R-502)
	ON	MOP Enabled (R-22/R-404A)
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	OFF	MOP Software Values (Must be Off)
	ON	MOP EEPROM Values (Do not turn on)
CNF11	OFF	Functions normal
	ON	Functions locked
CNF12	OFF	MOP R-22
	ON	MOP R-404A
CNF13	OFF	Cool/Heat/Defrost
	ON	Heat Only (Solara)
CNF14	OFF	Not Active
	ON	Reversible Multi-Temp Active
CNF15	OFF	Not Active
	ON	UltraFresh 2 Active
CNF16	OFF	Alt aux alarm only
	ON	Alt aux alarm shut unit down

4.31 CONTROLLER SENSOR CHECKOUT

An accurate ohmmeter must be used to check resistance values shown in Table 4-3.

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 4-3.

At least one lead from the sensor (RAS, terminals D1 and E1 or SAS, terminals D2 and E2) 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, is an ice bath at 32°F (0°C) or a calibrated temperature tester.

Table 4-3. Sensor Resistance (ATS, CDT, RAS, SAS, & WTS)

Temperature		ATS, RAS, SAS & 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

4.32 SUCTION PRESSURE TRANSDUCER

Before installing a new suction pressure transducer it must be calibrated.

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 can not be calibrated. Once the micro is calibrated, the display will readout the actual value.

1. Turn power off and remove starter solenoid wire, then let unit fail to start. This will de-energize run relay.
2. Connect wiring to new suction pressure transducer. Before installing suction pressure transducer into compressor, display the suction pressure via the unit status display. While the suction pressure is being displayed press ENTER key for 3 seconds, the display should read “0”. If display reads “0” install suction pressure transducer into compressor.

Table 4-4. 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		

4.33 UNIDRIVE TORQUE REQUIREMENTS (See Figure 4-30 or Figure 4-31)

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 engine bellhousing. The recommended sealant is Loctite screw lock no. 262.

The following figures show the torque value, size and grade of the hardware to be used when reassembling the unidrive assembly.

4.33.1 Drive Gear

When installing a nylon drive gear always:

1. Install with black dot facing steel gear.
2. Use new bolts and locking tabs included in drive gear kit.
3. Use Locktite or a similar thread locking compound on threads of drive gear bolts.
4. DO NOT use never-seize or any other lubricating compound on the nylon drive gear or compressor steel gear. The gear must be assembled dry.
5. Torque the (4 bolt) nylon drive gear bolts to 25 ft-lbs. Torque the (6 bolt) nylon drive gear bolts to 30 ft-lbs.

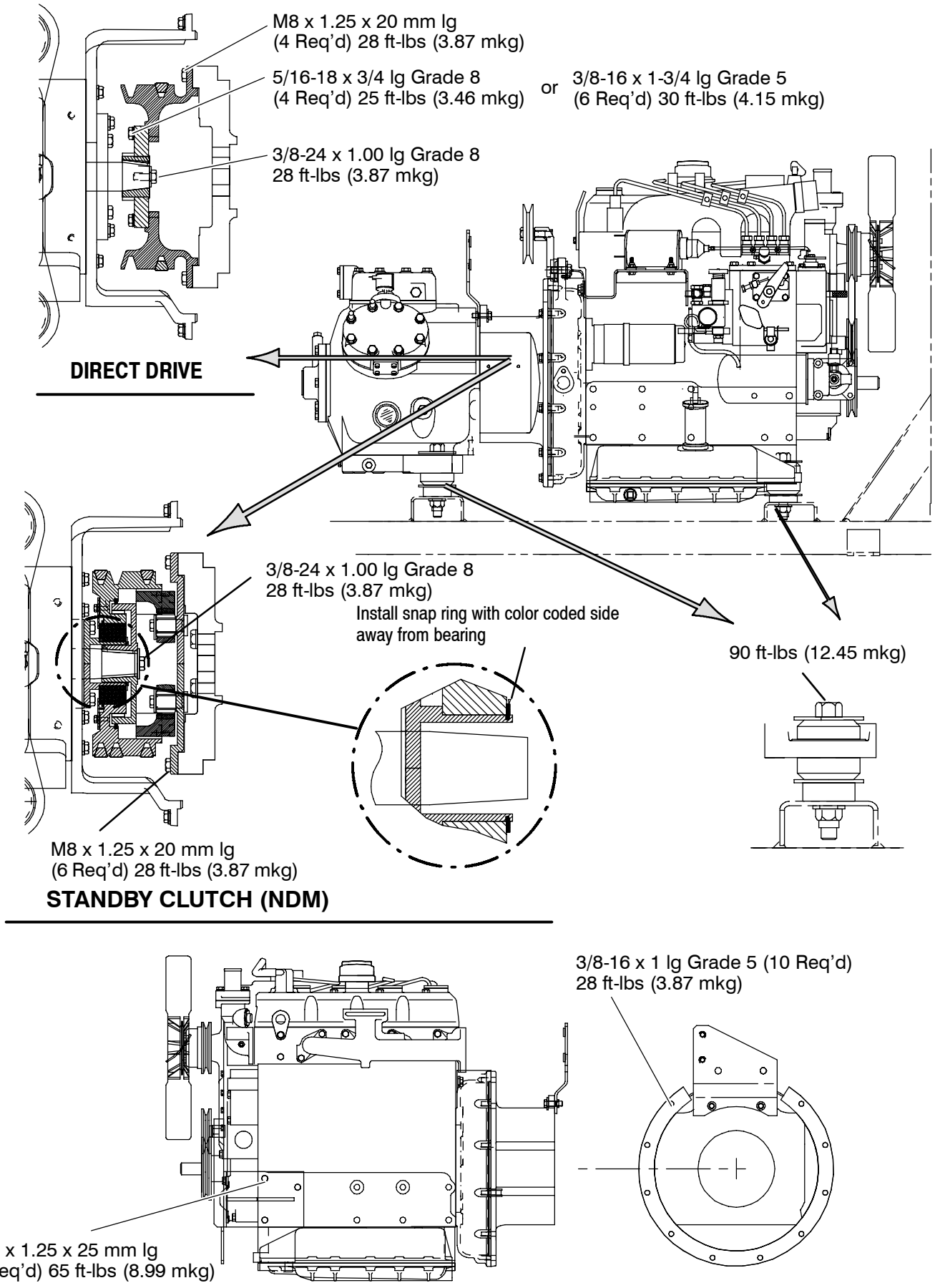


Figure 4-30. ULTIMA, PHOENIX ULTRA & EXTRA – Unidrive Torque Requirements

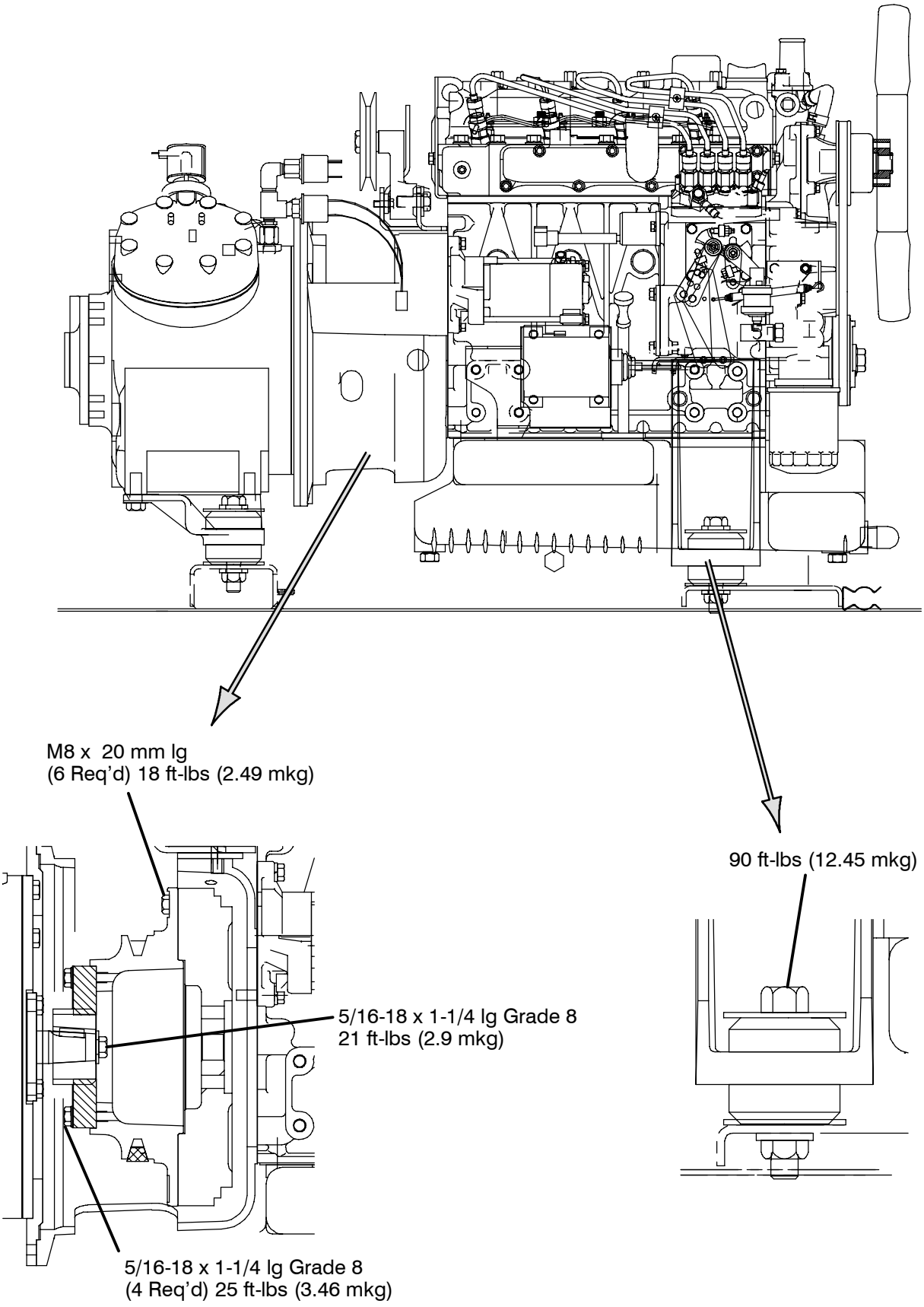


Figure 4-31. OPTIMA – Unidrive Torque Requirements

Table 4-5. R-22 Pressure – Temperature Chart

TEMPERATURE		PRESSURE			TEMPERATURE		PRESSURE		
°F	°C	Psig	Kg/cm2	Bar	°F	°C	Psig	Kg/cm2	Bar
–40	–40	.6	.04	.04	34	1	60.5	4.25	4.17
–36	–38	2.3	.16	.16	36	2	63.3	4.45	4.36
–32	–36	4.1	.29	.28	38	3	66.1	4.65	4.56
–28	–33	6.0	.42	.41	40	4	69	4.85	4.76
–26	–32	7.0	.49	.48	44	7	75.0	5.27	5.17
–24	–31	8.1	.57	.56	48	9	81.4	5.72	5.61
–22	–30	9.2	.65	.63	52	11	88.1	6.19	6.07
–20	–29	10.3	.72	.71	54	12	91.5	6.43	6.31
–18	–28	11.5	.81	.79	60	16	102.5	7.21	7.07
–16	–27	12.7	.89	.88	64	18	110.2	7.75	7.6
–14	–26	14.0	.98	.97	68	20	118.3	8.32	8.16
–12	–24	15.2	1.07	1.05	72	22	126.8	8.91	8.74
–10	–23	16.6	1.17	1.14	76	24	135.7	9.54	9.36
– 8	–22	18.0	1.27	1.24	80	27	145	10.19	10.0
– 6	–21	19.4	1.36	1.34	84	29	154.7	10.88	10.67
– 4	–20	21.0	1.48	1.45	88	31	164.9	11.59	11.37
– 2	–19	22.5	1.58	1.55	92	33	175.4	12.33	12.09
0	–18	24.1	1.69	1.66	96	36	186.5	13.11	12.86
2	–17	25.7	1.81	1.77	100	38	197.9	13.91	13.64
4	–16	27.4	1.93	1.89	104	40	209.9	14.76	14.47
6	–14	29.2	2.05	2.01	108	42	222.3	15.63	15.33
8	–13	31.0	2.18	2.14	112	44	235.2	16.54	16.22
10	–12	32.9	2.31	2.27	116	47	248.7	17.49	17.15
12	–11	34.9	2.45	2.41	120	49	262.6	18.46	18.11
14	–10	36.9	2.59	2.54	124	51	277.0	19.48	19.10
16	– 9	39.0	2.74	2.69	128	53	291.8	20.52	20.12
18	– 8	41.1	2.89	2.83	132	56	307.1	21.59	21.17
20	– 7	43.3	3.04	2.99	136	58	323.6	22.75	22.31
22	– 6	45.5	3.2	3.14	140	60	341.3	24.0	23.53
24	– 4	47.9	3.37	3.3	144	62	359.4	25.27	24.78
26	– 3	50.2	3.53	3.46	148	64	377.9	26.57	26.06
28	– 2	52.7	3.71	3.63	152	67	396.6	27.88	27.34
30	– 1	55.2	3.88	3.81	156	69	415.6	29.22	28.65
32	0	57.8	4.06	3.99	160	71	434.6	30.56	29.96

Table 4-6. R-404A Temperature–Pressure Chart

Temperature		Pressure		
°F	°C	Psig	Kg/cm2	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/cm2	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 Diagram covering the Models listed in Table 1-1. The following 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

High voltage in electrical box, disconnect power before servicing unit.

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.

WARNING

Beware of unannounced starting of the evaporator and condenser fan.

WARNING

Make sure power to unit is OFF and negative battery cable is disconnected before servicing the compressor unloader.

CAUTION

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

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

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.

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G15,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
J8	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
P8	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
G9,N8	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
M10	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
Q10	FH	FUEL HEATER (OPTIONAL)
N10,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
P10	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J9	FR	FAULT RELAY
O4	FP	FUEL PUMP (OPTIONAL)
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4/12,K4/10,P4/9	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F8/11,N5/6,J7	HR	HEAT RELAY
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
A6,F1/4/6,H2,N3 P2,Q4/5/6/7/8,R7 L6/7/8/9	SP	SPLICE POINT
B5	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
P7	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q6	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P5	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
L6	UR	UNLOADER REAR
F8,J6	URR	UNLOADER REAR RELAY
E16	VR	VOLTAGE REGULATOR
B6	WTS	WATER TEMPERATURE SENSOR

Figure 5-1. NDA-94A Electrical Schematic Wiring Diagram – Prior to S/N DAF90209263 – Dwg. No. 62-02457 Rev. C (Sheet 1 of 2)

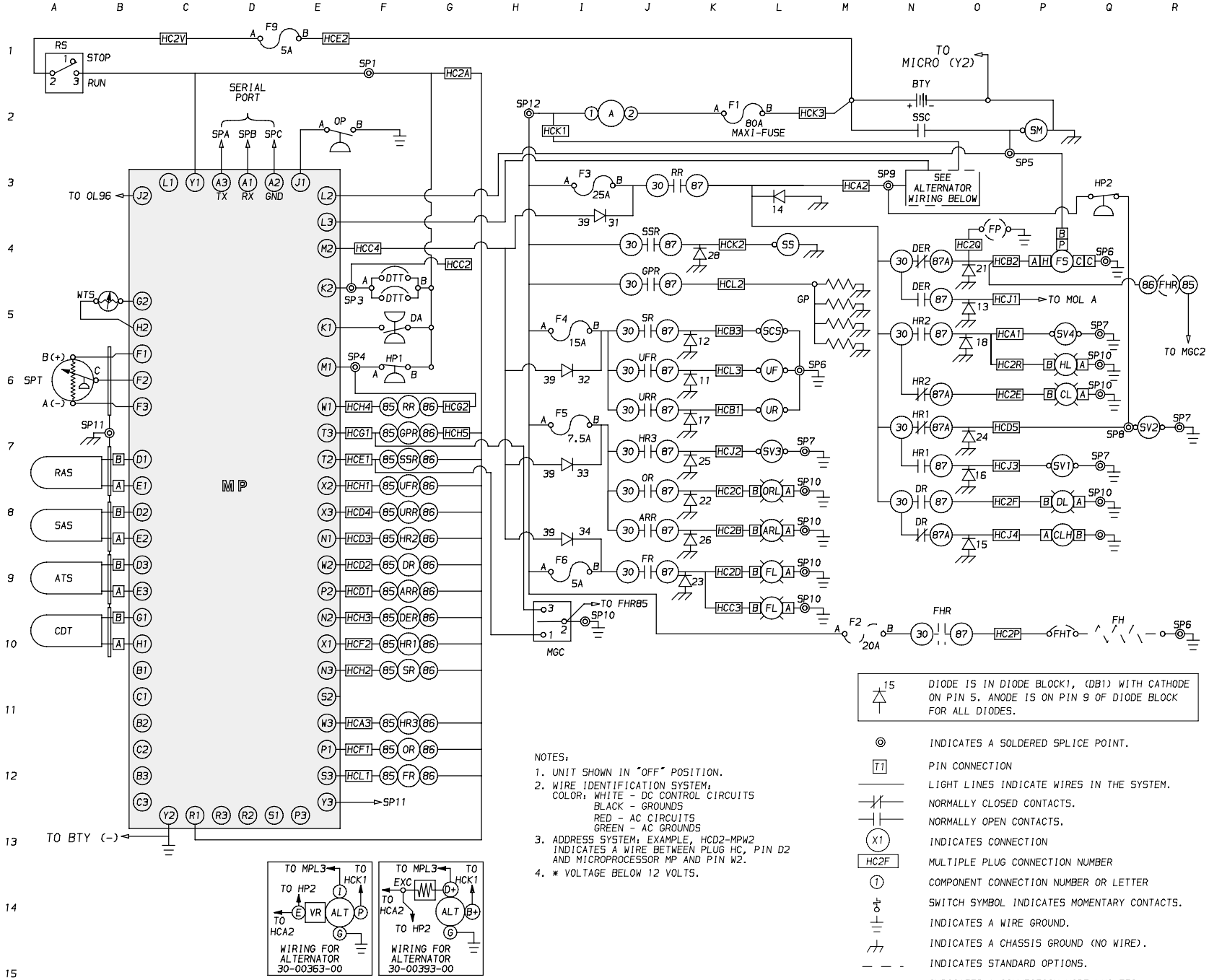


Figure 5-1. NDA-94A Electrical Schematic Wiring Diagram – Prior to S/N DAF90209263 – Dwg. No. 62-02457 Rev. C (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
J2	A	AMMETER
N3,E15,G15	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
A9	ATS	AMBIENT TEMPERATURE SENSOR
N2	BTY	BATTERY
A10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N5/6	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
R5,N11	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9/10	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J9	FR	FAULT RELAY
O4	FP	FUEL PUMP (OPTIONAL)
P5	FS	FUEL SOLENOID
M5	GP	GLOW PLUG
F7,J5	GPR	GLOW PLUG RELAY
F4/12,K4/10,P4/9	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N6/7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
F11,N10	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
A6,F1/2/4/6,H2, P2,Q4/5,P4,R7 L5/6/7/8/9	SP	SPLICE POINT
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
E14	VR	VOLTAGE REGULATOR
B5	WTS	WATER TEMPERATURE SENSOR

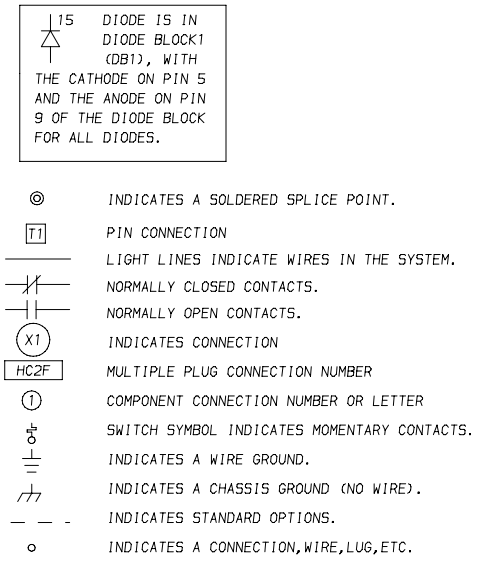


Figure 5-2. NDA-94A & NDA-94B Electrical Schematic Wiring Diagram – Starting with S/N DAF90209263 – Dwg. No. 62-02589 Rev A (Sheet 1 of 2)

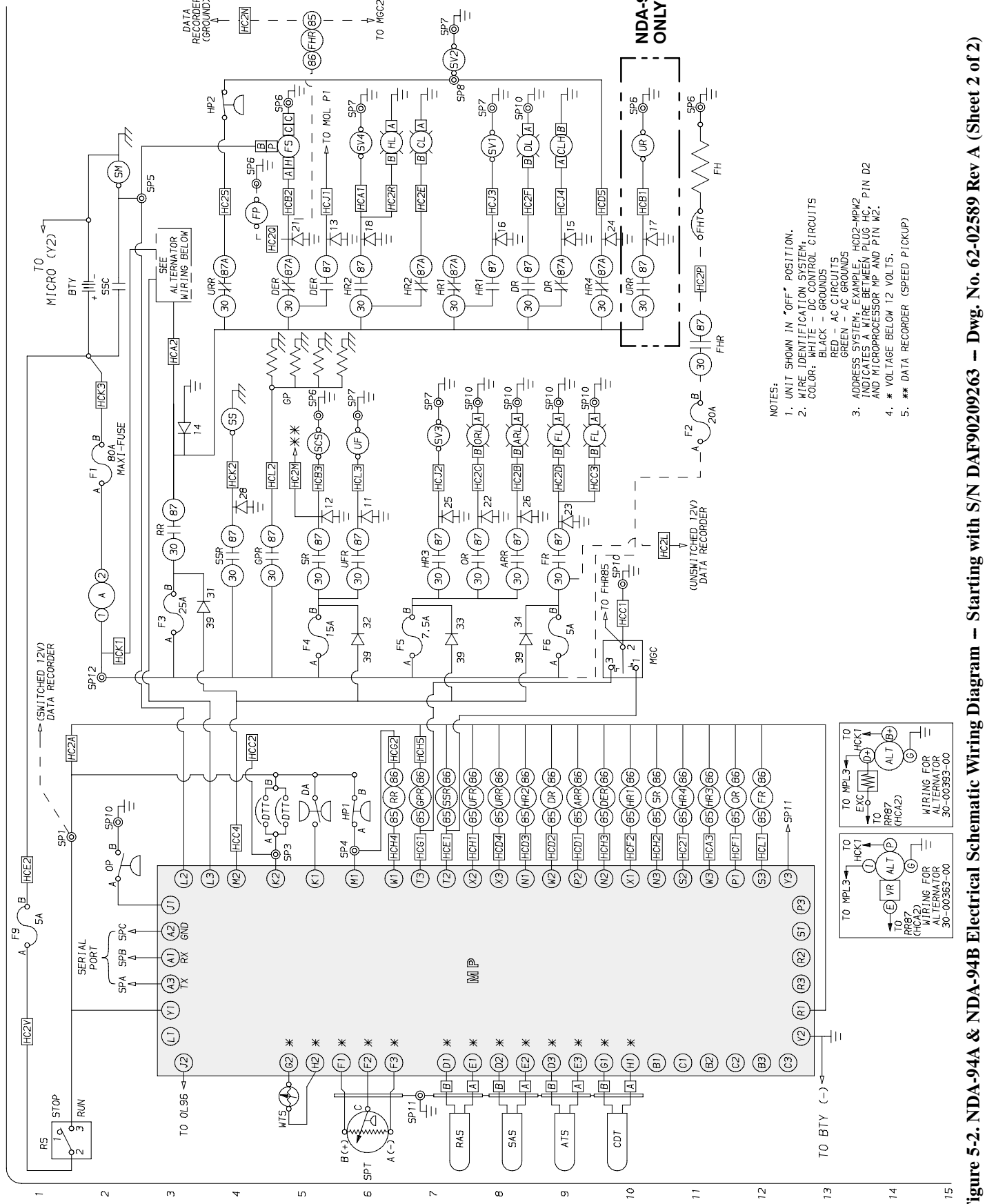
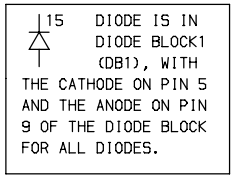


Figure 5-2. NDA-94A & NDA-94B Electrical Schematic Wiring Diagram – Starting with S/N DAF9020263 – Dwg. No. 62-02589 Rev A (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
E15,G15	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
A9	ATS	AMBIENT TEMPERATURE SENSOR
N2,B13	BTY	BATTERY
A10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
G1,J11,K5,P11,R4	DK	DATALINK (OPTIONAL)
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
R5,M11	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J9	FR	FAULT RELAY
O4	FP	FUEL PUMP (OPTIONAL)
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4-12,J11,K4-10, N11,N14,P4-9,Q11,R5	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N5/6	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N10,F11	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
A7,E4/5,H2,I10,L7, O3,Q6/8/12	SP	SPLICE POINT
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q6	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P5	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR (NDA-94A ONLY)
F8,N4/10	URR	UNLOADER REAR RELAY
B5	WTS	WATER TEMPERATURE SENSOR



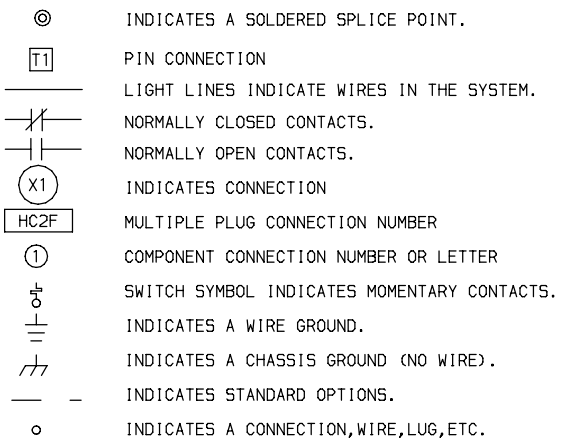


Figure 5-3. NDA-94 Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03935 (Sheet 1 of 2)

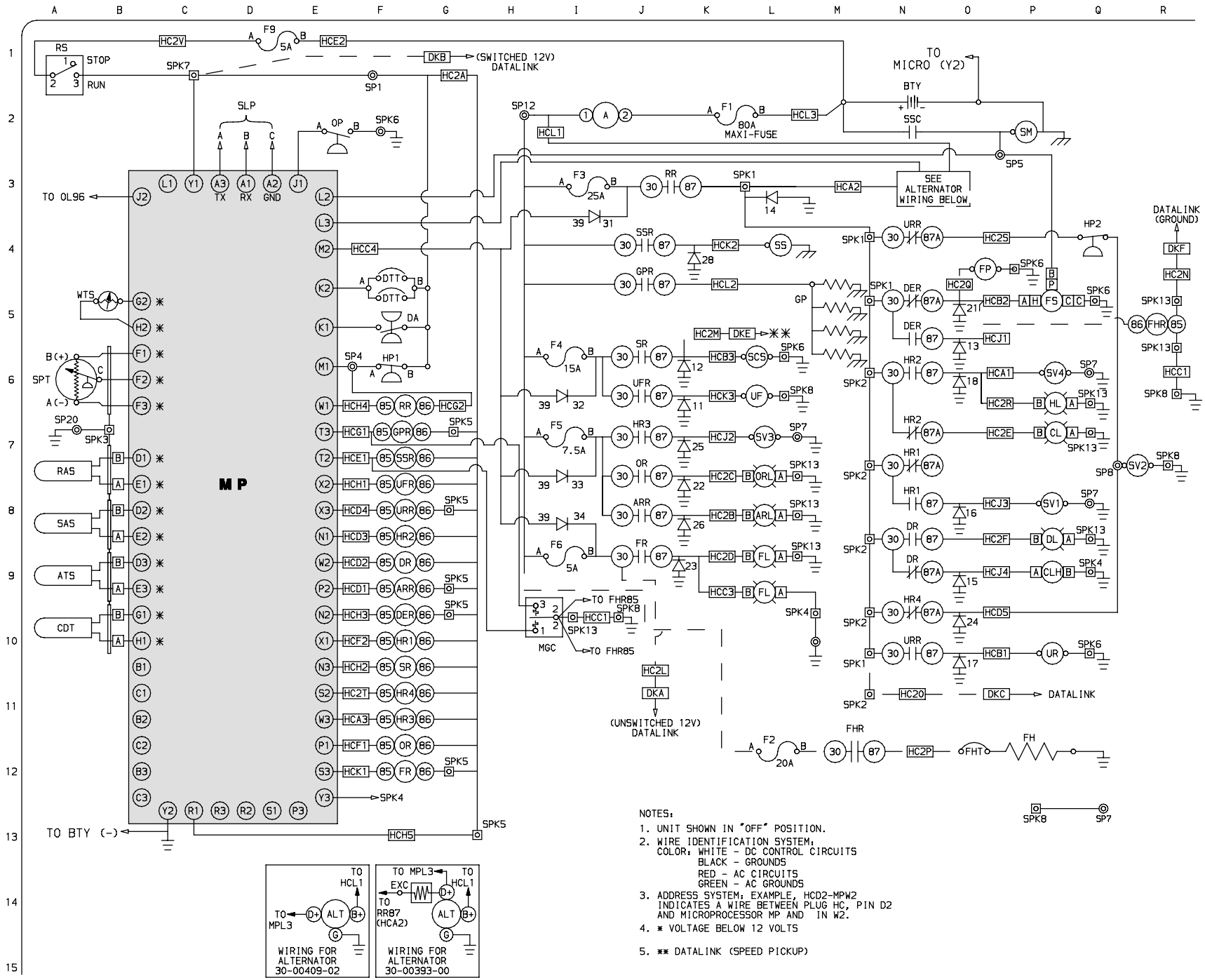


Figure 5-3. NDA-94 Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03935 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G15,N3,G14	ALT	ALTERNATOR
L9	ARL	AUTO RESTART LIGHT (LIGHT BAR)
J9,F9	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N5	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
M11,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9,L10	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P5	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4/12,K4/10,P4/9	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N6/7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N10,F11	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
C14,E16	MC1	MOTOR CONTACTOR (D/E ONLY)
B16	MOL	MOTOR OVERLOADER (D/E ONLY)
D15	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J8	OR	OUT OF RANGE RELAY
L8	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
A14	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
D14	SBM	STANDBY MOTOR (D/E ONLY)
L6	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
A6,B3,C2,F1/2/4/6, H2,Q4/5/6/9/10/11 L6/7/9,P2,R7	SP	SPLICE POINT
B6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J6	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
E16	VR	VOLTAGE REGULATOR
B5	WTS	WATER TEMPERATURE SENSOR

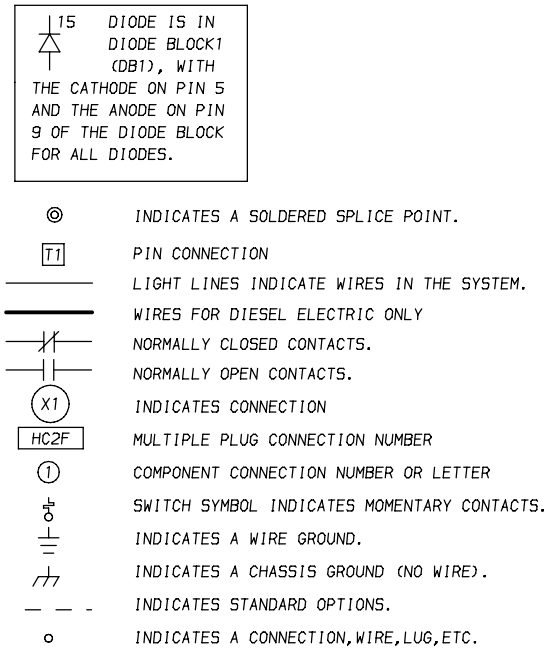


Figure 5-4. NDM-94A EURO Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02590 (Sheet 1 of 2)

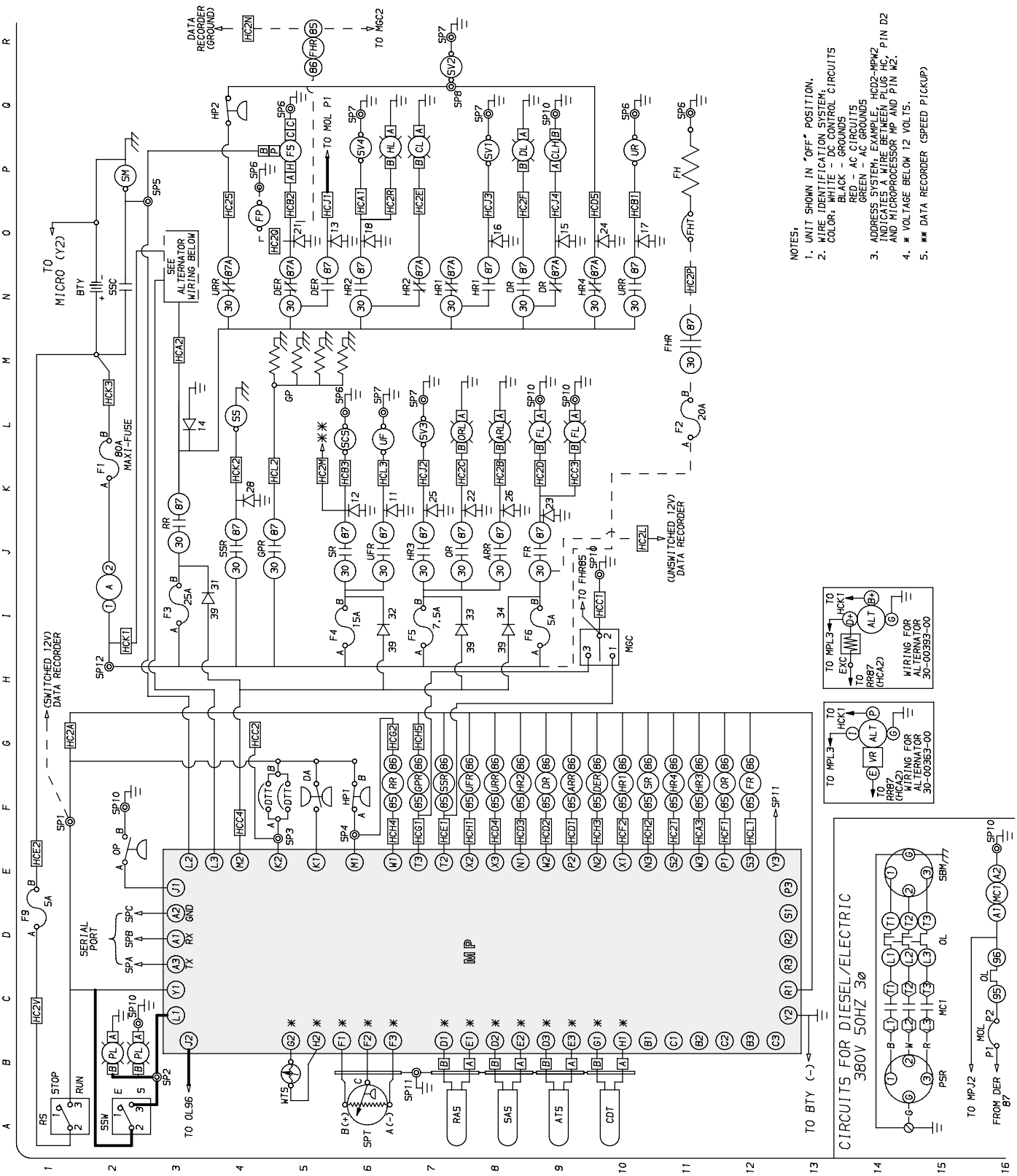
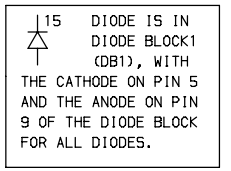


Figure 5-4. NDM-94A EURO Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02590 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G16,N3,G14	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
J9,F9	ARR	AUTO RESTART RELAY
A9	ATS	AMBIENT TEMPERATURE SENSOR
N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N5/6	DER	DIESEL ELECTRIC RELAY
G1,J11,L5,P11,R4	DK	DATALINK (OPTIONAL)
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
M11,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9,L10	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P5	FS	FUEL SOLENOID
M5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4-12,J11,K4-10, N11,N14,P4-9,R5,R6	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N6/7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N10,F11	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
C14,E16	MC1	MOTOR CONTACTOR (D/E ONLY)
C16	MOL	MOTOR OVERLOADER (D/E ONLY)
D15,C16	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J8	OR	OUT OF RANGE RELAY
L8	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
B15	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
E15	SBM	STANDBY MOTOR (D/E ONLY)
L6	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
A7,E4/5,H2,I10,L7, O3,Q6/8/12	SP	SPLICE POINT
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J6	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
B5	WTS	WATER TEMPERATURE SENSOR



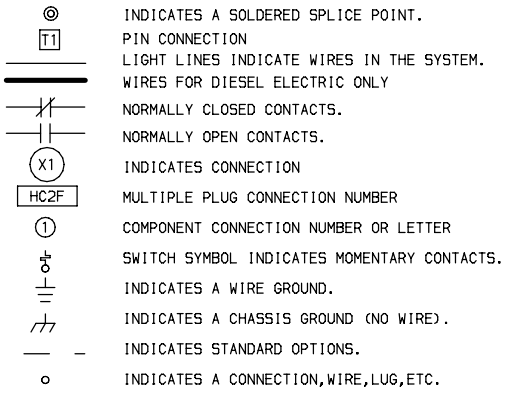


Figure 5-5. NDM-94 (EURO) Electrical Schematic Wiring Diagram Starting with S/N EAE90310998– Dwg. No. 62-03936 (Sheet 1 of 2)

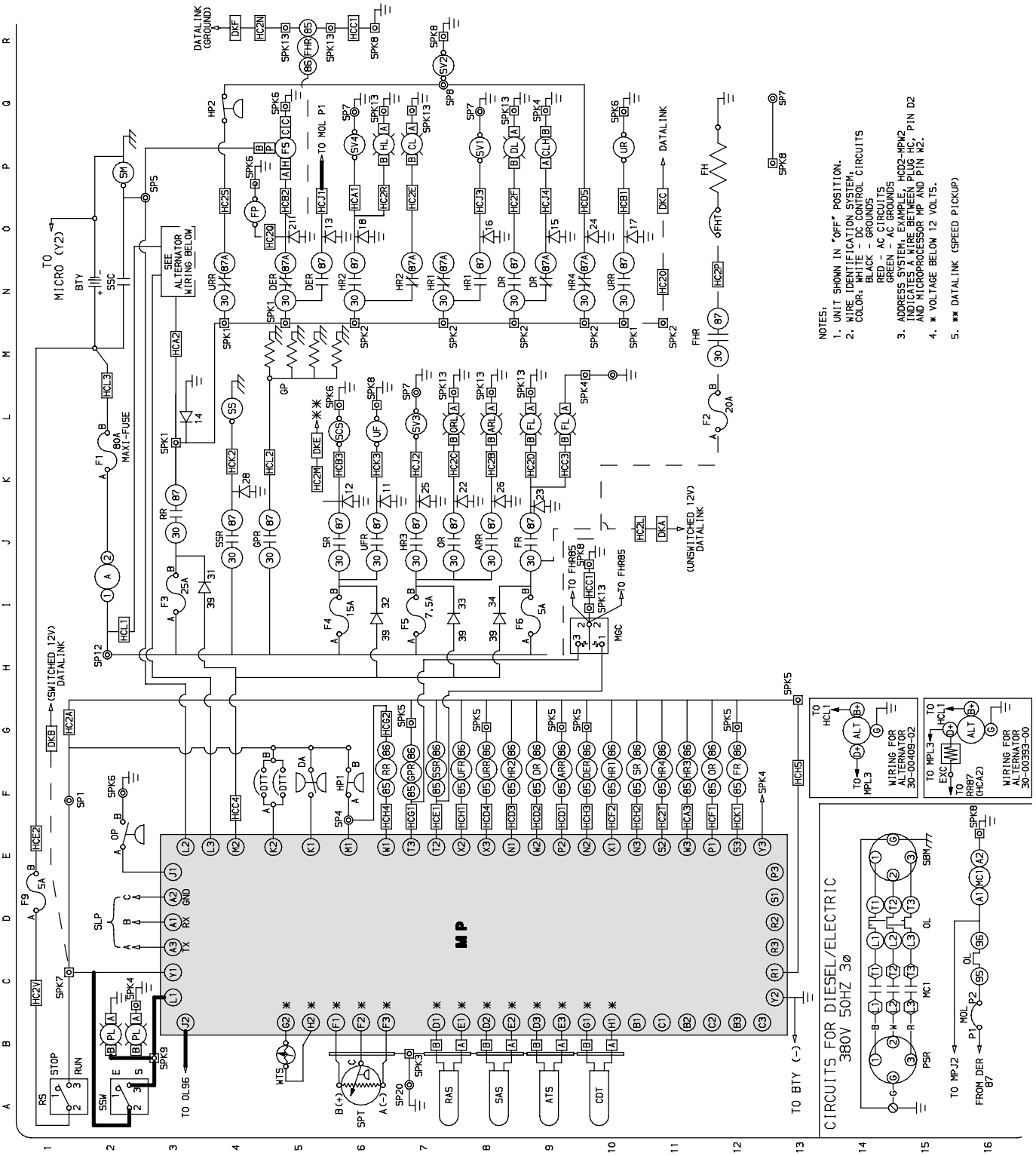


Figure 5-5. NDM-94 (EURO) Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03936 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G14,G15,G16,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
P8	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
M10	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
Q10	FH	FUEL HEATER (OPTIONAL)
N10,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
P10	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4/12,K4/10,P4/9	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N10,F11	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
C14,C16	MC1	MOTOR CONTACTOR ONE (D/E ONLY)
D15,D16	MCR	MOTOR CONTACTOR RELAY (D/E ONLY)
B15	MOL	MOTOR OVERLOADER (D/E ONLY)
C15	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
A14	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
D14	SBM	STANDBY MOTOR (D/E ONLY)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
A6,B3,C2,F1/2/4/6, H2,Q4/5/8/10,R7 L5/6/7//9,E16,P4	SP	SPLICE POINT
B6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P7	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q6	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P5	SV4	HOT GAS SOLENOID VALVE (N.C.)
B16	TR	TRANSFORMER (D/E ONLY)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
E16	VR	VOLTAGE REGULATOR
B5	WTS	WATER TEMPERATURE SENSOR

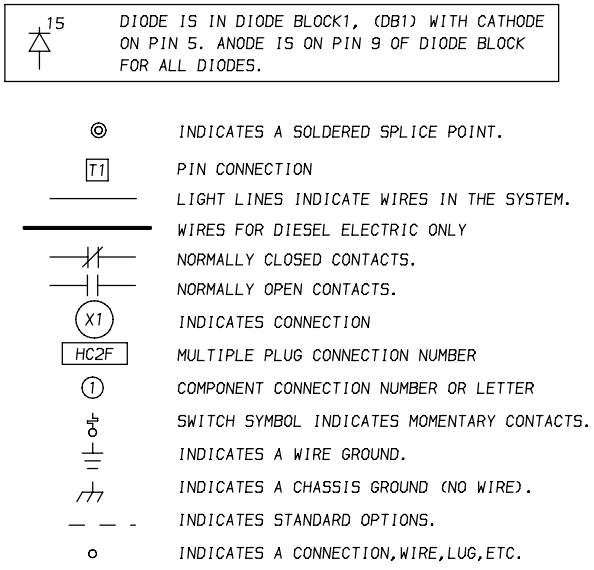


Figure 5-6. NDM-94A Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02620 (Sheet 1 of 2)

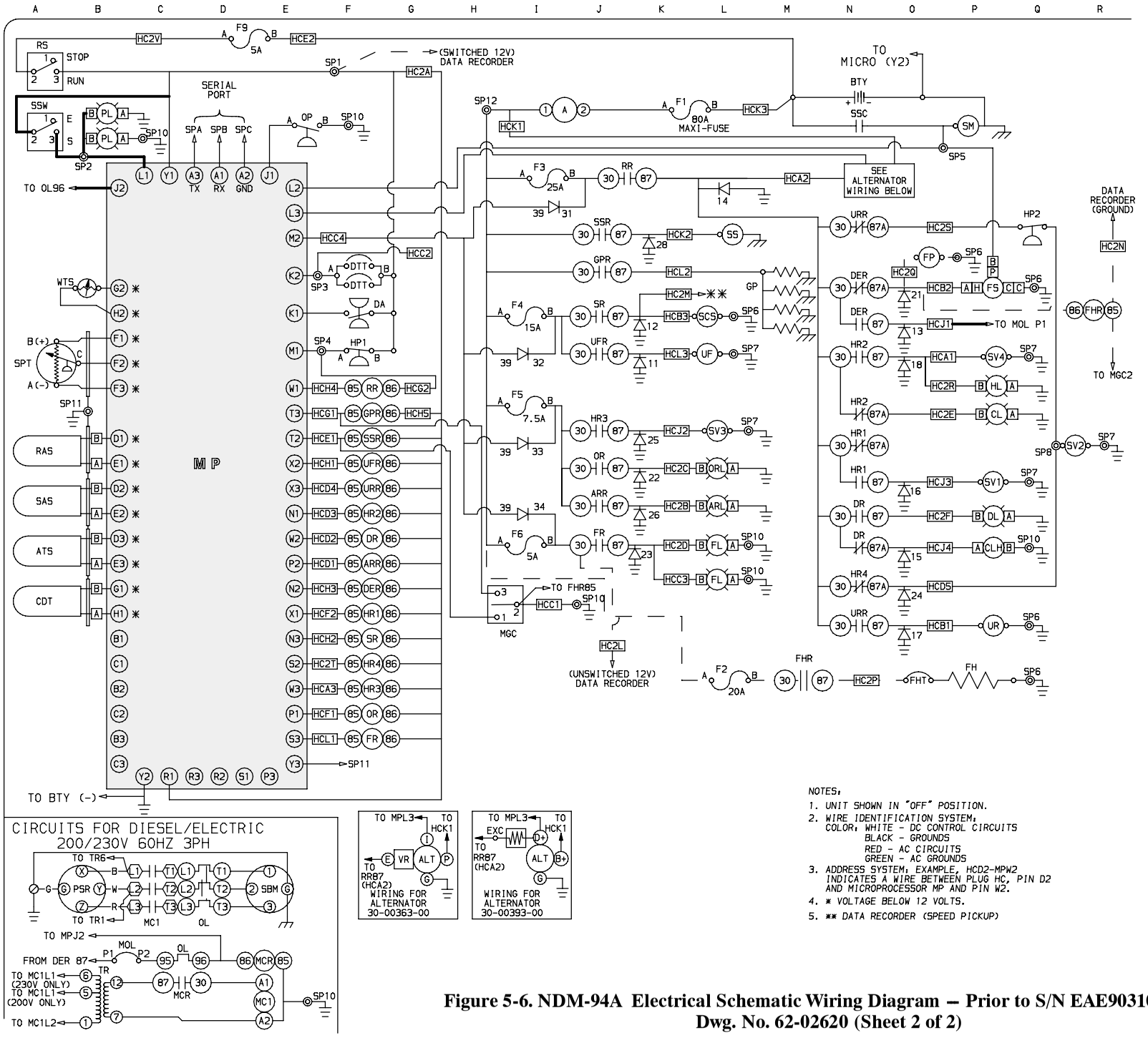
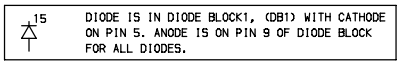


Figure 5-6. NDM-94A Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02620 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G14,G15,G16,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
A9	ATS	AMBIENT TEMPERATURE SENSOR
N2	BTY	BATTERY
A10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N5/6	DER	DIESEL ELECTRIC RELAY
G1,J11,K5,P11,R4	DK	DATALINK (OPTIONAL)
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
M11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
M11,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9/10	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P5	FS	FUEL SOLENOID
M5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4-12,J11,K4-10, N11,N14,P4-9,R5	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N10,F11	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
C14,E16	MC1	MOTOR CONTACTOR ONE (D/E ONLY)
E15,D16	MCR	MOTOR CONTACTOR RELAY (D/E ONLY)
B15	MOL	MOTOR OVERLOADER (D/E ONLY)
C15,D14	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J8	OR	OUT OF RANGE RELAY
L8	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
B14	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
E14	SBM	STANDBY MOTOR (D/E ONLY)
L5	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
A7,E4/5,H2,I10,L7, O3,Q6/8/12	SP	SPLICE POINT
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
B16	TR	TRANSFORMER (D/E ONLY)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
B5	WTS	WATER TEMPERATURE SENSOR



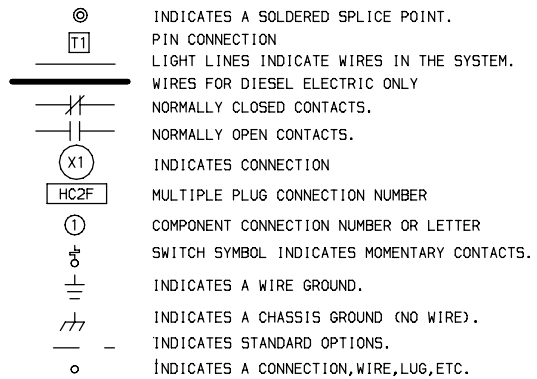


Figure 5-7. NDM-94 Electrical Schematic Wiring Diagram –Starting with S/N EAE90310998 – Dwg. No. 62-03937 (Sheet 1 of 2)

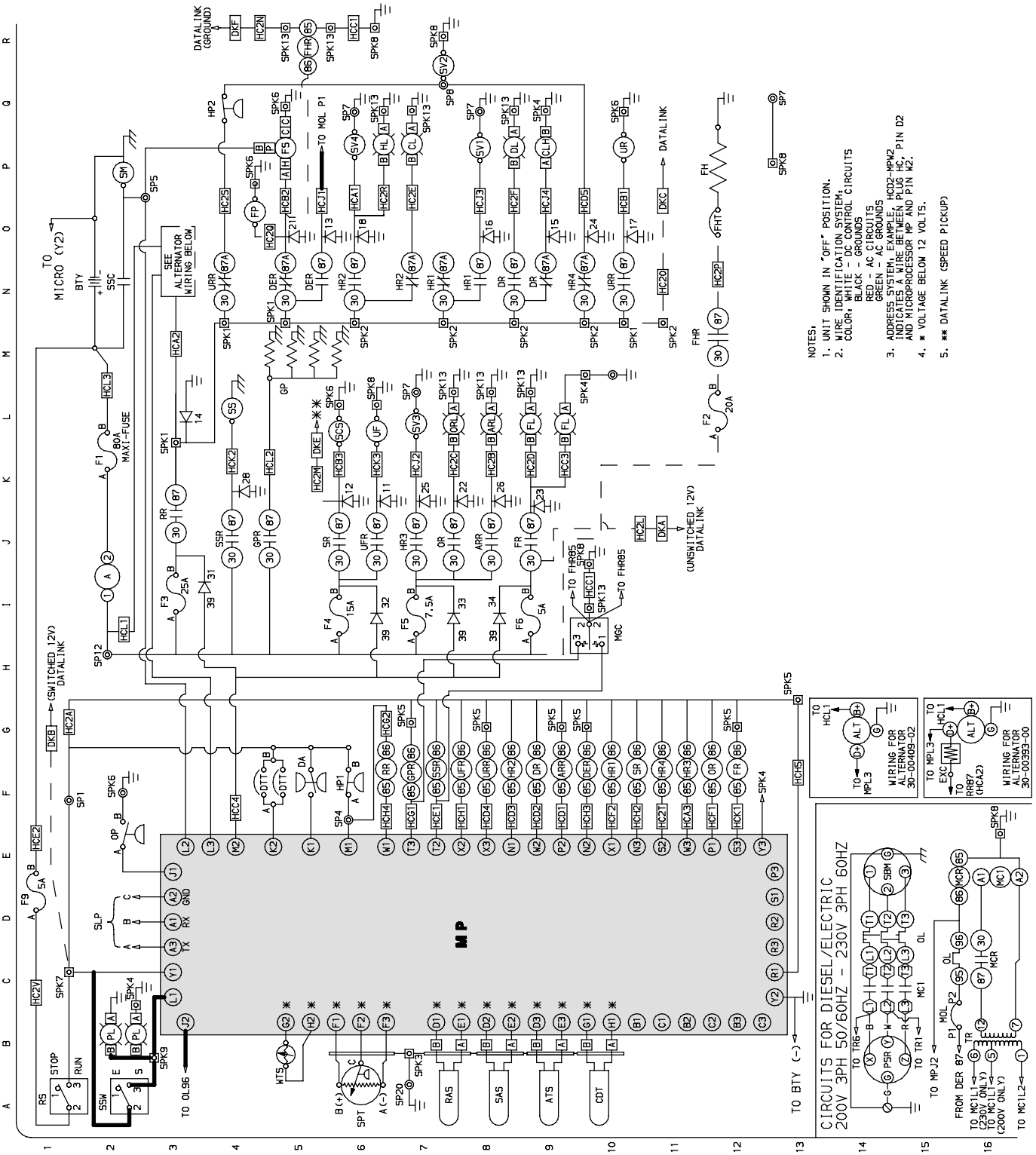


Figure 5-7. NDM-94 Electrical Schematic Wiring Diagram –Starting with S/N EAE90310098 – Dwg. No. 62-03937 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G14,G15,G16,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
P8	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
M11,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4/12,K4/10,P4/9	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
F11,N9	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
J12/13,L15	MC1/2	MOTOR CONTACTOR (D/E ONLY)
L14,L16	MCR	MOTOR CONTACTOR RELAY (D/E ONLY)
J16	MOL	MOTOR OVERLOADER (D/E ONLY)
K12,K16	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
K14	PRB	PHASE REVERSAL BOARD
H12	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L12	SBM	STANDBY MOTOR (D/E ONLY)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
A7,B3,C2,F1/2/4/6 H2,P2,Q4/5/7/11,R7 L5/6/7/9,M15,E16	SP	SPLICE POINT
B6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P7	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q6	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P5	SV4	HOT GAS SOLENOID VALVE (N.C.)
I15	TR	TRANSFORMER (D/E ONLY)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N10	URR	UNLOADER REAR RELAY
E16	VR	VOLTAGE REGULATOR
B5	WTS	WATER TEMPERATURE SENSOR

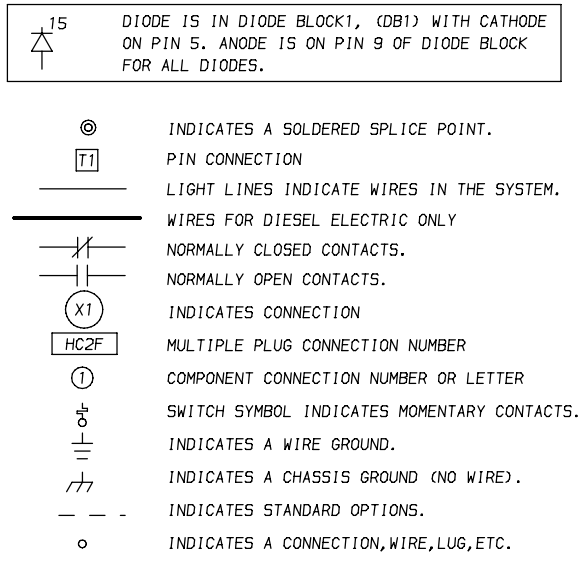


Figure 5-8. NDM-94A – 230v Phase Reversal Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02621 (Sheet 1 of 2)

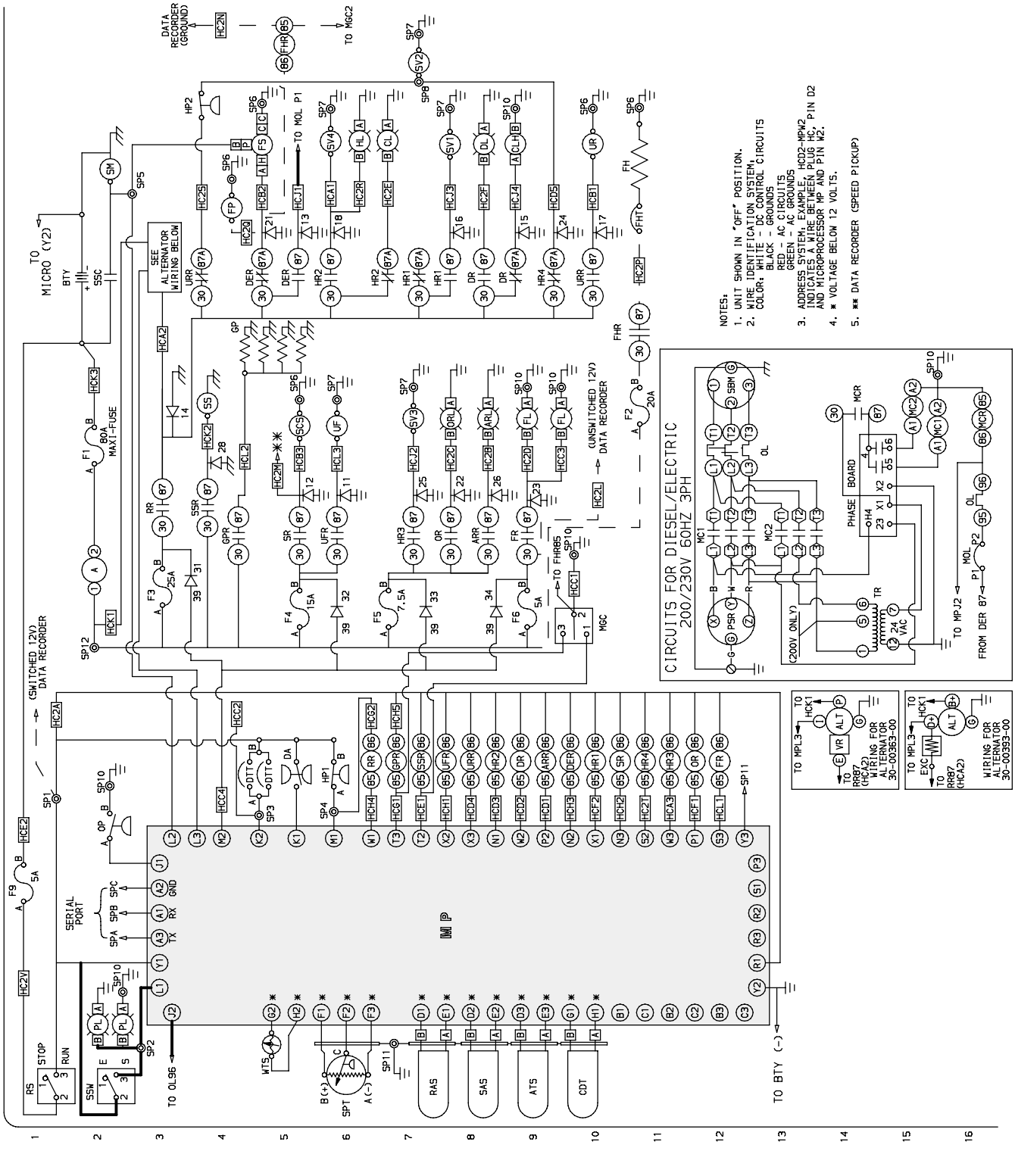
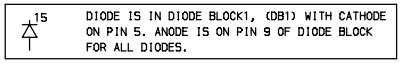


Figure 5-8. NDM-94A – 230v Phase Reversal Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02621 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G14,G15,G16,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
G1,K5,K10,P11,R4	DK	DATALINK (OPTIONAL)
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
M11,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9/10	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4-12,J11,K4-10, N11,N14,P4-9,R5	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
F11,N9	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
J12/13,L15	MC1/2	MOTOR CONTACTOR (D/E ONLY)
L14,L16	MCR	MOTOR CONTACTOR RELAY (D/E ONLY)
J16	MOL	MOTOR OVERLOADER (D/E ONLY)
L12,K16	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J8	OR	OUT OF RANGE RELAY
L8	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
K15	PRB	PHASE REVERSAL BOARD
I12	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L12	SBM	STANDBY MOTOR (D/E ONLY)
L5	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
A7,E4/5,H2,I10,L7, O3,Q6/8/12	SP	SPLICE POINT
B6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
I15	TR	TRANSFORMER (D/E ONLY)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
B5	WTS	WATER TEMPERATURE SENSOR



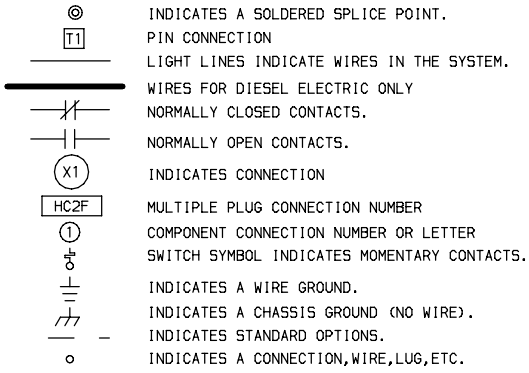


Figure 5-9. NDM-94 230v Phase Reversal Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03939 (Sheet 1 of 2)

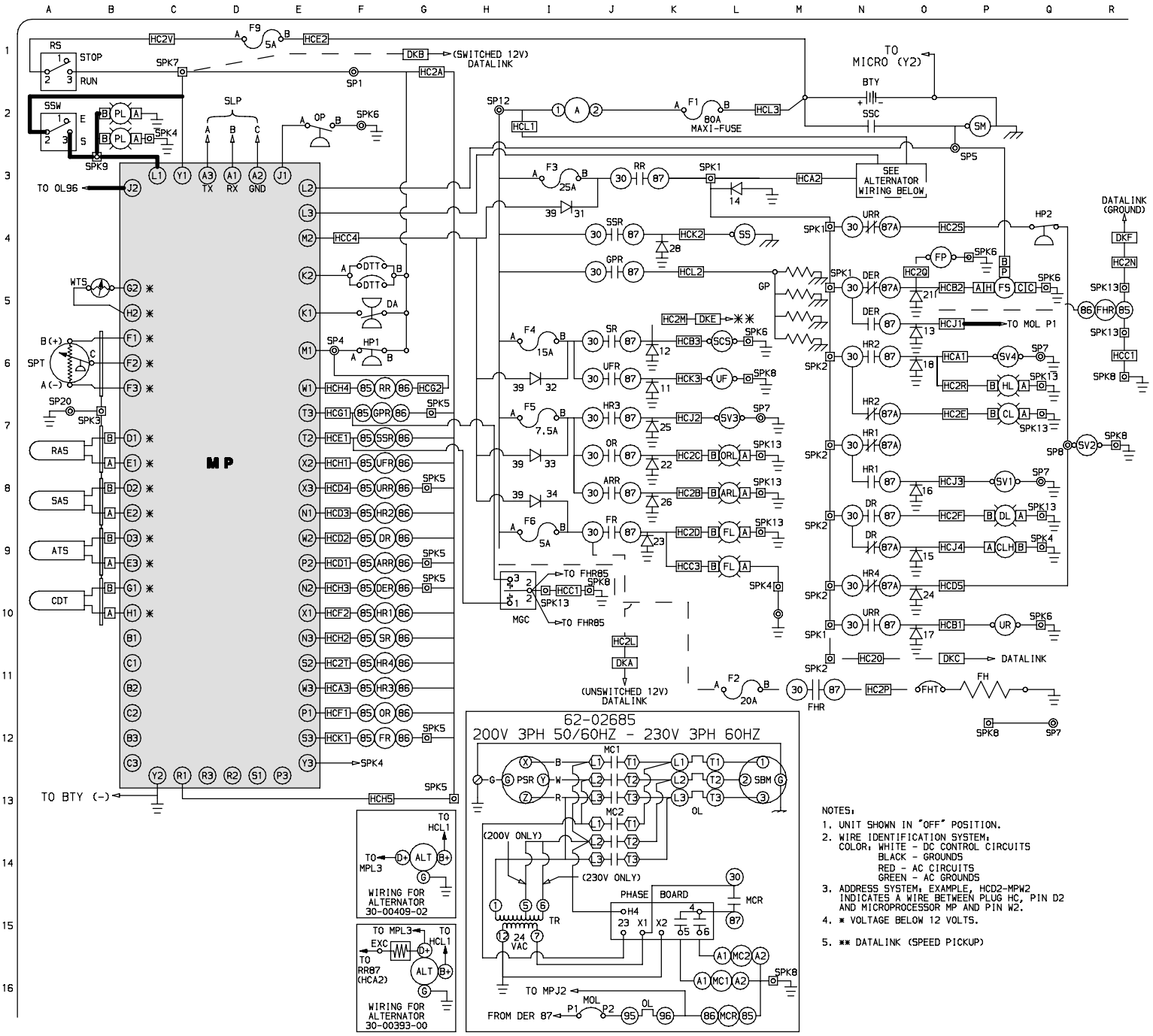
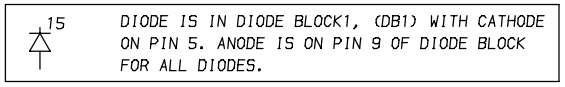


Figure 5-9. NDM-94 230v Phase Reversal Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03939 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G15,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N2	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
P8	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE) (80 AMPERE)
M10	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
Q10	FH	FUEL HEATER (OPTIONAL)
N10,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
P10	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
Q4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4/12,K4/10,P4/9	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7	HR1	HEAT RELAY #1
F8,N5	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N9	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
J12,L15	MC1	MOTOR CONTACTOR (D/E ONLY)
J13,L15	MC2	MOTOR CONTACTOR (D/E ONLY)
J16	MOL	MOTOR OVERLOADER (D/E ONLY)
K12	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR) (D/E ONLY)
K14	PRB	PHASE REVERSAL BOARD
H12	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L12	SBM	STANDBY MOTOR (D/E ONLY)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
A6,B3,F1/4/6,H2,N3 P2,Q4/5/6/7/8/9,R7 L6/7/8/9,E16	SP	SPLICE POINT
B6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P7	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q6	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P5	SV4	HOT GAS SOLENOID VALVE (N.C.)
I15	TR	TRANSFORMER (D/E ONLY)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
G14	VR	VOLTAGE REGULATOR
B5	WTS	WATER TEMPERATURE SENSOR



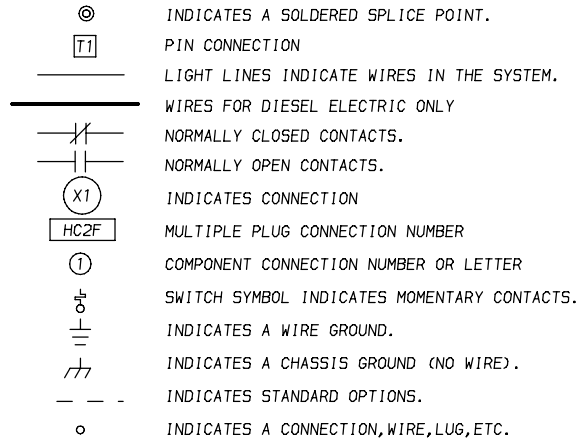


Figure 5-10. NDM-94A – 380v Phase Reversal Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02573 (Sheet 1 of 2)

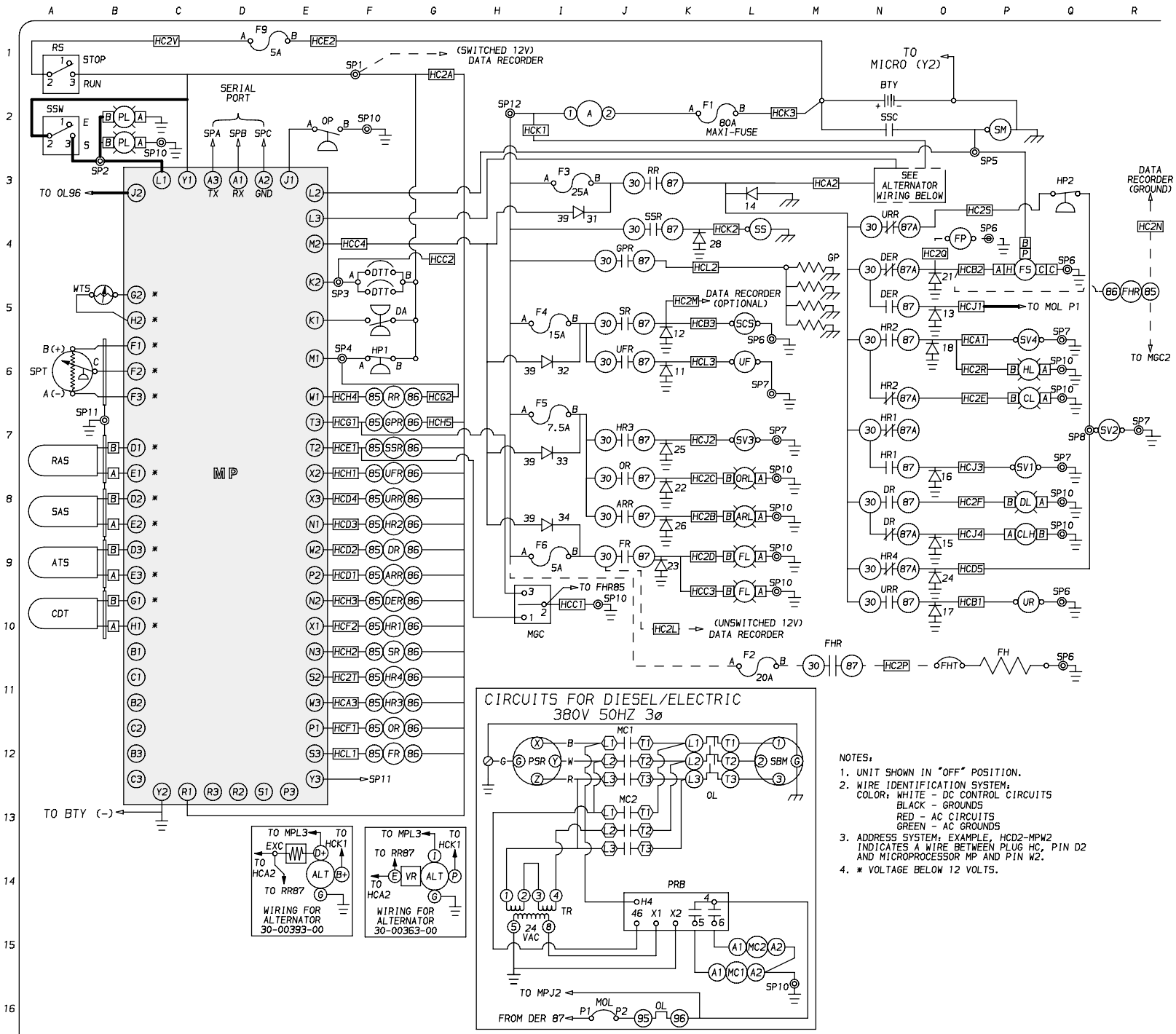
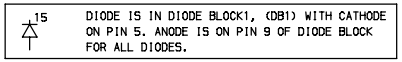


Figure 5-10. NDM-94A – 380v Phase Reversal Electrical Schematic Wiring Diagram – Prior to S/N EAE90310998 – Dwg. No. 62-02573 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
I2	A	AMMETER
G14/15,N3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
A9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N3	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N4/5	DER	DIESEL ELECTRIC RELAY
G1,J10,K5,P10,R4	DK	DATALINK (OPTIONAL)
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F5	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
L11	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
P11	FH	FUEL HEATER (OPTIONAL)
M11,R5	FHR	FUEL HEATER RELAY (OPTIONAL)
O11	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
O4	FP	FUEL PUMP (OPTIONAL)
F12,J9	FR	FAULT RELAY
P4	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
F4-12,J10,K4-10, N11,N14,P4-9,R5	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N5/6	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
N9,F11	HR4	HEAT RELAY #4
H10	MGC	MANUAL GLOW/CRANK
D3/D13	MP	MICROPROCESSOR BOARD
J12,L15	MC1	MOTOR CONTACTOR (D/E ONLY)
J13,L15	MC2	MOTOR CONTACTOR (D/E ONLY)
J16	MOL	MOTOR OVERLOADER (D/E ONLY)
K13/16	OL	OVERLOAD PROTECTOR (D/E ONLY)
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J8	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2,B3	PL	POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
K15	PRB	PHASE REVERSAL BOARD
I12	PSR	POWER SUPPLY RECEPTACLE (D/E ONLY)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L13	SBM	STANDBY MOTOR (D/E ONLY)
L5	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
A7,E4/5,H2,I10,L7, O3,Q6/8/12	SP	SPLICE POINT
B6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
I15	TR	TRANSFORMER (D/E ONLY)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
P10	UR	UNLOADER REAR
F8,N4/10	URR	UNLOADER REAR RELAY
G14	VR	VOLTAGE REGULATOR
B5	WTS	WATER TEMPERATURE SENSOR



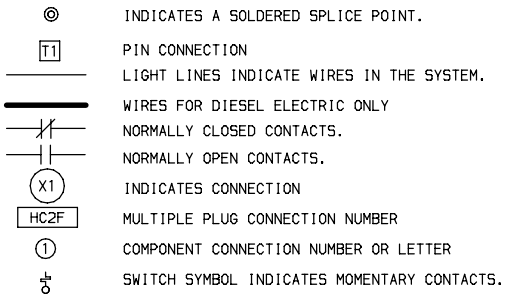


Figure 5-11. NDM-94 380v Phase Reversal Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03938 (Sheet 1 of 2)

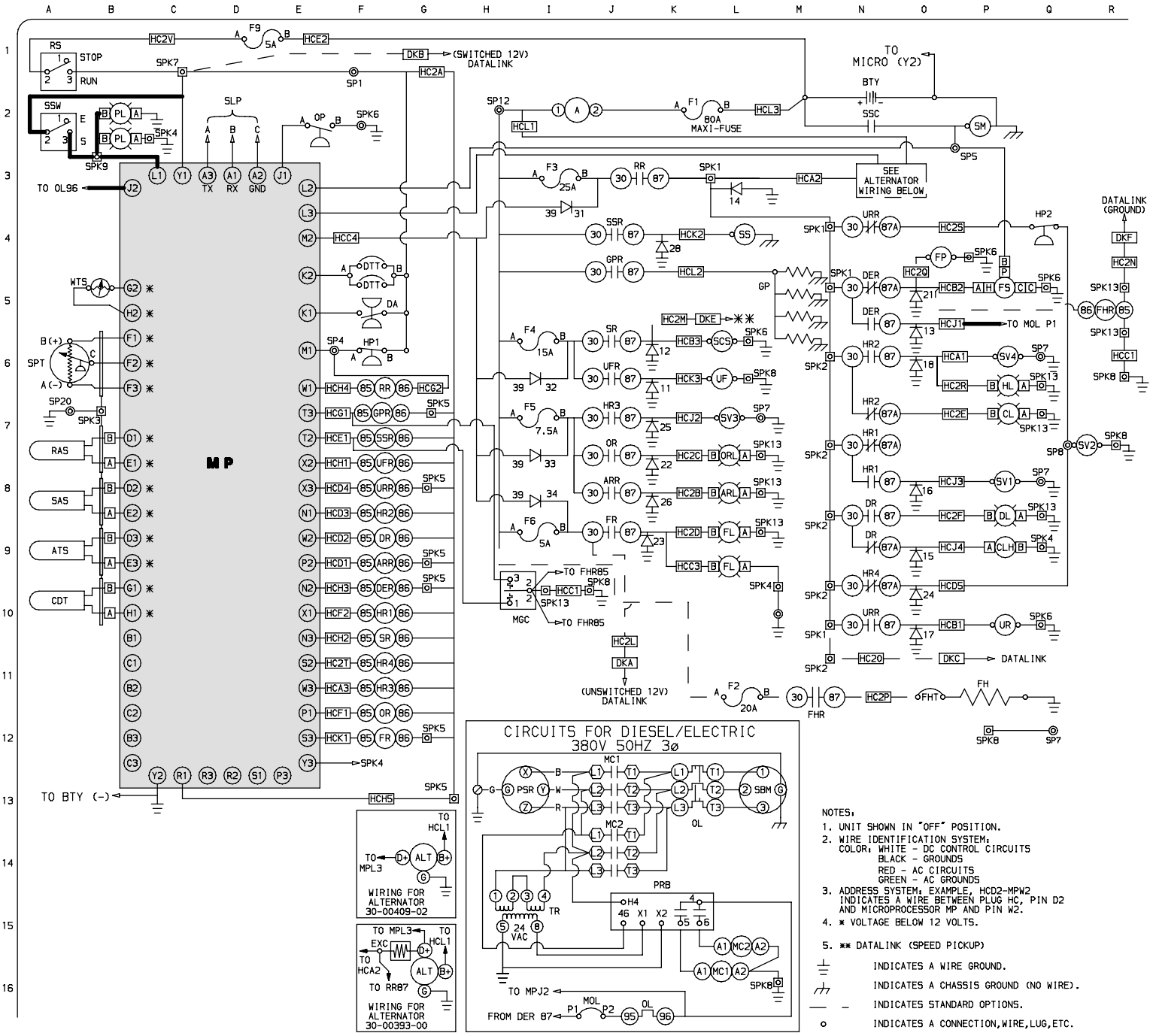


Figure 5-11. NDM-94 380v Phase Reversal Electrical Schematic Wiring Diagram – Starting with S/N EAE90310998 – Dwg. No. 62-03938 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
J2	A	AMMETER
M3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
F9,J8	ARR	AUTO RESTART RELAY
A9	ATS	AMBIENT TEMPERATURE SENSOR
G13	B	BUZZER
H1,B13	BTY	BATTERY
A10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
P9	CLH	CLUTCH
F5	DA	DEFROST AIR SWITCH
F10,N5	DER	DIESEL ELECTRIC RELAY
F1,J11,K5,013,R4	DK	DATALINK (OPTIONAL)
P8	DL	DEFROST LIGHT (LIGHT BAR)
F9,N8/9	DR	DEFROST RELAY
F4	DTT	DEFROST THERMOSTAT
K2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
I1	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I7	F5	FUSE (7.5 AMPERE)
I9	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
M1	FH	FUEL HEATER (OPTIONAL)
J1,R2	FHR	FUEL HEATER RELAY (OPTIONAL)
C1	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J9	FR	FAULT RELAY
O4	FP	FUEL PUMP (OPTIONAL)
P5	FS	FUEL SOLENOID
L5	GP	GLOW PLUG
F7,J4	GPR	GLOW PLUG RELAY
P6	HL	HEAT LIGHT (LIGHT BAR)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q3	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N7/8	HR1	HEAT RELAY #1
F8,N6/7	HR2	HEAT RELAY #2
F11,J7	HR3	HEAT RELAY #3
F11,N10	HR4	HEAT RELAY #4
B1	J-1	JUMPER (SHUT-DOWN OPTIONS)
H10	MGC	MANUAL GLOW/CRANK
D3-D13	MP	MICROPROCESSOR BOARD
Q5	MOL	MOTOR OVERLOAD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
B2	PL	POWER LIGHT (LIGHT BAR AND DOOR)
A7	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
L4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
Q7	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F8,J6	UFR	UNLOADER FRONT RELAY
Q10	UR	UNLOADER REAR (NDA-94A ONLY)
F8,N4/10	URR	UNLOADER REAR RELAY
B5	WTS	WATER TEMPERATURE SENSOR

DIODE IS IN DIODE BLOCK1, (DB1) WITH CATHODE ON PIN 5. ANODE IS ON PIN 9 OF DIODE BLOCK FOR ALL DIODES.

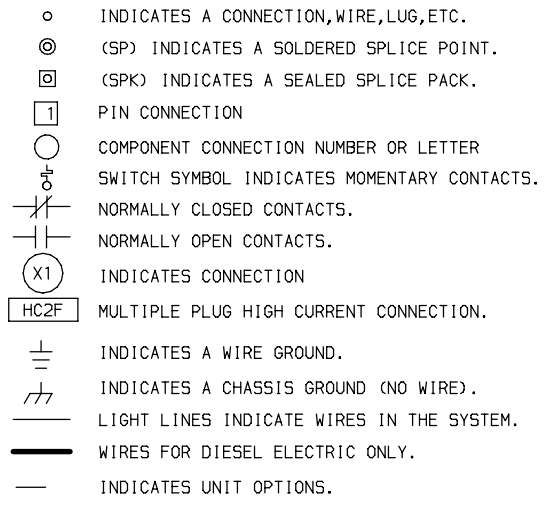


Figure 5-12. NDA, NDM and NDX Electrical Schematic – Units with Buzzer – Dwg. No. 62-04001 Rev. A (Sheet 1 of 4)

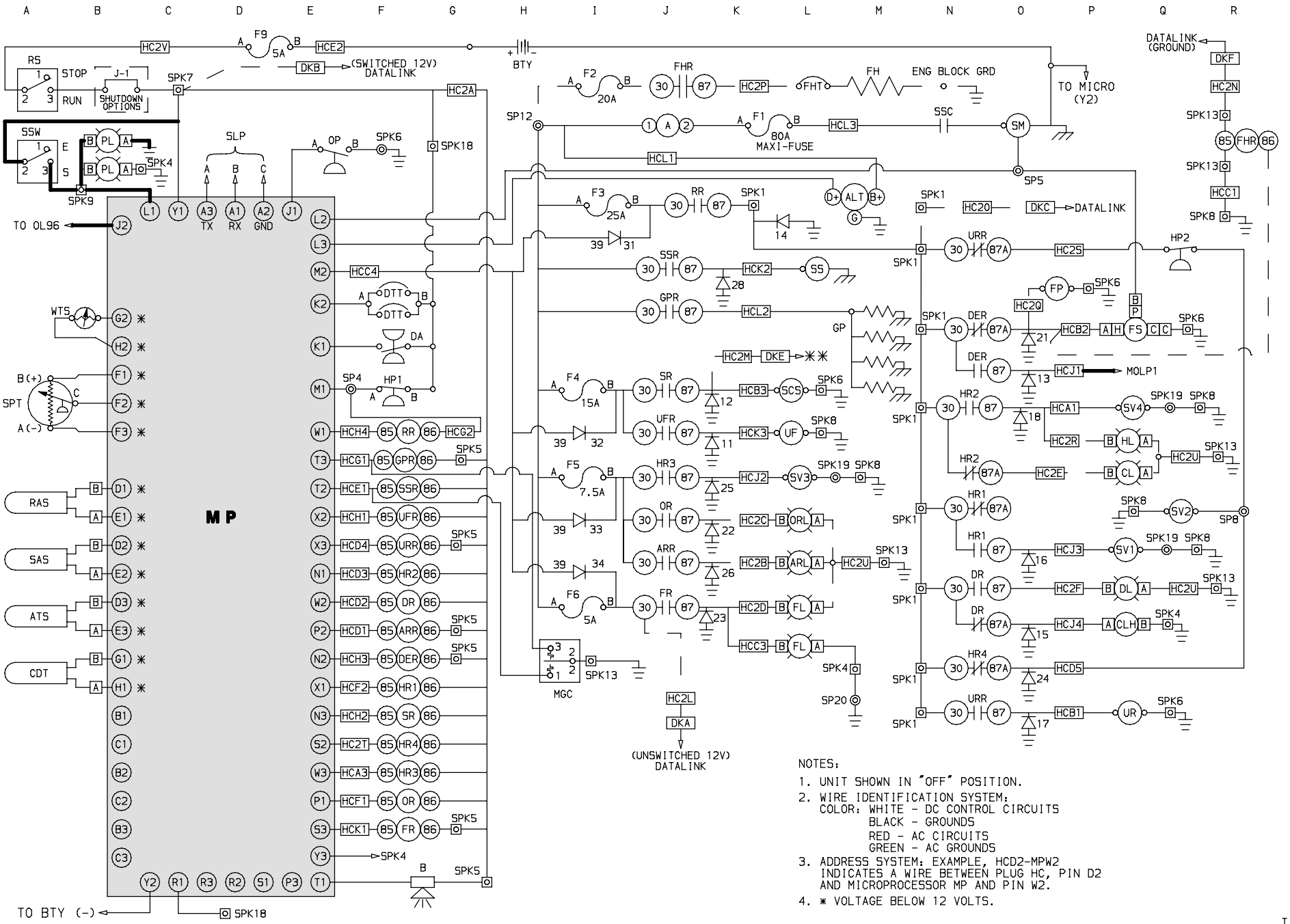
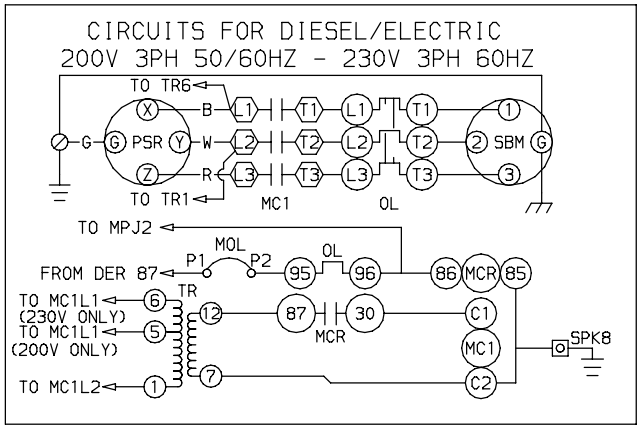
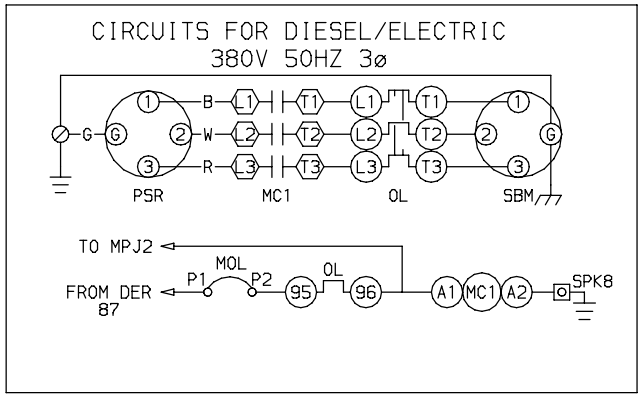
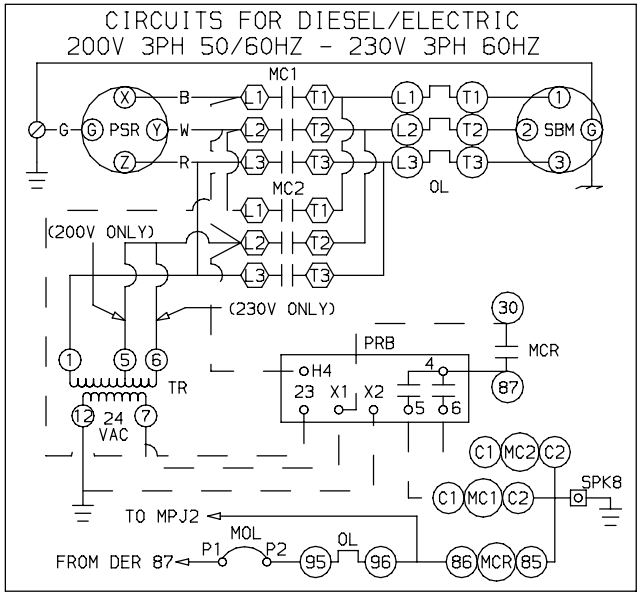


Figure 5-12. NDA, NDM and NDX Electrical Schematic – Units with Buzzer – Dwg. No. 62-04001 Rev. A (Sheet 2 of 4)







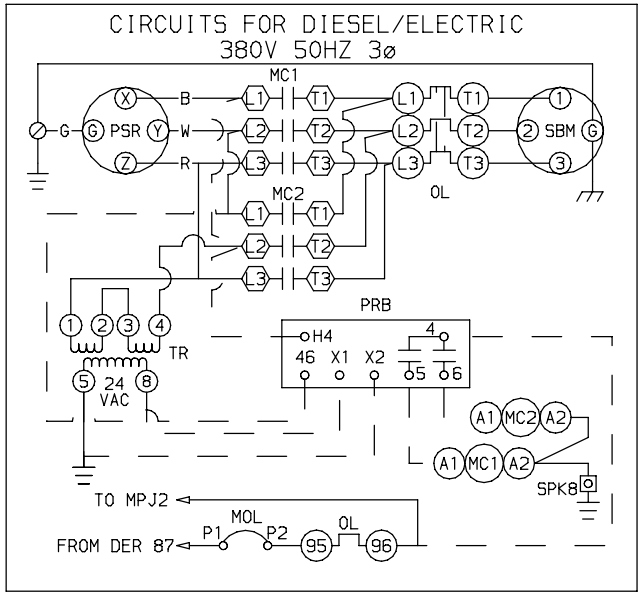


Figure 5-13. NDA, NDM and NDX Electrical Schematic – Units with Buzzer – Dwg. No. 62-04001 Rev. A (Sheet 3 of 4)

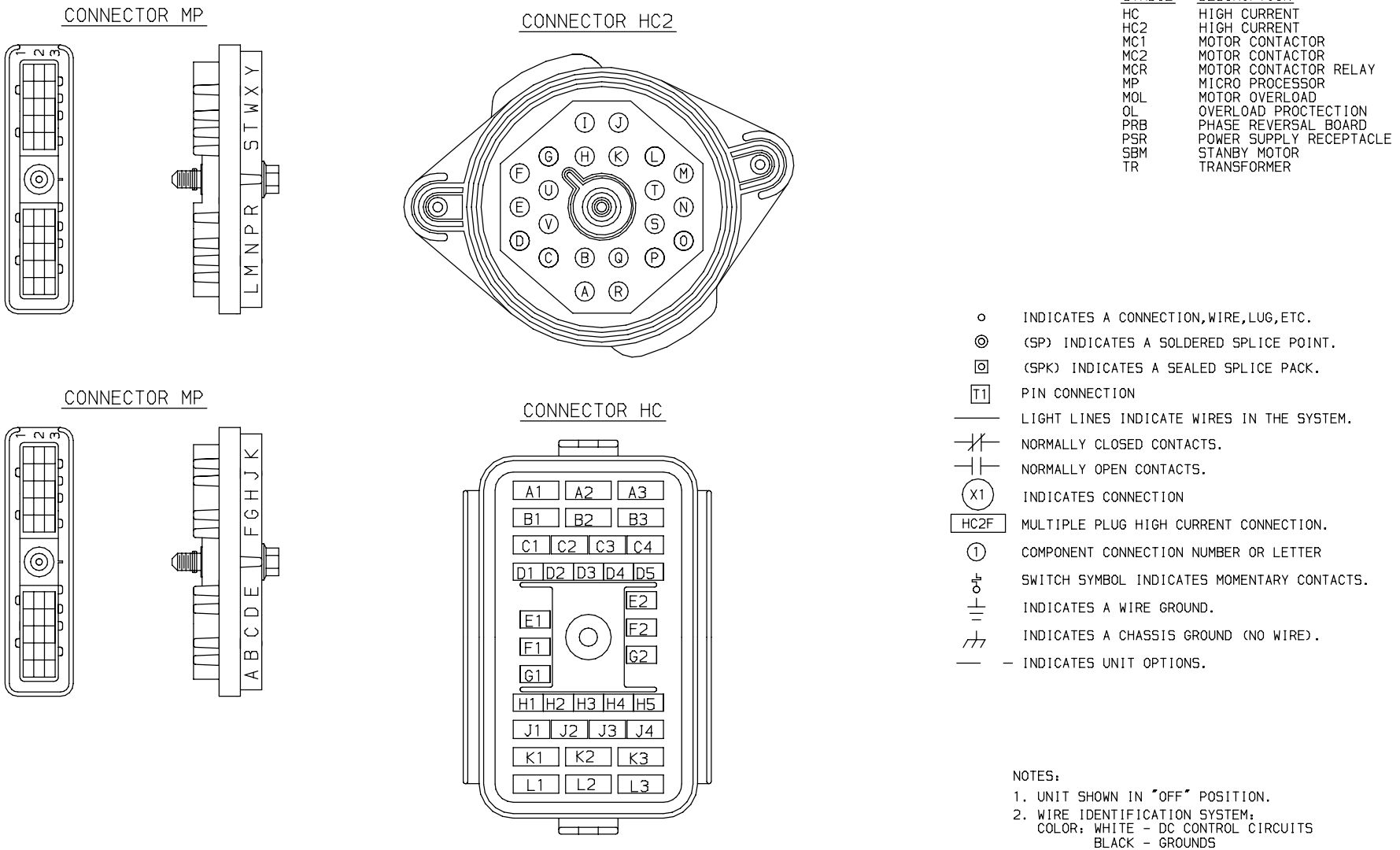
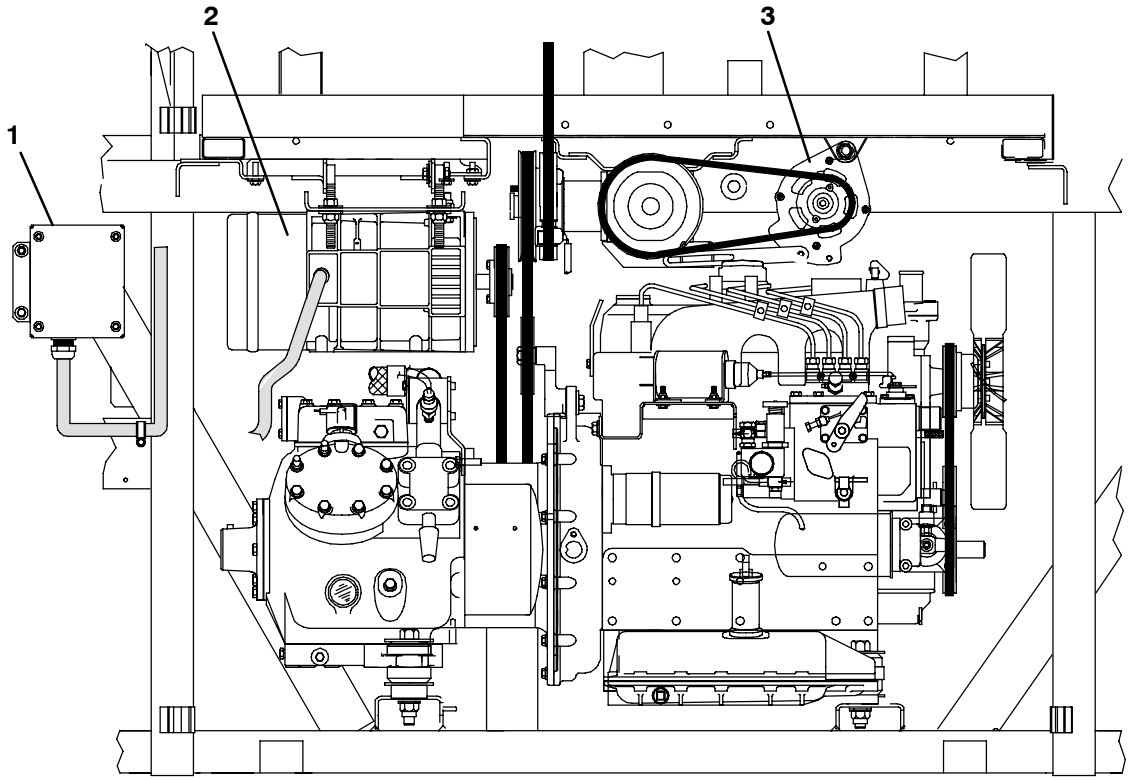


Figure 5-14. NDA, NDM and NDX Electrical Schematic – Units with Buzzer – Dwg. No. 62-04001 Rev. A (Sheet 4 of 4)

SECTION 6

MULTI-TEMP OPERATION AND SERVICE

6.1 INTRODUCTION



1. High Voltage Control Box – See Figure 6-2
2. Generator 5kw
3. Alternator 105 amps

Figure 6-1. Unit Front View

a. System

The Phoenix Ultra Multi-Temp, multiple compartment refrigeration system offers the versatility of two or three compartment temperature control. The Multi-Temp allows the shipper to ship frozen and perishable commodities in the same load under separate refrigeration control. The Genesis TM1000 (Reversible Multi-Temp) allows any compartment to be any temperature.

Table 6-1. Multi-Temp Model Chart

Models	Description
NDA-94 _ _ _ _ _M2	2 Compartment (Old Style)
NDA-94 _ _ _ _ _M3	3 Compartment (Old Style)
NDA-94 _ _ _ _ _U2	2 Compartment (New Style)
NDA-94 _ _ _ _ _U3	3 Compartment (New Style)
NDA-94 _ _ _ _ _R2	Reversible 2 Compartment
NDA-94 _ _ _ _ _R3	Reversible 3 Compartment

The Phoenix Ultra Multi-Temp unit is comprised of the basic Phoenix Ultra diesel nosemount unit with one or two remote evaporators for rear compartments.

The unit also is equipped with a 5-kilowatt, single phase, 240 v-ac generator in the nosemount to power the electric heaters in the rear evaporators.

Also mounted to the left of the generator is a high voltage box. In the high voltage box are two 30 amp fuses and high voltage relay(s).

The Phoenix Ultra Multi-Temp unit has a 105 amp alternator.

b. Remote Evaporator and Remote Control Box

The rear compartments of the Multi-Temp system is equipped with a separate evaporator and remote mounted control box.

The remote evaporators can be wall or ceiling mounted and includes evaporator coil and heaters, drain pan, evaporator fan and motor (12v-dc), defrost termination thermostat, liquid line solenoid, expansion valve, air switch and evaporator pressure regulator.

The remote control box includes indicating lights, switches and relays.

c. Microprocessor Controller

The Phoenix Ultra nosemount unit microprocessor controller controls all compartments (Refer to sections 6.7 and 1.10).

6.2 REFRIGERATION SYSTEM DATA

a. Defrost Air Switch (Remote Evaporator)

Initiates Defrost:

0.50 inch WG

6.3 ELECTRICAL DATA

a. Generator (5kw)

Wattage	5000 Watts
Volts	240 v-ac
Phase	1
Speed	3600 rpm at 60 hz
Rotation	either direction

b. Alternator

105 amps

c. Remote Evaporator Fan Motors

Volts	12 v-dc
Horsepower	1/8 hp
Speed	3000 rpm
Rotation	Clockwise when viewed from shaft end
Amps	12 to 14 nominal each

d. Remote Evaporator Defrost Heaters

1. Two Compartments

Number	2
Voltage	240 v-ac/1 ph/60hz
Wattage	2500 watts each

2. Three Compartments

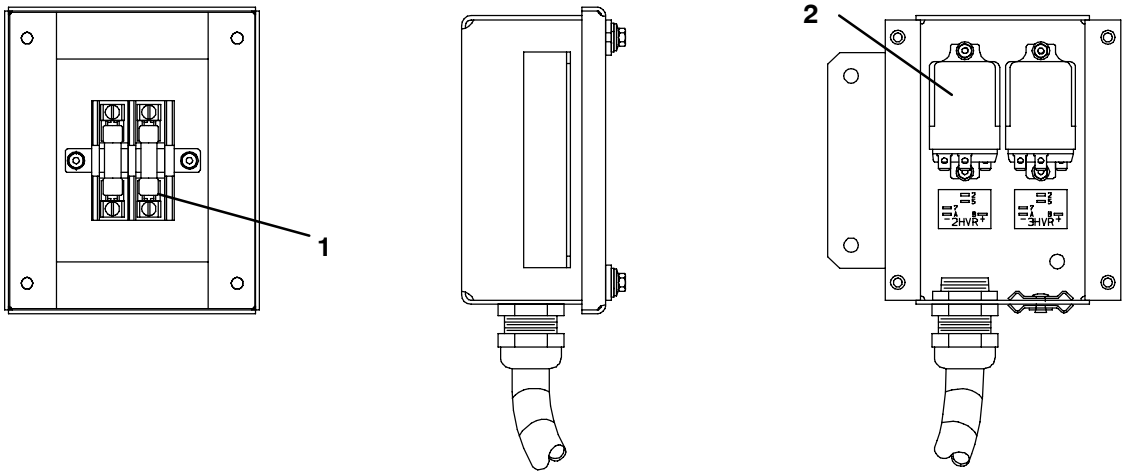
Number	2
Voltage	240 v-ac/1 ph/60hz
Wattage	1250 watts each

6.4 SAFETY DEVICES

Safety Devices for protection of the Remote Evaporator are listed in Table 6-2

Table 6-2. Safety Devices -- Remote Evaporator

Unsafe Conditions	Safety Device	Device Setting
1. Excessive current draw by 2 compartment	Fuse (F7)	Opens at 30 amps
2. Excessive current draw by 3 compartment	Fuse (F8)	Opens at 30 amps
3. Excessive current draw by 5 KW generator	Fuses (F10, F11)	Opens at 30 amps
4. Defrost heater over temperature	High Temperature Klixon	Opens at 120 $\pm$ 5°F



1. Fuse, 30 amps
2. High Voltage Relay

Figure 6-2. High Voltage Control Box

6.5 MULTI-TEMP REFRIGERANT CIRCUIT

The Multi-Temp refrigerant circuit is the same as the Phoenix Ultra but with the addition of a remote evaporator(s).

The remote evaporator(s) refrigerant flows through the electrically controlled liquid line solenoid valve (LSV) which starts or stops the flow of liquid refrigerant.

The remote evaporator(s) is fitted with an evaporator pressure regulating valve. This valve will automatically throttle flow from the evaporator in order to maintain the preset minimum evaporator pressure. Refer to Section 6.10

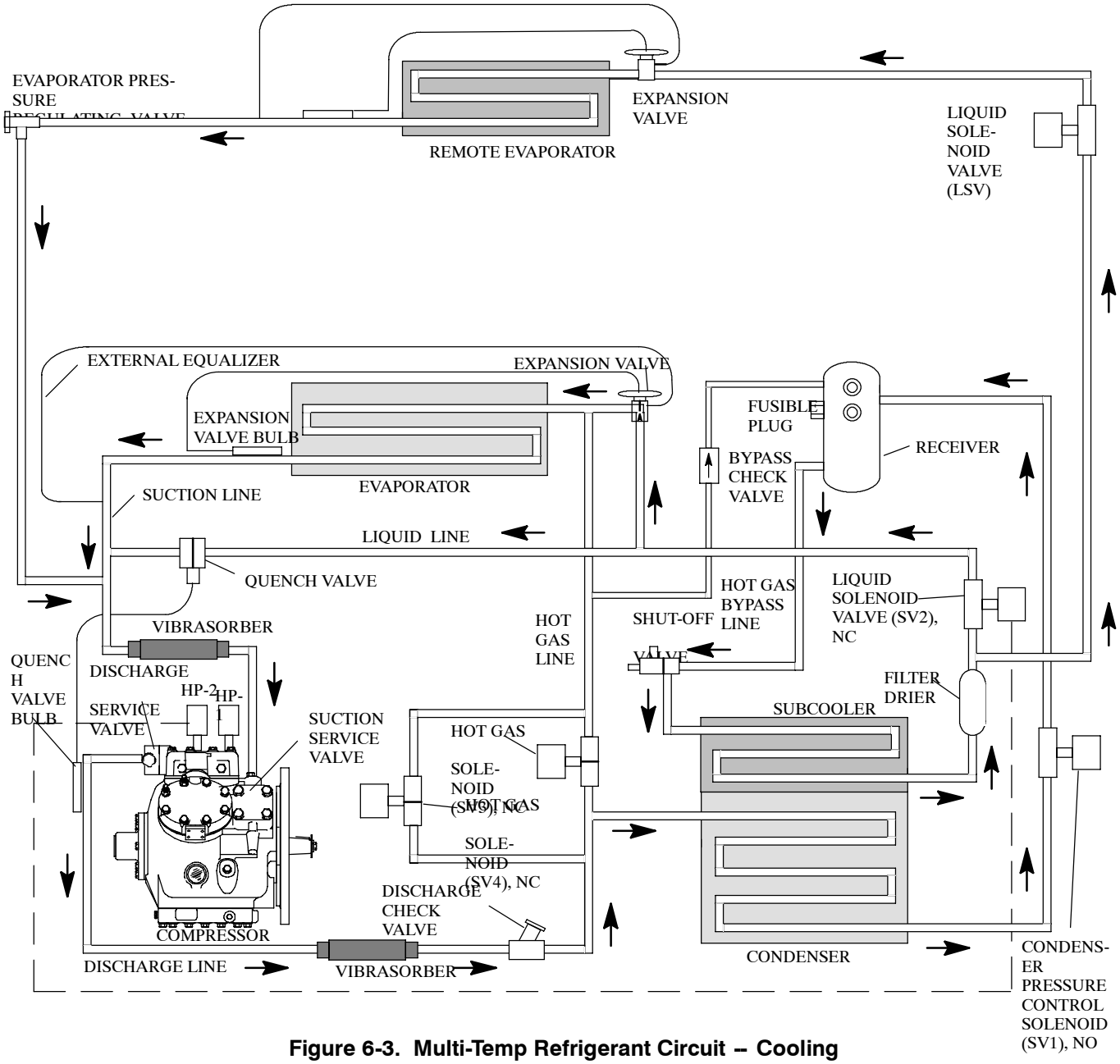


Figure 6-3. Multi-Temp Refrigerant Circuit -- Cooling

6.6 REMOTE COMPARTMENT OPERATION

a. To start remote evaporator, place the remote compartment switch in the ON position (See Figure 6-4 or Figure 6-5).

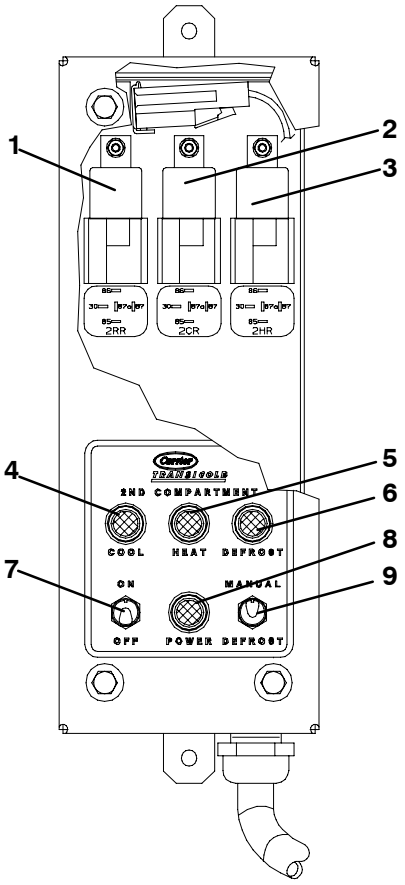
b. Set desired temperature using nosemount unit microprocessor controller (Refer to section 1.10).

c. The manual defrost switch and function lights for each compartment are on the remote control box.

d. Turn remote compartment switch OFF when remote evaporator is not required.

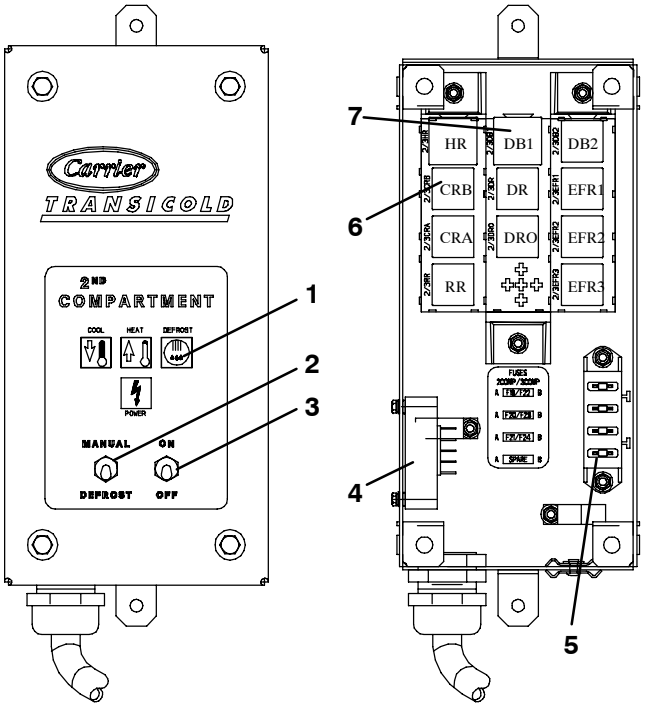
NOTE

For starting instructions on the nosemount unit refer to section 2.2.



1. Run Relay (Compartment)
2. Cool Relay (Compartment)
3. Heat Relay (Compartment)
4. Cool Light
5. Heat Light
6. Defrost Light
7. Compartment ON-OFF Switch (2ST or 3ST)
8. Power Light
9. Manual Defrost Switch

Figure 6-4. Remote Control Box



1. Cool/Heat/Defrost/Power Lights
2. Manual Defrost Switch
3. Compartment ON-OFF Switch (2ST or 3ST)
4. Defrost Timer
5. Fuse
6. Relays
7. Diode Block

Figure 6-5. Remote Control Box (For Reversible Units)

6.7 MICROPROCESSOR CONTROLLER

NOTE

The Phoenix Ultra nosemount unit microprocessor controller controls all compartments (Refer to section 1.10).

The Phoenix Ultra microprocessor controller controls up to two remote compartments. The compartments are enabled by the compartment ON-OFF switch located on the remote control box. When a compartment is enabled the controller will maintain temperature based on setpoints entered via the keypad function parameter selections. Two temperature thermistor sensors are used to monitor the return air of each evaporator. Temperature control is achieved by switching between 4 modes: high speed cool, low speed cool, null and high speed heat.

When heating is required the microprocessor will energize 2HR or 3HR and the speed relay at 1.8°F (1°C) below setpoint. The remote heat relays will be de-energized when the temperature rises above 0.9°F (0.5°C) below setpoint. When the heat relay is de-energized the compartment will stay in null mode until the temperature rises greater than 1.8°F (1°C) above setpoint. At this point the controller will energize 2CR or 3CR and de-energize the unloaders if possible. If the temperature continues to rise the speed relay will be

energized at 2.5°C above setpoint. If the temperature falls below 3.6°F(2°C) above setpoint the speed relay is de-energized and if it falls below 0.5°C above setpoint the remote cool relays are de-energized.

There are overriding factors which would prevent the remote compartments from cooling or heating. If the main compartment is in heat or defrost then no cool or heat will be allowed in the remote compartments. In addition if the unit is being forced to run in low speed remote heat will be locked out.

Defrost in the remote compartments will be activated independently from the controller. When a remote compartment is in defrost the controller will energize the speed solenoid.

Start/Stop mode is also available for Multi compartment units. A remote compartment can override shutdown after the minimum run time if the temperature is not within ± 1.8°F (1°C) of setpoint. A remote compartment will cause the unit to restart after the minimum off time if temperature is more than ± 3.6°F (2°C) from setpoint. The minimum off time can be overridden if the remote temperature is more than 6°C from setpoint.

6.8 SERVICING REMOTE EVAPORATOR

WARNING

Before servicing the remote evaporator, remove negative battery cable and tag nosemount start-run-stop switch to prevent starting.

a. Fan Motor or Blade Replacement

1. Remove front panel.
2. Remove fan guard, loosen fan hub set screw (#10-32 x 1/2 lg – cone point) and remove fan. Remove fan motor hardware and fan wiring (if required).
3. Replace fan motor and fan blade before tightening fan setscrew, align fan with 1/3 of the fan blades extending beyond the leaving edge of the housing. Replace fan guard and front panel, test fan operation.

b. Fan Motor Brushes and Commutator

Fan motor brushes should be inspected every 1500 operating hours. Brushes should be replaced when brush is approximately 1/4″ or less in length. Blow out brush holder with low pressure air to remove any carbon dust in holder. Before installing brushes, remove back cover of motor and inspect commutator. If commutator is heavily grooved, polish it using 220 grit sandpaper: do not use emery cloth. Wipe out any accumulation of dust using a clean rag with solvent. Reassemble motor and reinstall brushes.

c. Replacing Tubular Heaters

1. Remove front panel.
2. Disconnect heater wiring from junction block and spiral wrap.
3. Release spring tension on heater and remove from attaching clip.
4. Replace and rewire heater. Reinstall front panel and test heater operation.

6.9 SERVICING LIQUID SOLENOID VALVE (LSV)

NOTE

The liquid solenoid valve (LSV) is the same valve as (SV2). Refer to section 4.19 for servicing.

6.10 EVAPORATOR PRESSURE REGULATING VALVE

Evaporator pressure regulating valves offer an efficient means of balancing the system capacity and the load requirements during periods of low loads and maintaining different evaporator conditions on multi-temperature systems. The primary function of this type of valve is to prevent the evaporator pressure from falling below a predetermined value at which the valve has been set.

The valves will automatically throttle the vapor flow from the evaporator in order to maintain the desired minimum evaporator pressure. As the load increases, the evaporating pressure will increase above the valve setting and the valve will open further.

Operation

Evaporator pressure regulating valves respond only to variations in their inlet pressure (evaporator pressure). The outlet pressure is exerted on the underside of the bellows and on top of the seat disc. Since the effective area of the bellows is equal to the area of the port, the outlet pressure cancels out and the inlet pressure acting on the bottom of the seat disc opposes the adjustable spring force. These two forces are the operating forces of the valve. When the evaporator load changes, the valve opens or closes in response to the change in evaporator pressure.

An increase in inlet pressure above the valve setting tends to open the valve. If the load drops, less refrigerant is boiled off in the evaporator and the evaporator pressure will decrease. The decrease in evaporator pressure tends to move the valve to a more closed position which in turn keeps the evaporator pressure up. The net result is that the evaporator pressure does change as the load changes.

The operation of a valve of this type is improved by an anti-chatter device built into the valve. Without this device, the valve would be susceptible to compressor pulsations that can greatly reduce the life of a bellows. This feature allows the valve to function at low load conditions without chattering or other operating difficulties.

6.11 ADJUSTING EVAPORATOR PRESSURE REGULATING VALVE

a. Adjustment

0°F (−17. 8°C) Front and 35°F (1. 7°C) Rear Compartment Operation

1. Connect gauge to evaporator pressure regulating valve (EPR) access valve. Remove the cap from the EPR.

NOTE

To adjust valve, place 1/4″ hex wrench size in adjustment screw. A clockwise rotation increases the valve setting while a counterclockwise rotation decreases the setting. To obtain the desired setting, a pressure gauge should be utilized so the effects of any adjustment may be observed.

2. Set front and rear compartment controllers to above settings and start unit. When the front compartment suction Pressure reaches l8 to 22 Psig (1.3 to 1.5 kg/cm2) , set rear evaporator EPR. valve at 40 Psig 2.8 kg/cm2) . This setting will satisfy the operating requirements for most 2 compartment applications.
3. However, if the front compartment does not pull down to 0°F (−l7.8°C) within 2 hours, adjust the rear evaporator EPR to a higher pressure setting, increasing by 2 psig (0.1 kg/cm) increments. (Adjustment screw turned in a clockwise direction.) Allow temperature to stabilize after each new valve adjustment until the set compartment temperature is reached.
4. Conversely, if the front compartment reaches controller setting of 0°F (−17.8°C) but the rear compartment does not pull down to 35°F (l.7°C) within 1 hour, adjust the rear evaporator EPR. counterclockwise in 2 psig (0.1 kg/cm2) increments until the set rear compartment temperature is reached. Allow stabilization of temperature after each new adjustment is recommended.

EPR adjustments should be made when the ambient temperature is near summer maximum Adjustments made in cooler ambients may require resetting when the summer maximum is reached.

For other temperature and respective valve pressure settings, contact Carrier Transicold.

b. Service

Since these valves are hermetic and cannot be disassembled for inspection and cleaning, they usually must be replaced if they become inoperative. However, if the valve fails to open, close properly, Or won't adjust, it is probably due to solder or other foreign materials lodged in the port. It is sometimes possible to dislodge these materials. by turning the adjustment screw all the way out with the system running.

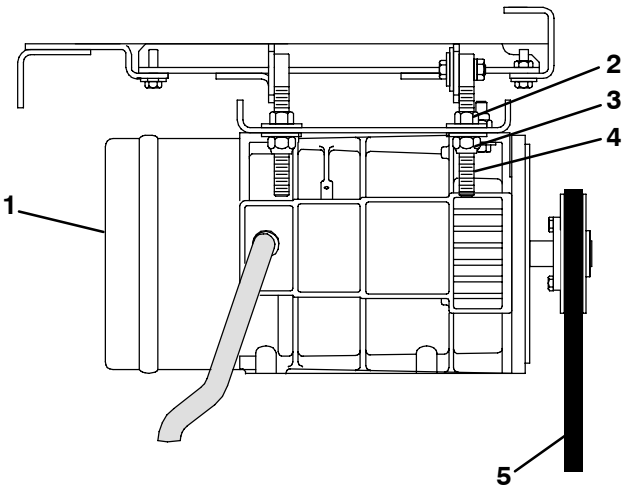
If the valve develops a refrigerant leak around the spring housing, it probably has been overheated during installation or the bellows has failed due to severe compressor pulsations. In either case the valve must be replaced.

6.12 REPLACING OR ADJUSTING GENERATOR BELT

a. Loosen locknut on adjusting screw (Item 3, Figure 6-6) enough to clear generator V-belt from the sheave.

b. To remove generator V-belt from drive shaft, follow instructions in section 4.4. (See Figure 4-9)

c. After replacing belt, take up on jam nut and locknut on adjusting screw until a belt tension of 60 ft-lbs is maintained.



1. Generator 5kw
2. Jam Nut
3. Locknut
4. Adjusting Screw
5. V-Belt

Figure 6-6. Generator

6.13 5KW GENERATOR MAINTENANCE

The 5KW generator require very little preventative maintenance to insure good performance.

1. Belt tension should be maintained at 60 ft-lbs Refer to section 6.12.
2. The generator is equipped with an air filter located under the black plastic housing at the back of the generator. Air is drawn through this filter as the generator operates, and keeps all internal components cool. Any restriction caused by a dirty filter can result in generator overheating problems.

The air filter should be removed and cleaned with warm water and soap, then rinsed well, at every regularly scheduled service interval (at least once a year), or more frequently depending on environmental conditions (more often in dusty conditions), in order to protect against over-heating of the capacitor and generator windings.

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 1900 rpm with unit operating in fully loaded high speed cool mode, with all compartments turned on. Refer to Table 6-3 for corresponding generator voltage output.

Table 6-3. Generator Voltage Output

Engine RPM	Generator RPM	Volts / HZ.
1970	3600	240 /60
1900	3450	200 /55

A generator fault finding guide is shown in Figure 6-7. This should be used whenever troubleshooting a problem with a 5KW generator.

6.13.1 Generator Flashing

In the event of voltage output failure, the generator may have lost its residual magnetism. This loss can be restored by "flashing" the generator by following these steps:

1. Shut the unit OFF and turn the remote compartment power switch OFF.
2. Connect an A.C. voltmeter to the generator output wires at the high voltage fuse block.
3. Connect two (2) jumper wires, one to each of the generator capacitor terminals.
4. Start the unit and run in high speed; leave the remote compartment power OFF.
5. Touch one jumper wire to a 12vdc ground connection.
6. Touch the other jumper wire to a 12vdc positive connection.

WARNING

The jumpers should only be connected to 12vdc for no longer than one(l) second in order to flash the generator and restore the residual magnetism required for generator output.

7. Observe the voltmeter; the voltage should increase to approximately 220vac.
8. Shut the unit OFF and disconnect the jumper wires.
9. Restart the unit; run in high speed and check the generator voltage output and rear compartment heater amperage.

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.

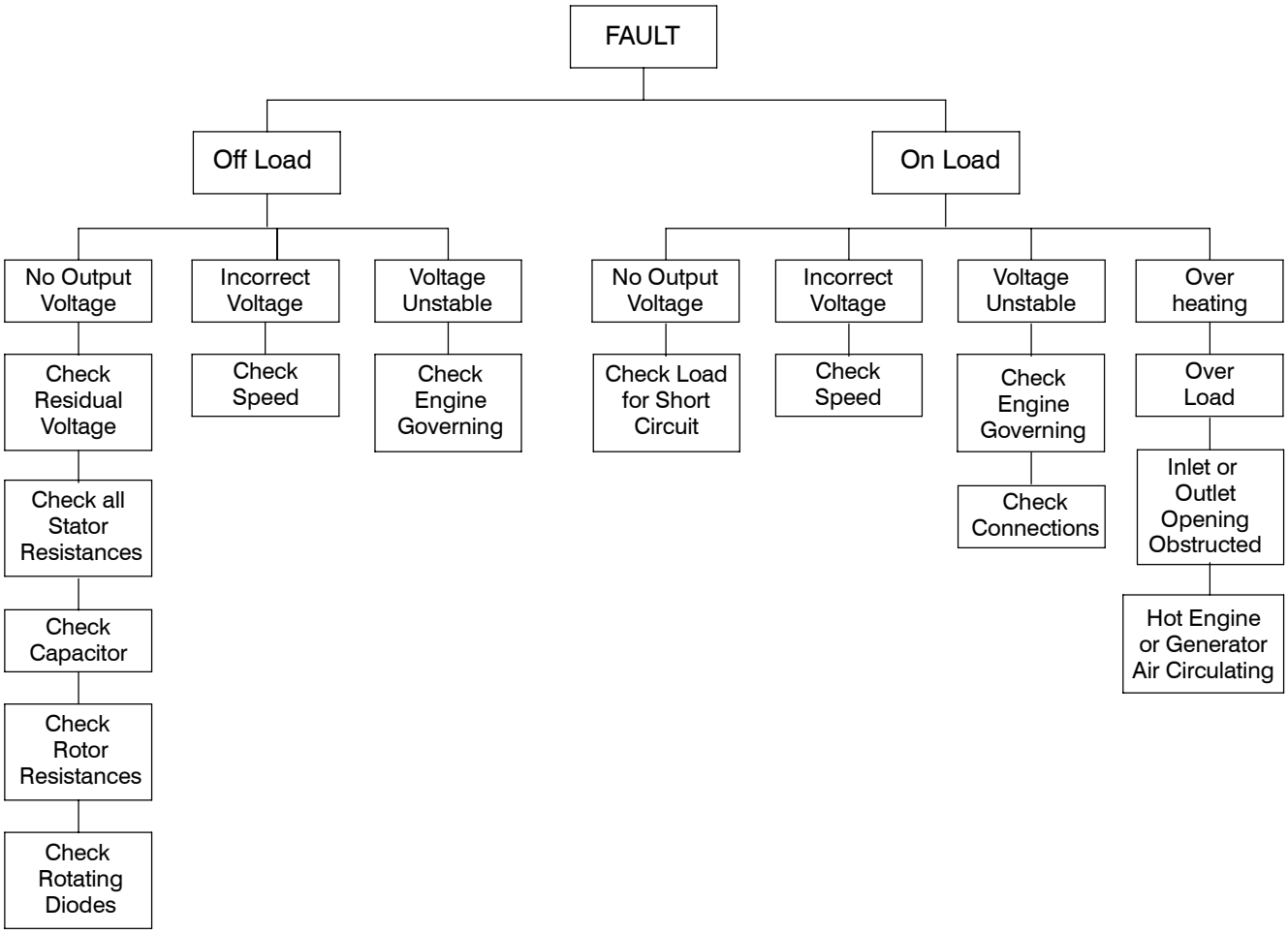


Figure 6-7. Generator Fault Finding Guide

Table 6-4. 2 Compartment Reversible Multi-Temp Logic Control							
Compartment Need		**Front Heat**	**Front Cool**	**2CR**	**2HR**	**Engine Speed**	**Unloader**
Front	**Rear**						
Cool	Cool	O	I	I	O	High	O
Cool	Heat	O	I	O	I	High	M
Cool	Null	O	I	O	O	Micro	M
Cool	Defrost	O	I	O	O	High	M
Heat	Cool	Electric	O	I	O	High	M
Heat	Heat	Hot Gas	O	O	I	High	M
Heat	Null	Hot Gas	O	O	O	Micro	M
Heat	Defrost	Hot Gas	O	O	O	High	M
Defrost	Cool	Hot Gas	O	O	O	High	O
Defrost	Heat	Hot Gas	O	O	I	High	O
Defrost	Null	Hot Gas	O	O	O	High	O
Defrost	Defrost	Hot Gas	O	O	O	High	O
Null	Cool	O	O	I	O	Micro	M
Null	Heat	Hot Gas	I	O	I	High	M
Null	Null	Hot Gas	I	O	O	Micro	M
Null	Defrost	Hot Gas	I	O	O	High	M
Under	Cool	Electric	O	I	O	High	I
Under	Heat	O	I	O	I	High	I
Under	Null	Electric	I	O	O	High	I
Under	Defrost	O	I	O	O	High	I

I = Output is ON
O = Output is OFF
Micro = Micro control on temperature demand
M = Control both suction pressure and temperature demand

Table 6-5. 3 Compartment Reversible Multi-Temp Logic Control										
Compartment Need			Front Heat	Front Cool	2CR	2HR	3CR	3HR	Engine Speed	Unloader
Front	Middle	Rear								
Cool	Cool	Cool	O	I	I	O	I	O	High	O
Cool	Cool	Heat	O	I	I	O	O	I	High	O
Cool	Cool	Null	O	I	I	O	O	O	High	O
Cool	Cool	Defrost	O	I	O	O	O	O	High	M
Cool	Heat	Cool	O	I	O	I	I	O	High	O
Cool	Heat	Heat	O	I	O	I	O	I	High	M
Cool	Heat	Null	O	I	O	I	O	O	High	M
Cool	Heat	Defrost	O	I	O	O	O	O	High	M
Cool	Null	Cool	O	I	O	O	I	O	High	O
Cool	Null	Heat	O	I	O	O	O	I	High	M
Cool	Null	Null	O	I	O	O	O	O	Micro	M
Cool	Null	Defrost	O	I	O	O	O	O	High	M
Cool	Defrost	Cool	O	I	O	O	O	O	High	M
Cool	Defrost	Heat	O	I	O	O	O	O	High	M
Cool	Defrost	Null	O	I	O	O	O	O	High	M
Cool	Defrost	Defrost	O	I	O	O	O	O	High	M
Heat	Cool	Cool	Electric	O	I	O	I	O	High	M
Heat	Cool	Heat	Electric	O	I	O	O	I	High	M
Heat	Cool	Null	Electric	O	I	O	O	O	High	M
Heat	Cool	Defrost	Hot Gas	O	O	O	O	O	High	M
Heat	Heat	Cool	Electric	O	O	I	I	O	High	M
Heat	Heat	Heat	Hot Gas	O	O	I	O	I	High	M
Heat	Heat	Null	Hot Gas	O	O	I	O	O	High	M
Heat	Heat	Defrost	Hot Gas	O	O	O	O	O	High	M
Heat	Null	Cool	Electric	O	O	O	I	O	High	M
Heat	Null	Heat	Hot Gas	O	O	O	O	I	High	M
Heat	Null	Null	Hot Gas	O	O	O	O	O	Micro	M
Heat	Null	Defrost	Hot Gas	O	O	O	O	O	High	M
Heat	Defrost	Cool	Hot Gas	O	O	O	O	O	High	M
Heat	Defrost	Heat	Hot Gas	O	O	O	O	O	High	M
Heat	Defrost	Null	Hot Gas	O	O	O	O	O	High	M
Heat	Defrost	Defrost	Hot Gas	O	O	O	O	O	High	M
Defrost	Cool	Cool	Hot Gas	O	O	O	O	O	High	O
Defrost	Cool	Heat	Hot Gas	O	O	O	O	O	High	O
Defrost	Cool	Null	Hot Gas	O	O	O	O	O	High	O
Defrost	Cool	Defrost	Hot Gas	O	O	O	O	O	High	O
Defrost	Heat	Cool	Hot Gas	O	O	O	O	O	High	O
Defrost	Heat	Heat	Hot Gas	O	O	O	O	I	High	O
Defrost	Heat	Null	Hot Gas	O	O	O	O	O	High	O
Defrost	Heat	Defrost	Hot Gas	O	O	O	O	O	High	O
Defrost	Null	Cool	Hot Gas	O	O	O	O	O	High	O
Defrost	Null	Heat	Hot Gas	O	O	O	O	O	High	O
Defrost	Null	Null	Hot Gas	O	O	O	O	O	High	O
Defrost	Null	Defrost	Hot Gas	O	O	O	O	O	High	O
Defrost	Defrost	Cool	Hot Gas	O	O	O	O	O	High	O
Defrost	Defrost	Heat	Hot Gas	O	O	O	O	O	High	O
Defrost	Defrost	Null	Hot Gas	O	O	O	O	O	High	O
Defrost	Defrost	Defrost	Hot Gas	O	O	O	O	O	High	O

Table 6-5. 3 Compartment Reversible Multi-Temp Logic Control										
Compartment Need			Front Heat	Front Cool	2CR	2HR	3CR	3HR	Engine Speed	Unloader
Front	Middle	Rear								
Null	Cool	Cool	O	O	I	O	I	O	High	M
Null	Cool	Heat	O	O	I	O	O	I	High	M
Null	Cool	Null	O	O	I	O	O	O	Micro	M
Null	Cool	Defrost	Hot Gas	I	O	O	O	O	High	M
Null	Heat	Cool	O	O	O	I	I	O	High	M
Null	Heat	Heat	Hot Gas	I	O	I	O	I	High	M
Null	Heat	Null	Hot Gas	I	O	I	O	O	High	M
Null	Heat	Defrost	Hot Gas	I	O	O	O	O	High	M
Null	Null	Cool	O	O	O	O	I	O	Micro	M
Null	Null	Heat	Hot Gas	I	O	O	O	I	High	M
Null	Null	Null	Hot Gas	I	O	O	O	O	Micro	M
Null	Null	Defrost	Hot Gas	I	O	O	O	O	High	M
Null	Defrost	Cool	Hot Gas	I	O	O	O	O	High	M
Null	Defrost	Heat	O	O	O	O	O	O	High	M
Null	Defrost	Null	O	O	O	O	O	O	High	M
Null	Defrost	Defrost	O	O	O	O	O	O	High	M
Under	Cool	Cool	Electric	O	I	O	I	O	High	M
Under	Cool	Heat	Electric	O	I	O	O	I	High	M
Under	Cool	Null	Electric	O	I	O	O	O	High	M
Under	Cool	Defrost	O	I	O	O	O	O	High	I
Under	Heat	Cool	Electric	O	O	I	I	O	High	M
Under	Heat	Heat	O	I	O	I	O	I	High	I
Under	Heat	Null	Electric	I	O	I	O	O	High	I
Under	Heat	Defrost	O	I	O	O	O	O	High	I
Under	Null	Cool	Electric	O	O	O	I	O	High	M
Under	Null	Heat	Electric	I	O	O	O	I	High	I
Under	Null	Null	Electric	I	O	O	O	O	High	I
Under	Null	Defrost	O	I	O	O	O	O	High	I
Under	Defrost	Cool	O	I	O	O	O	O	High	I
Under	Defrost	Heat	O	I	O	O	O	O	High	I
Under	Defrost	Null	O	I	O	O	O	O	High	I
Under	Defrost	Defrost	O	I	O	O	O	O	High	I

I = Output is ON
O = Output is OFF
Micro = Micro control on temperature demand
M = Control both suction pressure and temperature demand

ZONE	SYMBOL	DESCRIPTION
K2	A	AMMETER
L2	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
J7,F9	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N1	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
M14	3CL	COOL LIGHT (REMOTE LIGHT)
P7	CLH	CLUTCH
J13,Q9	2CR	COOL RELAY (2ND COMPARTMENT)
N13,P10	3CR	COOL RELAY (3RD COMPARTMENT)
F5	DA	DEFROST AIR SWITCH
J16,M16,Q11	DC	DIODE CARD
N3,F9	DER	DIESEL ELECTRIC RELAY
P7	DL	DEFROST LIGHT (LIGHT BAR)
J15	2DL	DEFROST LIGHT (2ND COMPARTMENT)
N15	3DL	DEFROST LIGHT (3RD COMPARTMENT)
F9,N7	DR	DEFROST RELAY
I13,I15	2DR	DEFROST RELAY (2ND COMPARTMENT)
L12,M15	3DR	DEFROST RELAY (3RD COMPARTMENT)
F4	DTT	DEFROST THERMOSTAT
H12	2EM	EVAPORATOR MOTORS (2ND COMPARTMENT)
L12	3EM	EVAPORATOR MOTORS (3RD COMPARTMENT)
L2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
H9	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I6	F5	FUSE (7.5 AMPERE)
I8	F6	FUSE (5 AMPERE)
I2	F7	FUSE (30 AMPERE)
I1	F8	FUSE (30 AMPERE)
D1	F9	FUSE (5 AMPERE)
A13,A15	F10	FUSE (30 AMPERE)
A14,A16	F11	FUSE (30 AMPERE)
L9	FH	FUEL HEATER (OPTIONAL)
J9,R3	FHR	FUEL HEATER RELAY (OPTIONAL)
L9	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J8	FR	FAULT RELAY
Q2	FP	FUEL PUMP (OPTIONAL)
P2	FS	FUEL SOLENOID
A14,A15	GEN	GENERATOR
L5	GP	GLOW PLUG
F6,J4	GPR	GLOW PLUG RELAY
F4/12,K1/9,03/8	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
H16	2HL	HEAT LIGHT (2ND COMPARTMENT)
L16	3HL	HEAT LIGHT (3RD COMPARTMENT)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
P4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N8	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
I6,F11	HR3	HEAT RELAY #3
L16,P11	3HR	HEAT RELAY (3RD COMPARTMENT)
B13,B15,J16	2HVR	HIGH VOLTAGE RELAY
B15,M16	3HVR	HIGH VOLTAGE RELAY (3RD COMPARTMENT)
N12	2LSV	LIQUID SOLENOID VALVE (2ND COMPARTMENT)
J12	3LSV	LIQUID SOLENOID VALVE (3RD COMPARTMENT)

ZONE	SYMBOL	DESCRIPTION
I14	2MDS	MANUAL DEFROST SWITCH (2ND COMPARTMENT)
L14	3MDS	MANUAL DEFROST SWITCH (3RD COMPARTMENT)
H10	MGC	MANUAL GLOW/CRANK
D2/12	MP	MICROPROCESSOR BOARD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
I12	2PL	POWER LIGHT (2ND COMPARTMENT)
L12	3PL	POWER LIGHT (3RD COMPARTMENT)
I2,M1	PS	POWER STUD
A7	RAS	RETURN AIR SENSOR
A11	2RAS	RETURN AIR SENSOR (2ND COMPARTMENT)
A12	3RAS	RETURN AIR SENSOR (3RD COMPARTMENT)
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
H11	2RR	RUN RELAY (2ND COMPARTMENT)
K11,P10	3RR	RUN RELAY (3RD COMPARTMENT)
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
	SP	SPLICE POINT
	SPK	SPLICE PACK
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
M4	SS	STARTER SOLENOID
N1	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
R4	SV2	LIQUID SOLENOID VALVE (N.C.)
L6	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
G4	TP	TEST POINT
L6	UF	UNLOADER FRONT
F7,J6	UFR	UNLOADER FRONT RELAY
P5	UR	UNLOADER REAR
N4,N5,F8	URR	UNLOADER REAR RELAY
B5	WTS	WATER TEMPERATURE SENSOR

Figure 6-8. Electrical Schematic Wiring Diagram (Multi-Temp) – Prior to S/N EAE90310998 – Dwg. No. 62-03893 Rev. A (Sheet 1 of 2)

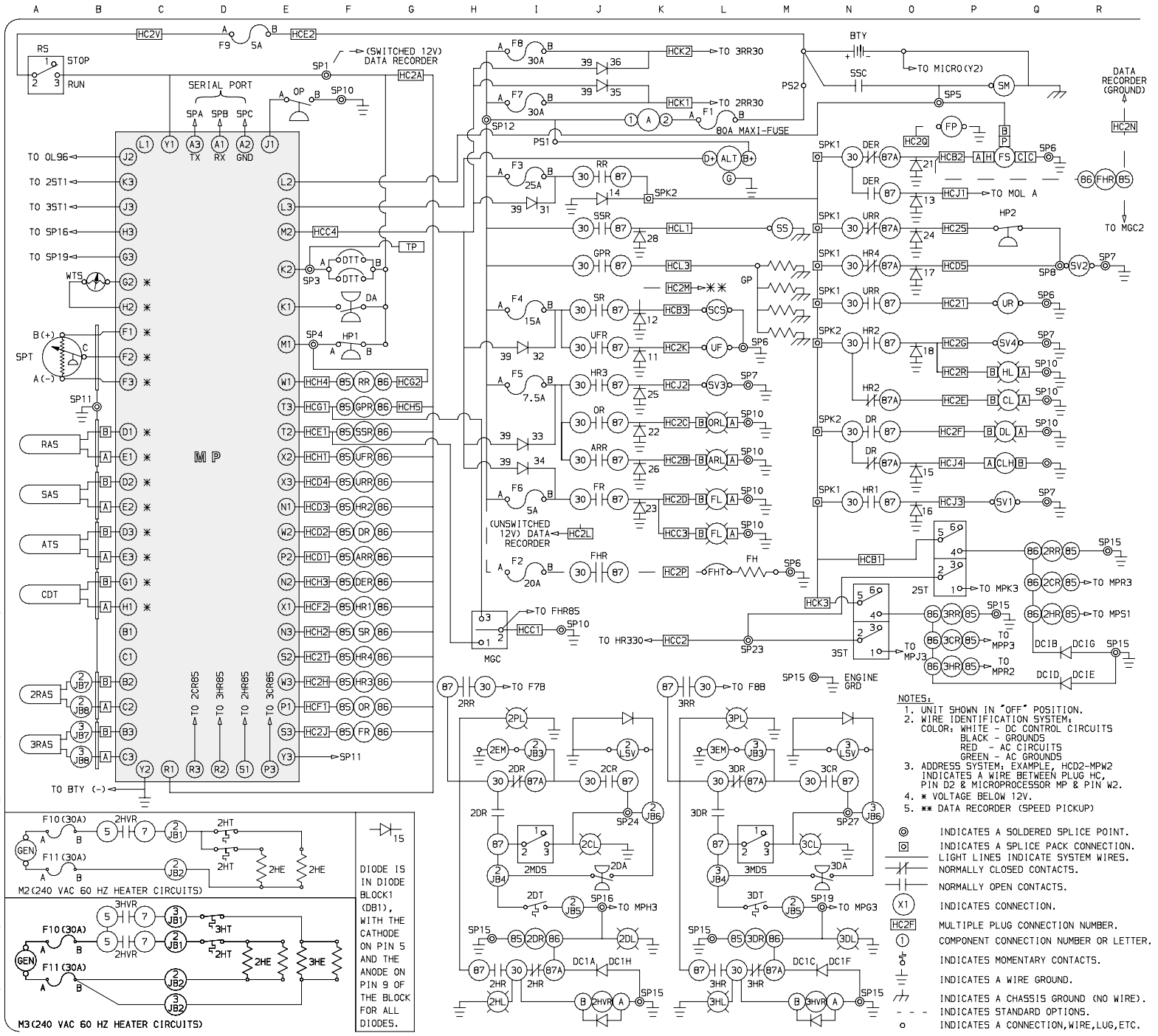


Figure 6-8. Electrical Schematic Wiring Diagram (Multi-Temp) – Prior to S/N EAE90310998 – Dwg. No. 62-03893 Rev. A (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
K2	A	Ammeter
L2	ALT	Alternator
L8	ARL	Auto Restart Light (Light Bar)
J7, F9	ARR	Auto Restart Relay
A8	ATS	Ambient Temperature Sensor
N1	BTY	Battery
A9	CDT	Compressor Discharge Temperature Sensor
P6	CL	Cool Light (Light Bar)
J14, M14	2/3CL	Cool Light (Remote Light)
P8	CLH	Clutch
H12,J12,P4,Q9	2CR/8	Cool Relay (2nd Compartment)
L12,M12,P10,R4	3CR/8	Cool Relay (3rd Compartment)
F5	DA	Defrost Air Switch
J14,N14	2/3DA	Defrost Air Switch (2nd/3rd Compartment)
I3−7,J16,M16,P11,Q10	DC	Diode Card
N3,F9	DER	Diesel Electric Relay
F1, J9, K5, O5, R2	DK	Datalink (Optional)
P7	DL	Defrost Light (Light Bar)
J15,N15	2/3DL	Defrost Light (Remote Light)
F13,F15,G16	2/3DP	Drain Pan Heater (2nd/3rd Compartment)
F8,N7	DR	Defrost Relay
I13−15,L13−15	2/3DR	Defrost Relay (2nd/3rd Compartment)
F4	DTT	Defrost Thermostat
I15,L15	2/3DT	Defrost Thermostat (2nd/3rd Compartment)
J11,N11	2/3EM	Evaporator Motors (2nd/3rd Compartment)
H11,J13	2EMR	Evaporator Motor Relay (2nd Compartment)
L11,M13	3EMR	Evaporator Motor Relay (3rd Compartment)
L2	FI	Fuse (Maxi−fuse) (80 Ampere)
I9	F2	Fuse (20 Ampere) (Optional)
I3	F3	Fuse (25 Ampere)
I5	F4	Fuse (15 Ampere)
I6	F5	Fuse (7.5 Ampere)
I8	F6	Fuse (5 Ampere)
I2	F7	Fuse (30 Ampere)
I1	F8	Fuse (30 Ampere)
D1	F9	Fuse (5 Ampere)
A13,A15	F10	Fuse (30 Ampere)
A14,A16	F11	Fuse (30 Ampere)
L9	FH	Fuel Heater (Optional)
J9, R3	FHR	Fuel Heater Relay (Optional)
L9	FHT	Fuel Heater Thermostat (Optional)
L9	FL	Fault Light (Light Bar And Door)
F12, J8	FR	Fault Relay
O2	FP	Fuel Pump (Optional)
P2	FS	Fuel Solenoid
A14,A16	GEN	Generator
L5	GP	Glow Plug
F6,J4	GPR	Glow Plug Relay
C1,E1, F4−12, G2−7,I9−11, K1−9,O3−8,R2	HC	High Current Box Plug
E14,E15,F16	2/3HE	Heater Electric (2nd/3rd Compartment)
P6	HL	Heat Light (Light Bar)
H16,L16	2/3HL	Heat Light (2nd/3rd Compartment)
F6	HP1	High Pressure Cut-Out-Switch (N.C.)
R4	HP2	High Pressure Cut-Out-Control (N.C.)
F9,N8	HR1	Heat Relay #1
F8,N6,N7	HR2	Heat Relay #2
F11,J6	HR3	Heat Relay #3
F10,N4	HR4	Heat Relay #4
H16, I 16, L16, P11,Q10	2/3HR	Heat Relay (2nd/3rd Compartment)
D13,D15	2HT	High Temp. Thermostat #2 (2nd Compartment)
D15	3HT	High Temp. Thermostat #3 (3rd Compartment)
B13,B15, I16	2HVR	High Voltage Relay (2nd Compartment)
B15,M16	3HVR	High Voltage Relay (3rd Compartment)
J12,N12	2/3LSV	Liquid Solenoid Valve (2nd/3rd Comp.)
I14,L14	2/3MDS	Manual Defrost Switch (2nd/3rd Comp.)
H10	MGC	Manual Glow/Crank
D2/12	MP	Microprocessor Board
E2	OP	Oil Pressure Safety Switch (N.O.)
F11,J7	OR	Out Of Range Relay
L7	ORL	Out Of Range Light (Light Bar)
H12,L12	2/3PL	Power Light (2nd/3rd Compartment)
I2,M2	PS	Power Stud
A7	RAS	Return Air Sensor
A11,A12	2/3RAS	Return Air Sensor (2nd/3rd Compartment)
A1	RS	Run Stop Switch
F6, J3	RR	Run Relay
H12,L12,P10,Q9	2/3RR	Run Relay (2nd/3rd Compartment)
A8	SAS	Supply Air Sensor (Optional)
L5	SCS	Speed Control Solenoid
D2	SLP	Serial Port
P2	SM	Starter Motor
	SP	Splice Point
	SPK	Splice Pack
A6	SPT	Suction Pressure Transducer
F10,J5	SR	Speed Relay
M4	SS	Starter Solenoid
N1	SSC	Starter Solenoid Contactor
F7, J4	SSR	Starter Solenoid Relay
N10,P9	2/3ST	Start − Stop Switch
P8	SV1	Con. Pressure Control Valve (N.O.)
P4	SV2	Liquid Solenoid Valve (N.C.)
L6	SV3	Hot Gas Solenoid Valve (N.C.)
P6	SV4	Hot Gas Solenoid Valve (N.C.)
L6	UF	Unloader Front
F7,J6	UFR	Unloader Front Relay
P5	UR	Unloader Rear
N4, N5,F8	URR	Unloader Rear Relay
B4	WTS	Water Temperature Sensor

Figure 6-9. Electrical Schematic Wiring Diagram (Multi-Temp) − Starting with S/N EAE90310998 − Dwg. No. 62-03944 (Sheet 1 of 2)

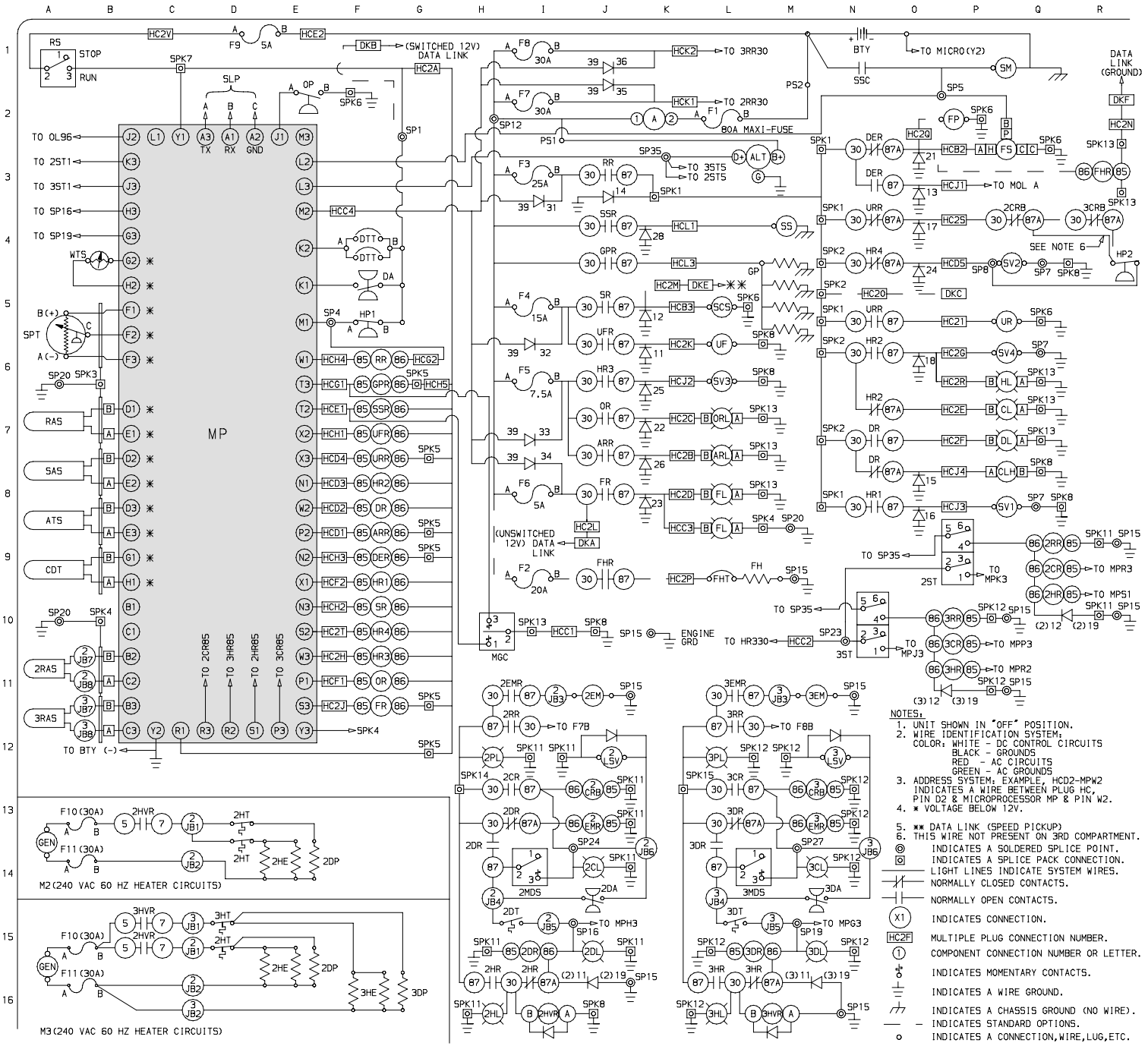


Figure 6-9. Electrical Schematic Wiring Diagram (Multi-Temp) – Starting with S/N EAE90310998 – Dwg. No. 62-03944 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
K2	A	AMMETER
L3	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
J8,F9	ARR	AUTO RESTART RELAY
B9	ATS	AMBIENT TEMPERATURE SENSOR
B13,N1	BTY	BATTERY
B10	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P7	CL	COOL LIGHT (LIGHT BAR)
J13	2CL	COOL LIGHT (REMOTE COMPARTMENT)
Q8	CLH	CLUTCH
Q10,J12	2CR	COOL RELAY (2ND COMPARTMENT)
F5	DA	DEFROST AIR SWITCH
J14	2DA	DEFROST AIR SWITH (2ND COMPARTMENT)
L14	3DA	DEFROST AIR SWITH (3RD COMPARTMENT)
J16,Q11	DC	DIODE CARD
N3,F9	DER	DIESEL ELECTRIC RELAY
P8	DL	DEFROST LIGHT (LIGHT BAR)
K15	2DL	DEFROST LIGHT (REMOTE COMPARTMENT)
F9,N7	DR	DEFROST RELAY
I12,I15	2DR	DEFROST RELAY (2ND COMPARTMENT)
I15	2DT	DEFROST THERMOSTAT (2ND COMPARTMENT)
L15	3DT	DEFROST THERMOSTAT (3RD COMPARTMENT)
F4	DTT	DEFROST THERMOSTAT
I12	2EM	EVAP MOTORS (2ND COMPARTMENT)
J12,L10	3EMR	EVAP MOTORS (3RD COMPARTMENT)
L2	F1	FUSE (MAXI-FUSE) (80 AMPERE)
I9	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I6	F5	FUSE (7.5 AMPERE)
I8	F6	FUSE (5 AMPERE)
I2	F7	FUSE (30 AMPERE)
I1	F8	FUSE (30 AMPERE)
D1	F9	FUSE (5 AMPERE)
A14	F10	FUSE (30 AMPERE/600V)
A15	F11	FUSE (30 AMPERE/600V)
L10	FH	FUEL HEATER (OPTIONAL)
J10,R3	FHR	FUEL HEATER RELAY (OPTIONAL)
L10	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J8	FR	FAULT RELAY
P3	FP	FUEL PUMP (OPTIONAL)
P3	FS	FUEL SOLENOID
A14	GEN	GENERATOR
L5	GP	GLOW PLUG
F7,J5	GPR	GLOW PLUG RELAY
F4/12,K1/9,03/8	HC	HIGH CURRENT BOX PLUG
P6	HL	HEAT LIGHT (LIGHT BAR)
I16	2HL	HEAT LIGHT (REMOTE COMPARTMENT)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
Q4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N8	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
J7,F11	HR3	HEAT RELAY #3
N5,F11	HR4	HEAT RELAY #4
Q10,J16	2HR	HEAT RELAY (2ND COMPARTMENT)
J16,B14	2HVR	HIGH VOLTAGE RELAY (2ND COMPARTMENT)
K11	2LSV	LIQUID SOLENOID VALVE (2ND COMPARTMENT)
L13	3LSV	LIQUID SOLENOID VALVE (3RD COMPARTMENT)
I13	2MDS	MANUAL DEFROST SWITCH (REMOTE)
H10	MGC	MANUAL GLOW/CRANK
D2/12	MP	MICROPROCESSOR BOARD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
I11	2PL	POWER LIGHT (REMOTE COMPARTMENT)
I2,M1	PS	POWER STUD
A7	RAS	RETURN AIR SENSOR
A11	2RAS	RETURN AIR SENSOR (2ND COMPARTMENT)
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
G14,Q9	2RR	RUN RELAY (2ND COMPARTMENT)
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
P2	SM	STARTER MOTOR
	SP	SPLICE POINT
	SPK	SPLICE PACK (HIGH CURRENT BOX)
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
M4	SS	STARTER SOLENOID
N2	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
O10	2ST	START SWITCH (REMOTE)
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
R5	SV2	LIQUID SOLENOID VALVE (N.C.)
L7	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
G4	TP	TEST POINT
L6	UF	UNLOADER FRONT
F7,J6	UFR	UNLOADER FRONT RELAY
P5	UR	UNLOADER REAR
N4,N5,F8	URR	UNLOADER REAR RELAY
F14	VR	VOLTAGE REGULATOR
B6	WTS	WATER TEMPERATURE SENSOR

Figure 6-10. Electrical Schematic Wiring Diagram (Multi-Temp 2 Compartment & 2 Evaps) – Prior to S/N EAE90310998 – Dwg. No. 62-03894 Rev. A (Sheet 1 of 2)

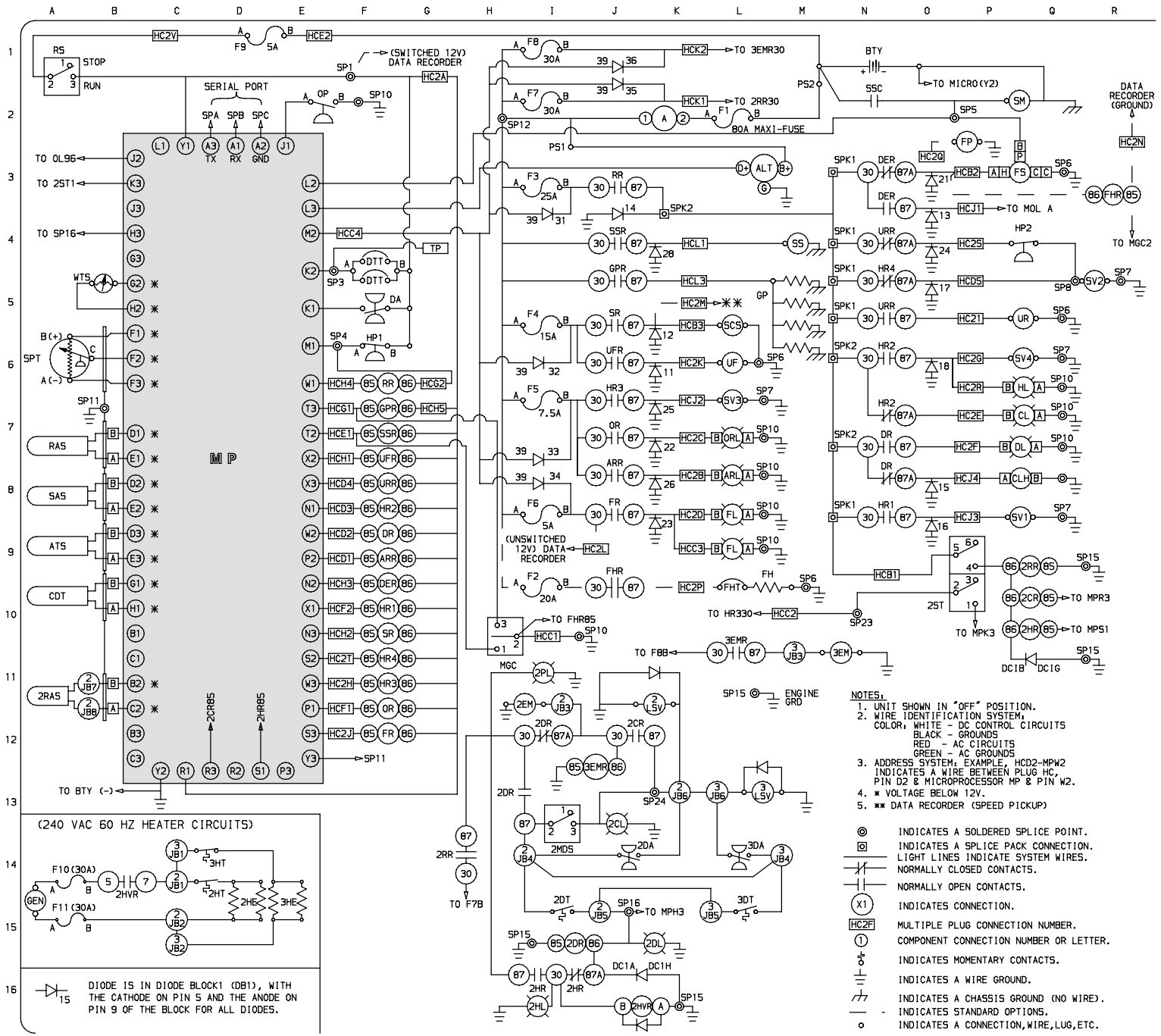


Figure 6-10. Electrical Schematic Wiring Diagram (Multi-Temp 2 Compartment & 2 Evaps) – Prior to S/N EAE90310998 – Dwg. No. 62-03894 Rev. A (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
K2	A	Ammeter
L2	ALT	Alternator
L8	ARL	Auto Restart Light (Light Bar)
J7, F9	ARR	Auto Restart Relay
A8	ATS	Ambient Temperature Sensor
N1	BTY	Battery
A9	CDT	Compressor Discharge Temperature Sensor
P6	CL	Cool Light (Light Bar)
J14	2CL	Cool Light (Remote Light)
P8	CLH	Clutch
I13,J12,P4,Q9	2CR/8	Cool Relay (2nd Compartment)
F5	DA	Defrost Air Switch
J14,L14	2/3DA	Defrost Air Switch (2nd/3rd Compartment)
I3−7,J16,M16,P11,Q10	DC	Diode Card
N3,F9	DER	Diesel Electric Relay
F1, J9, K5, O5, R2	DK	Datalink (Optional)
P7	DL	Defrost Light (Light Bar)
J15	2DL	Defrost Light (Remote Light)
E15,G15	2/3DP	Drain Pan Heater (2nd/3rd Compartment)
F8,N7	DR	Defrost Relay
I13,I14	2DR	Defrost Relay (2nd Compartment)
F4	DTT	Defrost Thermostat
I15,L15	2/3DT	Defrost Thermostat (2nd/3rd Compartment)
J11,M12	2/3EM	Evaporator Motors (2nd/3rd Compartment)
I11,J13	2EMR	Evaporator Motor Relay (2nd Compartment)
J13,L12	3EMR	Evaporator Motor Relay (3rd Compartment)
L2	FI	Fuse (Maxi−fuse) (80 Ampere)
I9	F2	Fuse (20 Ampere) (Optional)
I3	F3	Fuse (25 Ampere)
I5	F4	Fuse (15 Ampere)
I6	F5	Fuse (7.5 Ampere)
I8	F6	Fuse (5 Ampere)
I2	F7	Fuse (30 Ampere)
I1	F8	Fuse (30 Ampere)
D1	F9	Fuse (5 Ampere)
B14	F10	Fuse (30 Ampere)
B15	F11	Fuse (30 Ampere)
L9	FH	Fuel Heater (Optional)
J9, R3	FHR	Fuel Heater Relay (Optional)
L9	FHT	Fuel Heater Thermostat (Optional)
L9	FL	Fault Light (Light Bar And Door)
F12, J8	FR	Fault Relay
O2	FP	Fuel Pump (Optional)
P2	FS	Fuel Solenoid
A15	GEN	Generator
L5	GP	Glow Plug
F6,J4	GPR	Glow Plug Relay
C1,E1, F4−12, G2−7,I9−11, K1−9,O3−8,R2	HC	High Current Box Plug

ZONE	SYMBOL	DESCRIPTION
E15,F15	2/3HE	Heater Electric (2nd/3rd Compartment)
P6	HL	Heat Light (Light Bar)
H16	2HL	Heat Light (2nd Compartment)
F6	HP1	High Pressure Cut-Out-Switch (N.C.)
R4	HP2	High Pressure Cut-Out-Control (N.C.)
F9,N8	HR1	Heat Relay #1
F8,N6,N7	HR2	Heat Relay #2
F11,J6	HR3	Heat Relay #3
F10,N4	HR4	Heat Relay #4
H16, Q10	2HR	Heat Relay (2nd Compartment)
D14	2HT	High Temp. Thermostat #2 (2nd Compartment)
D14	3HT	High Temp. Thermostat #3 (3rd Compartment)
B14, I16	2HVR	High Voltage Relay (2nd Compartment)
L13	2/3LSV	Liquid Solenoid Valve (2nd/3rd Comp.)
I14	2MDS	Manual Defrost Switch (2nd Comp.)
H10	MGC	Manual Glow/Crank
D2/12	MP	Microprocessor Board
E2	OP	Oil Pressure Safety Switch (N.O.)
F11,J7	OR	Out Of Range Relay
L7	ORL	Out Of Range Light (Light Bar)
H12	2PL	Power Light (2nd Compartment)
I2,M2	PS	Power Stud
A7	RAS	Return Air Sensor
A11	2RAS	Return Air Sensor (2nd Compartment)
A1	RS	Run Stop Switch
F6, J3	RR	Run Relay
I12,Q9	2RR	Run Relay (2nd Compartment)
A8	SAS	Supply Air Sensor (Optional)
L5	SCS	Speed Control Solenoid
D2	SLP	Serial Port
P2	SM	Starter Motor
	SP	Splice Point
	SPK	Splice Pack
A6	SPT	Suction Pressure Transducer
F10,J5	SR	Speed Relay
M4	SS	Starter Solenoid
N1	SSC	Starter Solenoid Contactor
F7, J4	SSR	Starter Solenoid Relay
N10	2ST	Start − Stop Switch
P8	SV1	Con. Pressure Control Valve (N.O.)
P4	SV2	Liquid Solenoid Valve (N.C.)
L6	SV3	Hot Gas Solenoid Valve (N.C.)
P6	SV4	Hot Gas Solenoid Valve (N.C.)
L6	UF	Unloader Front
F7,J6	UFR	Unloader Front Relay
P5	UR	Unloader Rear
N4, N5,F8	URR	Unloader Rear Relay
B4	WTS	Water Temperature Sensor

Figure 6-11. Electrical Schematic Wiring Diagram (Multi-Temp) − Starting with S/N EAE90310998 − Dwg. No. 62-03932 (Sheet 1 of 2)

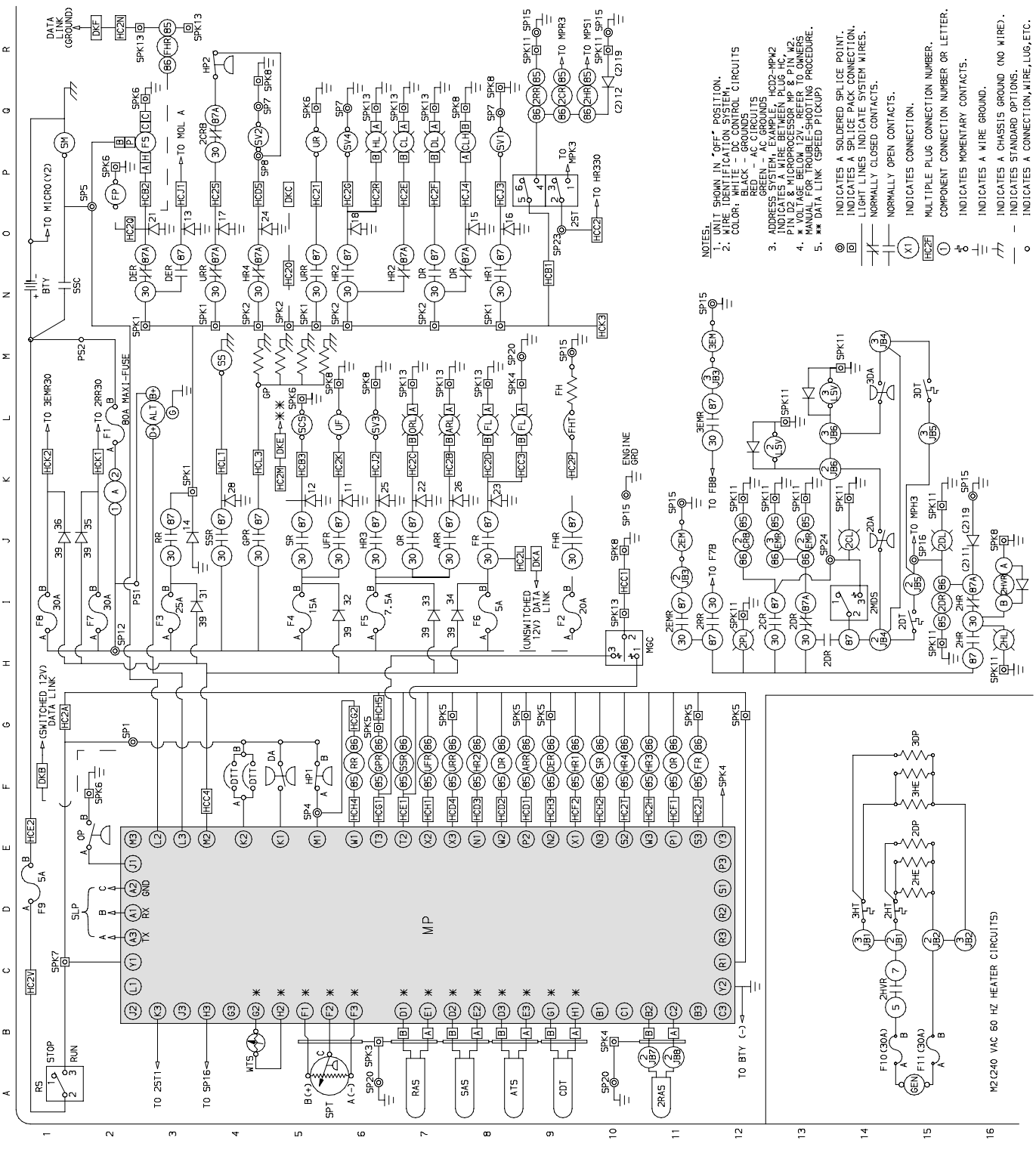


Figure 6-11. Electrical Schematic Wiring Diagram (Multi-Temp) – Starting with S/N EAE90310998 – Dwg. No. 62-03932 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
K2	A	AMMETER
L2	ALT	ALTERNATOR
L8	ARL	AUTO RESTART LIGHT (LIGHT BAR)
J7,F9	ARR	AUTO RESTART RELAY
A8	ATS	AMBIENT TEMPERATURE SENSOR
N1	BTY	BATTERY
A9	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6	CL	COOL LIGHT (LIGHT BAR)
J14,M14	2/3CL	COOL LIGHT (REMOTE LIGHT)
P8	CLH	CLUTCH
H12,J12,P4,Q9	2CR/B	COOL RELAY (2ND COMPARTMENT)
L12,M12,P10,R4	3CR/B	COOL RELAY (3RD COMPARTMENT)
F5	DA	DEFROST AIR SWITCH
J14,N14	2/3DA	DEFROST AIR SWITCH (2ND/3RD COMPARTMENT)
I3-7,J16,M16,P11,Q10	DC	DIODE CARD
N3,F9	DER	DIESEL ELECTRIC RELAY
F1,J9,K5,O5,R2	DK	DATALINK (OPTIONAL)
P7	DL	DEFROST LIGHT (LIGHT BAR)
J15,N15	2/3DL	DEFROST LIGHT (REMOTE LIGHT)
F13,F15,G16	2/3DP	DRAINPAN HEATER (2ND/3RD COMPARTMENT)
F8,N7	DR	DEFROST RELAY
I13-15,L13-15	2/3DR	DEFROST RELAY (2ND/3RD COMPARTMENT)
F4	DTT	DEFROST THERMOSTAT
I15,L15	2/3DT	DEFROST THERMOSTAT (2ND/3RD COMPARTMENT)
J11,N11	2/3EM	EVAPORATOR MOTORS (2ND/3RD COMPARTMENT)
H11,J13	2EMR	EVAPORATOR MOTOR RELAY (2ND COMPARTMENT)
L11,M13	3EMR	EVAPORATOR MOTOR RELAY (3RD COMPARTMENT)
L2	F1	FUSE (MAXI-FUSE) (80 AMPERE)
I9	F2	FUSE (20 AMPERE) (OPTIONAL)
I3	F3	FUSE (25 AMPERE)
I5	F4	FUSE (15 AMPERE)
I6	F5	FUSE (7.5 AMPERE)
I8	F6	FUSE (5 AMPERE)
I2	F7	FUSE (30 AMPERE)
I1	F8	FUSE (30 AMPERE)
D1	F9	FUSE (5 AMPERE)
A13,A15	F10	FUSE (30 AMPERE)
A14,A16	F11	FUSE (30 AMPERE)
L9	FH	FUEL HEATER (OPTIONAL)
J9,R3	FHR	FUEL HEATER RELAY (OPTIONAL)
L9	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
L9	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
F12,J8	FR	FAULT RELAY
Q2	FP	FUEL PUMP (OPTIONAL)
P2	FS	FUEL SOLENOID
A14,A16	GEN	GENERATOR
L5	GP	GLOW PLUG
F6,J4	GPR	GLOW PLUG RELAY
C1,E1,F4-12,G2-7,I9-11, K1-9,N10,O3-8,R2	HC	HIGH CURRENT BOX PLUG
D14,D16	1HE	HEATER ELECTRIC (MAIN UNIT)
E15,F15,G15	2/3HE	HEATER ELECTRIC (2ND/3RD COMPARTMENT)
P6	HL	HEAT LIGHT (LIGHT BAR)
H16,L16	2/3HL	HEAT LIGHT (2ND/3RD COMPARTMENT)
F6	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
R4	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F9,N8	HR1	HEAT RELAY #1
F8,N6,N7	HR2	HEAT RELAY #2
F11,J6	HR3	HEAT RELAY #3
F10,N4	HR4	HEAT RELAY #4
H16,I16,L16,P11,Q10	2/3HR	HEAT RELAY (2ND/3RD COMPARTMENT)
D13,D15	1HT	HIGH TEMP. THERMOSTAT #1 (MAIN UNIT)
E15,F14	2HT	HIGH TEMP. THERMOSTAT #2 (2ND COMPARTMENT)
D15	3HT	HIGH TEMP. THERMOSTAT #3 (3RD COMPARTMENT)
F2,B13,B15	1HVR	HIGH VOLTAGE RELAY
B13,B15,I16	2HVR	HIGH VOLTAGE RELAY (2ND COMPARTMENT)
B15,M16	3HVR	HIGH VOLTAGE RELAY (3RD COMPARTMENT)
J12,N12	2/3LSV	LIQUID SOLENOID VALVE (2ND/3RD COMP.)
I14,L14	2/3MDS	MANUAL DEFROST SWITCH (2ND/3RD COMP.)
H10	MGC	MANUAL GLOW/CRANK
D2/12	MP	MICROPROCESSOR BOARD
E2	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7	OR	OUT OF RANGE RELAY
L7	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
H12,L12	2/3PL	POWER LIGHT (2ND/3RD COMPARTMENT)
I2,M2	PS	POWER STUD
A7	RAS	RETURN AIR SENSOR
A11,A12	2/3RAS	RETURN AIR SENSOR (2ND/3RD COMPARTMENT)
A1	RS	RUN STOP SWITCH
F6,J3	RR	RUN RELAY
H12,L12,P10,Q9	2/3RR	RUN RELAY (2ND/3RD COMPARTMENT)
A8	SAS	SUPPLY AIR SENSOR (OPTIONAL)
L5	SCS	SPEED CONTROL SOLENOID
D2	SLP	SERIAL PORT
P2	SM	STARTER MOTOR
	SP	SPLICE POINT
	SPK	SPLICE PACK
A6	SPT	SUCTION PRESSURE TRANSDUCER
F10,J5	SR	SPEED RELAY
M4	SS	STARTER SOLENOID
N1	SSC	STARTER SOLENOID CONTACTOR
F7,J4	SSR	STARTER SOLENOID RELAY
N10,P9	2/3ST	START - STOP SWITCH
P8	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
P4	SV2	LIQUID SOLENOID VALVE (N.C.)
L6	SV3	HOT GAS SOLENOID VALVE (N.C.)
P6	SV4	HOT GAS SOLENOID VALVE (N.C.)
L6	UF	UNLOADER FRONT
F7,J6	UFR	UNLOADER FRONT RELAY
P5	UR	UNLOADER REAR
N4,N5,F8	URR	UNLOADER REAR RELAY
B4	WTS	WATER TEMPERAT RE SENSOR

DIODE IS IN DIODE BLOCK1 (DB1), THE CATHODE ON PIN 5 AND THE ANODE ON PIN 9 OF THE BLOCK FOR ALL DIODES.

Figure 6-12. Electrical Schematic Wiring Diagram (NDA-94 REVERSIBLE Multi-Temp 2 & 3 Compartment) – Dwg. No. 62-03933 (Sheet 1 of 2)

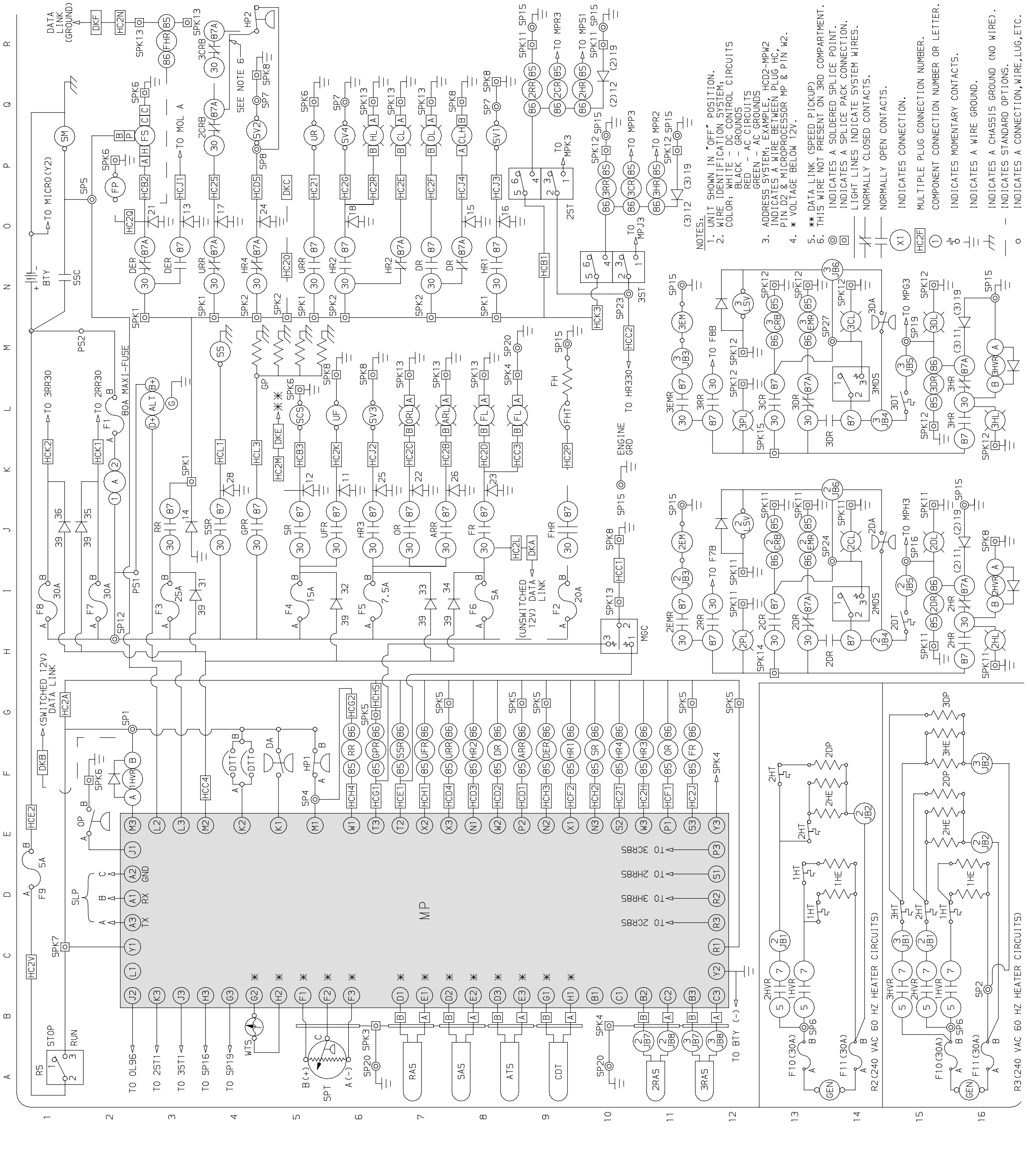


Figure 6-12 Electrical Schematic Wiring Diagram (NDA-94 REVERSIBLE Multi-Temp 2 & 3 Compartment) – Dwg. No. 62-03933 (Sheet 2 of 2)

ZONE	SYMBOL	DESCRIPTION
K2	A	Ammeter
L2	ALT	Alternator
L8	ARL	Auto Restart Light (Light Bar)
J7, F9	ARR	Auto Restart Relay
A8	ATS	Ambient Temperature Sensor
N1	BTY	Battery
A9	CDT	Compressor Discharge Temperature Sensor
P6	CL	Cool Light (Light Bar)
J14	2CL	Cool Light (Remote Light)
P8	CLH	Clutch
I13,J12,P4,Q9	2CR/8	Cool Relay (2nd Compartment)
F5	DA	Defrost Air Switch
J14,L14	2/3DA	Defrost Air Switch (2nd/3rd Compartment)
I3−7,J16,M16,P11,Q10	DC	Diode Card
N3,F9	DER	Diesel Electric Relay
F1, J9, K5, O5, R2	DK	Datalink (Optional)
P7	DL	Defrost Light (Light Bar)
J15	2DL	Defrost Light (Remote Light)
F15,G15	2/3DP	Drain Pan Heater (2nd/3rd Compartment)
F8,N7	DR	Defrost Relay
I13,I14	2DR	Defrost Relay (2nd Compartment)
F4	DTT	Defrost Thermostat
I15,L15	2/3DT	Defrost Thermostat (2nd/3rd Compartment)
J11,M12	2/3EM	Evaporator Motors (2nd/3rd Compartment)
I11,J13	2EMR	Evaporator Motor Relay (2nd Compartment)
J13,L12	3EMR	Evaporator Motor Relay (3rd Compartment)
L2	FI	Fuse (Maxi−fuse) (80 Ampere)
I9	F2	Fuse (20 Ampere) (Optional)
I3	F3	Fuse (25 Ampere)
I5	F4	Fuse (15 Ampere)
I6	F5	Fuse (7.5 Ampere)
I8	F6	Fuse (5 Ampere)
I2	F7	Fuse (30 Ampere)
I1	F8	Fuse (30 Ampere)
D1	F9	Fuse (5 Ampere)
A14	F10	Fuse (30 Ampere)
A15	F11	Fuse (30 Ampere)
L9	FH	Fuel Heater (Optional)
J9, R3	FHR	Fuel Heater Relay (Optional)
L9	FHT	Fuel Heater Thermostat (Optional)
L9	FL	Fault Light (Light Bar And Door)
F12, J8	FR	Fault Relay
O2	FP	Fuel Pump (Optional)
P2	FS	Fuel Solenoid
A15	GEN	Generator
L5	GP	Glow Plug
F6,J4	GPR	Glow Plug Relay
C1,E1, F4−12, G2−7,I9−11, K1−9,O3−8,R2	HC	High Current Box Plug
D15	1HE	Heater Electric (Main Unit)
E15,F15	2/3HE	Heater Electric (2nd/3rd Compartment)
P6	HL	Heat Light (Light Bar)
H16	2HL	Heat Light (2nd Compartment)
F6	HP1	High Pressure Cut-Out-Switch (N.C.)
R4	HP2	High Pressure Cut-Out-Control (N.C.)
F9,N8	HR1	Heat Relay #1
F8,N6,N7	HR2	Heat Relay #2
F11,J6	HR3	Heat Relay #3
F10,N4	HR4	Heat Relay #4
H16, Q10	2HR	Heat Relay (2nd Compartment)
C14, D14	1HT	High Temp. Thermostat #1 (Main Unit)
E14	2HT	High Temp. Thermostat #2 (2nd Compartment)
F14	3HT	High Temp. Thermostat #3 (3rd Compartment)
B14, F2	1HVR	High Voltage Relay
B14, I16	2HVR	High Voltage Relay (2nd Compartment)
L13	2/3LSV	Liquid Solenoid Valve (2nd/3rd Comp.)
I14	2MDS	Manual Defrost Switch (2nd Comp.)
H10	MGC	Manual Glow/Crank
D2/12	MP	Microprocessor Board
E2	OP	Oil Pressure Safety Switch (N.O.)
F11,J7	OR	Out Of Range Relay
L7	ORL	Out Of Range Light (Light Bar)
H12	2PL	Power Light (2nd Compartment)
I2,M2	PS	Power Stud
A7	RAS	Return Air Sensor
A11	2RAS	Return Air Sensor (2nd Compartment)
A1	RS	Run Stop Switch
F6, J3	RR	Run Relay
I12,Q9	2RR	Run Relay (2nd Compartment)
A8	SAS	Supply Air Sensor (Optional)
L5	SCS	Speed Control Solenoid
D2	SLP	Serial Port
P2	SM	Starter Motor
	SP	Splice Point
	SPK	Splice Pack
A6	SPT	Suction Pressure Transducer
F10,J5	SR	Speed Relay
M4	SS	Starter Solenoid
N1	SSC	Starter Solenoid Contactor
F7, J4	SSR	Starter Solenoid Relay
N10	2ST	Start − Stop Switch
P8	SV1	Con. Pressure Control Valve (N.O.)
P4	SV2	Liquid Solenoid Valve (N.C.)
L6	SV3	Hot Gas Solenoid Valve (N.C.)
P6	SV4	Hot Gas Solenoid Valve (N.C.)
L6	UF	Unloader Front
F7,J6	UFR	Unloader Front Relay
P5	UR	Unloader Rear
N4, N5,F8	URR	Unloader Rear Relay
B4	WTS	Water Temperature Sensor

Figure 6-13 Electrical Schematic Wiring Diagram (NDA-94 REVERSIBLE Multi-Temp 2 Compartment & 2 Evaps) − Dwg. No. 62-03934 (Sheet 1 of 2)

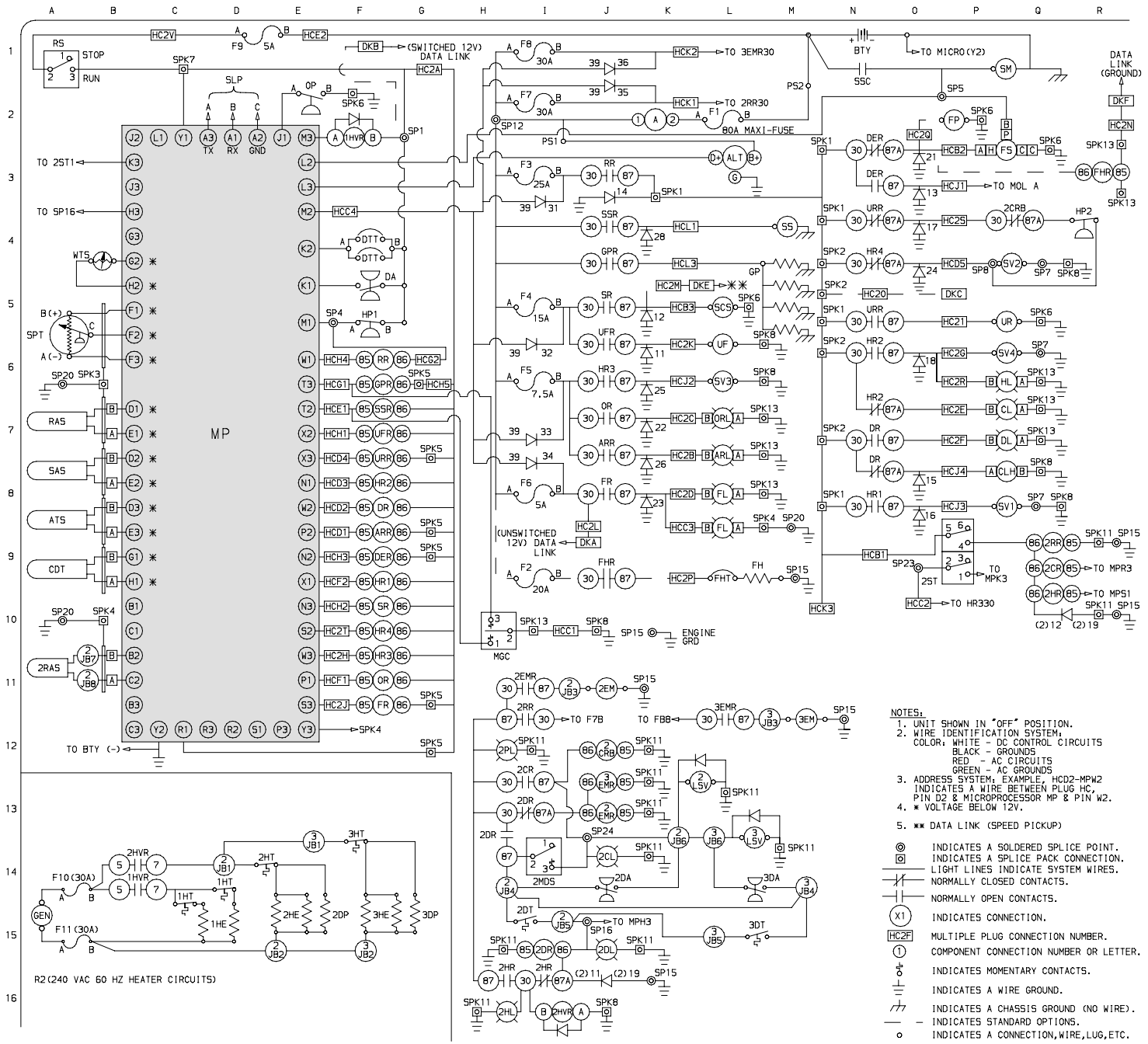


Figure 6-13 Electrical Schematic Wiring Diagram (NDA-94 REVERSIBLE Multi-Temp 2 Compartment & 2 Evaps) – Dwg. No. 62-03934 (Sheet 2 of 2)

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