Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

FOR

Supra 550, 650, 750, 850 & 950
TRUCK REFRIGERATION UNITS

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SAFETY SUMMARY

GENERAL SAFETY NOTICES

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

SAFETY PRECAUTIONS

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

FIRST AID

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

OPERATING PRECAUTIONS

Always wear safety glasses. Wear hearing protection as required.

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

No work should be performed on the unit until all circuit breakers and the RUN/STOP Switch are turned off, and battery power supply is disconnected.

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

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

MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the unit. This unit is equipped with Auto–Start in both the road and standby modes. The unit may start at any time. When performing any check of the system make certain the Emergency Switch is in the OFF position.

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

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

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

In case of electrical fire, open circuit switch and extinguish with CO_2 (never use water).

AUTO-START

Your refrigeration unit is equipped with Auto-Start in both Start/Stop and Continuous Run modes. The unit may start at any time. A buzzer will sound for 5 seconds before the unit is started. When performing any check of the refrigeration unit (e.g., checking the belts, checking the oil), make certain that the RUN/STOP Switch is in the OFF (0) position.

ENGINE COOLANT

The engine is equipped with a pressurized cooling system. Under normal operating conditions, the coolant in the engine and radiator is under high pressure and is very hot. Contact with hot coolant can cause severe burns. Do not remove the cap from a hot radiator; if the cap must be removed, do so very slowly in order to release the pressure without spray.

REFRIGERANTS

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

BATTERY

This unit is equipped with a lead-acid type battery. The battery normally vents small amounts of flammable hydrogen gas. Do not smoke when checking the battery. A battery explosion can cause serious physical harm and/or blindness.

SPECIFIC WARNING AND CAUTION STATEMENTS

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

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

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

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

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

⚠ WARNING

Beware of unannounced starting of the engine, standby motor, evaporator fan or condenser fan. The unit may cycle the engine, standby motor or fans unexpectedly as control requirements dictate

⚠ WARNING

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

⚠ WARNING

Make sure the power plug is clean and dry before connecting to any power source.

Do not attempt to connect or remove power plug or perform service and/or maintenance before ensuring the unit RUN/STOP Switch is in the STOP position and the I/O switch is in the "O" position.

⚠ 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

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

⚠ WARNING

Since refrigerant traps a certain quantity of oil, to avoid oil loss during maintenance, add 50 cc of POE oil to the refrigeration system when any evacuation is performed.

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

Unit with R404A and POE oil, the use of inert gas brazing procedures is mandatory; otherwise compressor failure will occur. For more information see Technical Procedure 98-50553-00 Inert Gas Brazing

⚠ 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.

⚠ 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.

⚠ CAUTION

When changing fuel filter, the new filter should be filled with clean fuel.

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

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.

⚠ CAUTION

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

⚠ CAUTION

Under no circumstances should a technician electrically probe the microprocessor 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 microprocessor.

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

Refrigerant R404A must be charged as a liquid. Refrigerant R404A is a blend. Charging as a vapor will change the properties of the refrigerant.

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

⚠ WARNING

Beware of unannounced starting of the engine, standby motor, evaporator fan or condenser fan. The unit may cycle the engine, standby motor or fans unexpectedly as control requirements dictate

This manual contains operating data, electrical data and service instructions for the Carrier Transicold Supra model truck refrigeration units listed in Table 1-1.

Additional Supra support manuals are listed in Table 1-2.

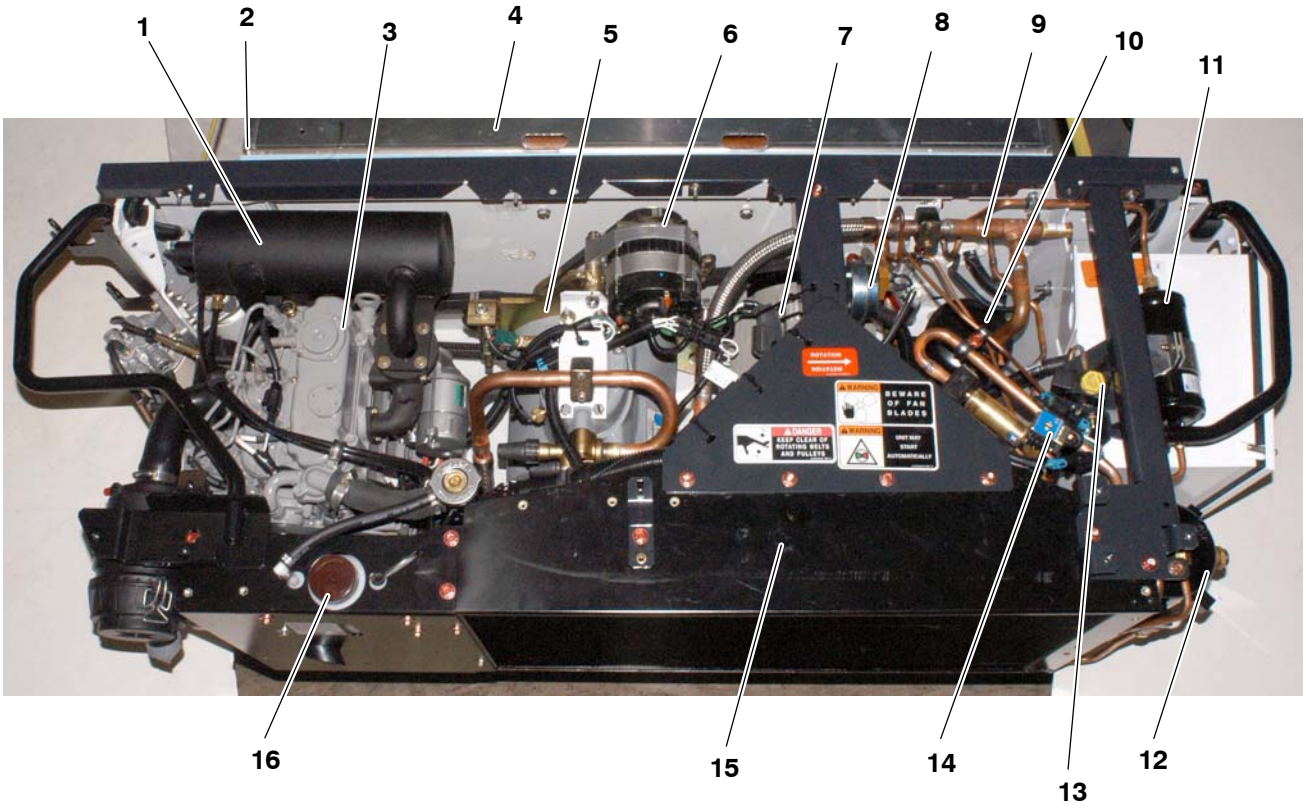
The model/serial number plate is located inside the unit on the frame as shown in Figure 1-2.

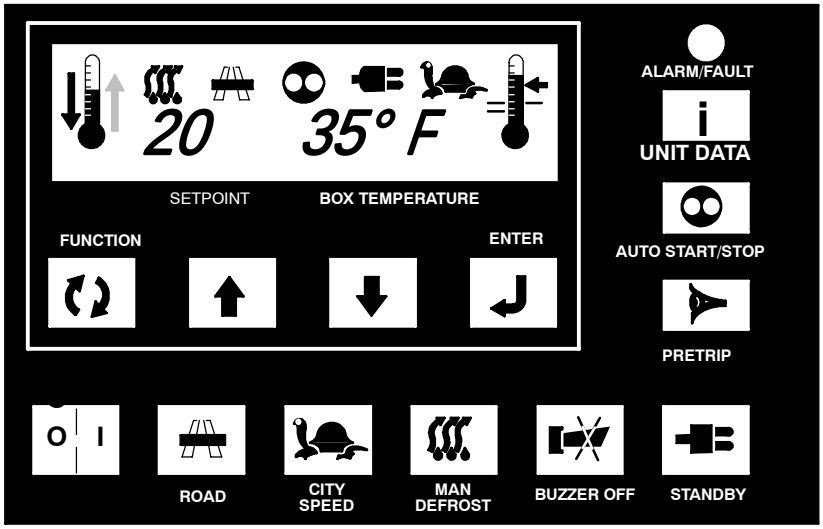
Table 1-1. Model Chart

MODEL	REFRIGERANT R-404A		ENGINE	COMPRESSOR	STANDBY MOTOR
	LB	KG			60 Hz
Supra 550, TDB-13	9	4	CT2-29TV	05K 012 2 Cylinder	5.9 hp (4.4 kW)
Supra 550, TDS-13					
Supra 650, TDB-16	13	5.9	CT3-44TV		7.6 hp (5.7 kW)
Supra 650, TDS-16					
Supra 750, TDB-19	13	5.9			
Supra 750, TDS-19					
Supra 850, TDB-24	15	6.8		05K24 4 Cylinder	8.3 hp (6.2 kW)
Supra 850, TDS-24					
Supra 950, TDB-36			CT3-69TV	05G37 6 Cylinder	14.8 hp (11 kW)
Supra 950, TDS-36					

Table 1-2. Additional Support Manuals

Manual Number	Equipment Covered	Type of Manual
62-10829	Supra 550	Parts List
62-11091	Supra 650,750	Parts List
62-11089	Supra 850	Parts List
62-11092	Supra 950	Parts List
62-10826	Supra 50 Series	Easy to Run
62-10827	Supra 50 Series	Operator's Manual
62-02491	Compressor (05K012)	Operation and Service
62-02460	Compressor (05K4)	Parts List
62-02756	Compressor (05G)	Operation and Service
62-11052	Compressor (05G Twinport)	Operation and Service
62-10299	Compressor (05G)	Parts List
62-11053	Compressor (05G Twinport)	Parts List

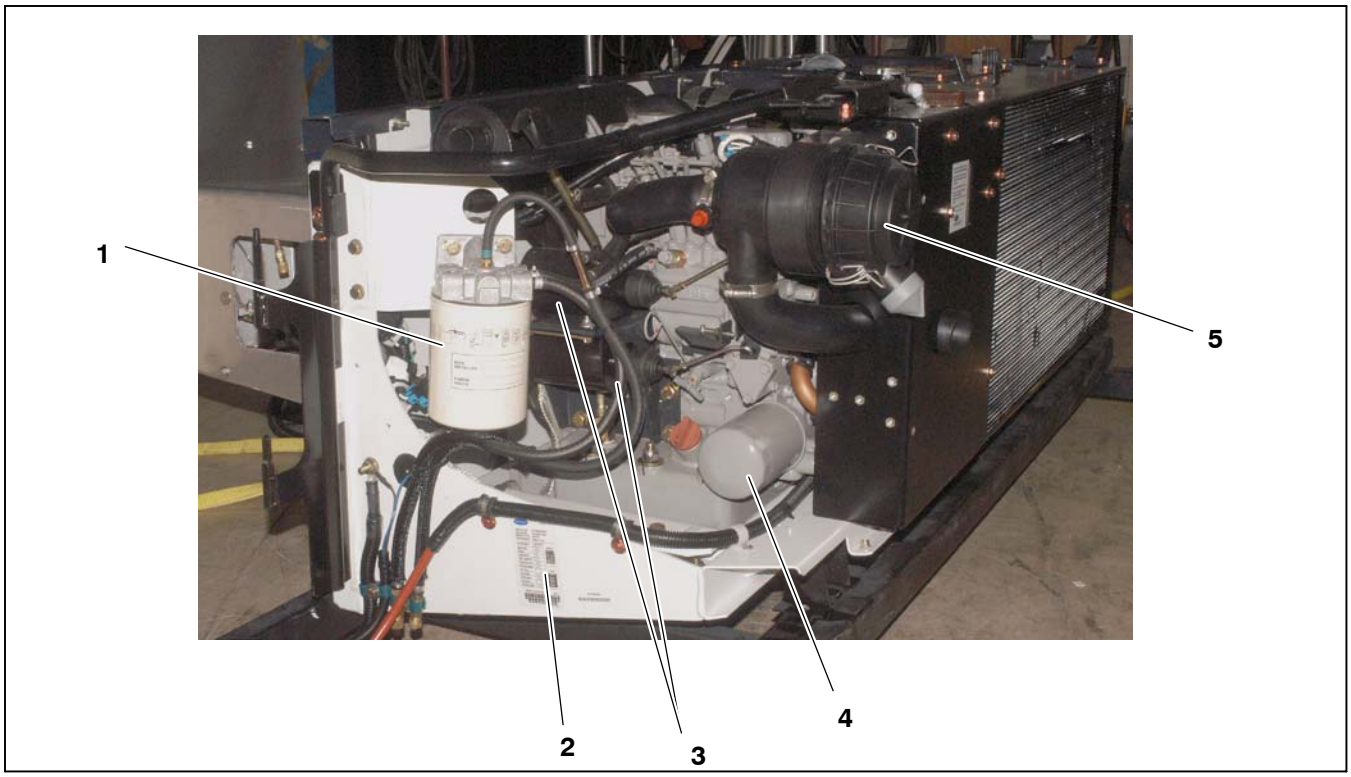




CAB COMMAND

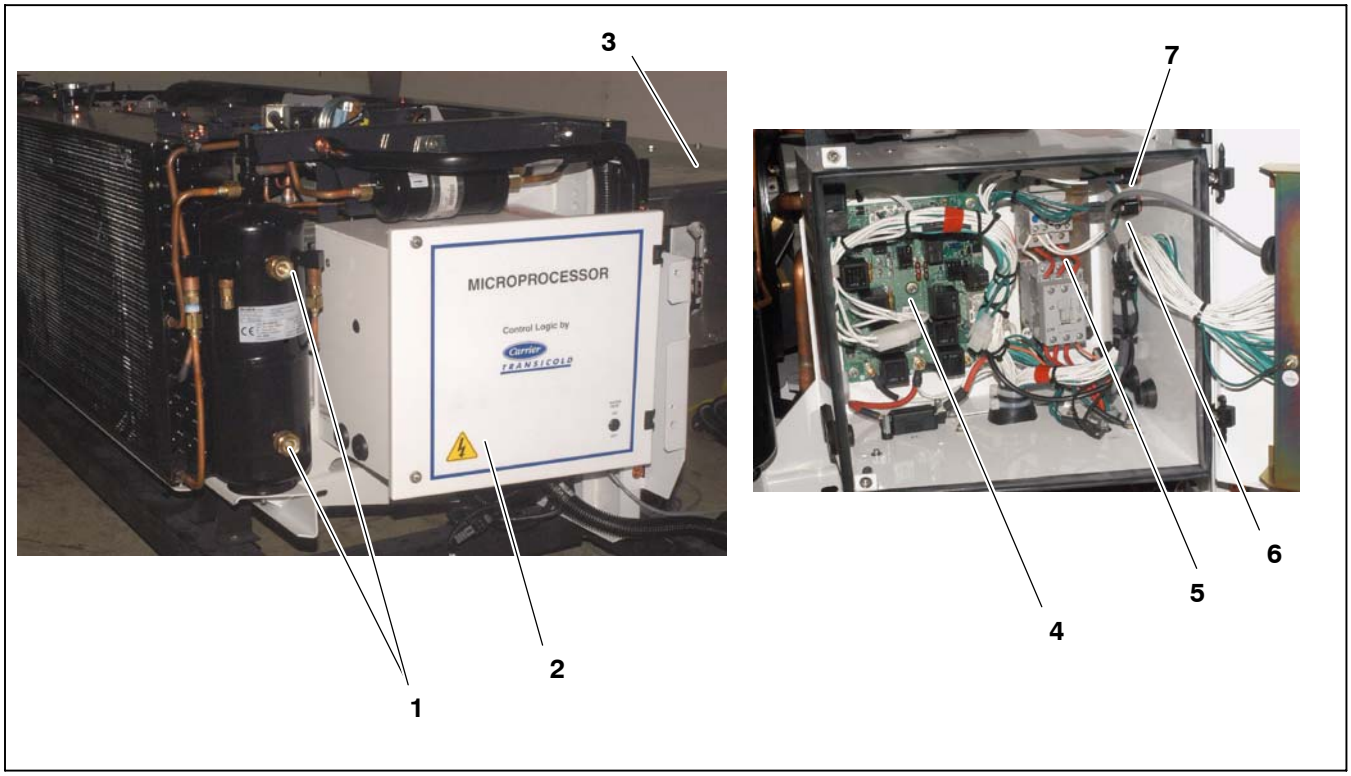
1. Muffler
2. Thermal Expansion Valve (Location)
3. Engine (Refer toTable 1-1)
4. Heat Exchanger (Location)
5. Compressor
6. Alternator
7. Electric Standby Motor
8. Defrost Air Switch
9. Compressor Pressure Regulating Valve (CPR)
10. Accumulator
11. Filter-Drier
12. Receiver
13. Hot Gas Bypass Solenoid (HGS2)
14. Hot Gas Valve (Three-Way) (HGS1)
15. Condenser
16. Radiator Overflow Reservoir

Figure 1-1. Condensing Section - Top View/Cab Command



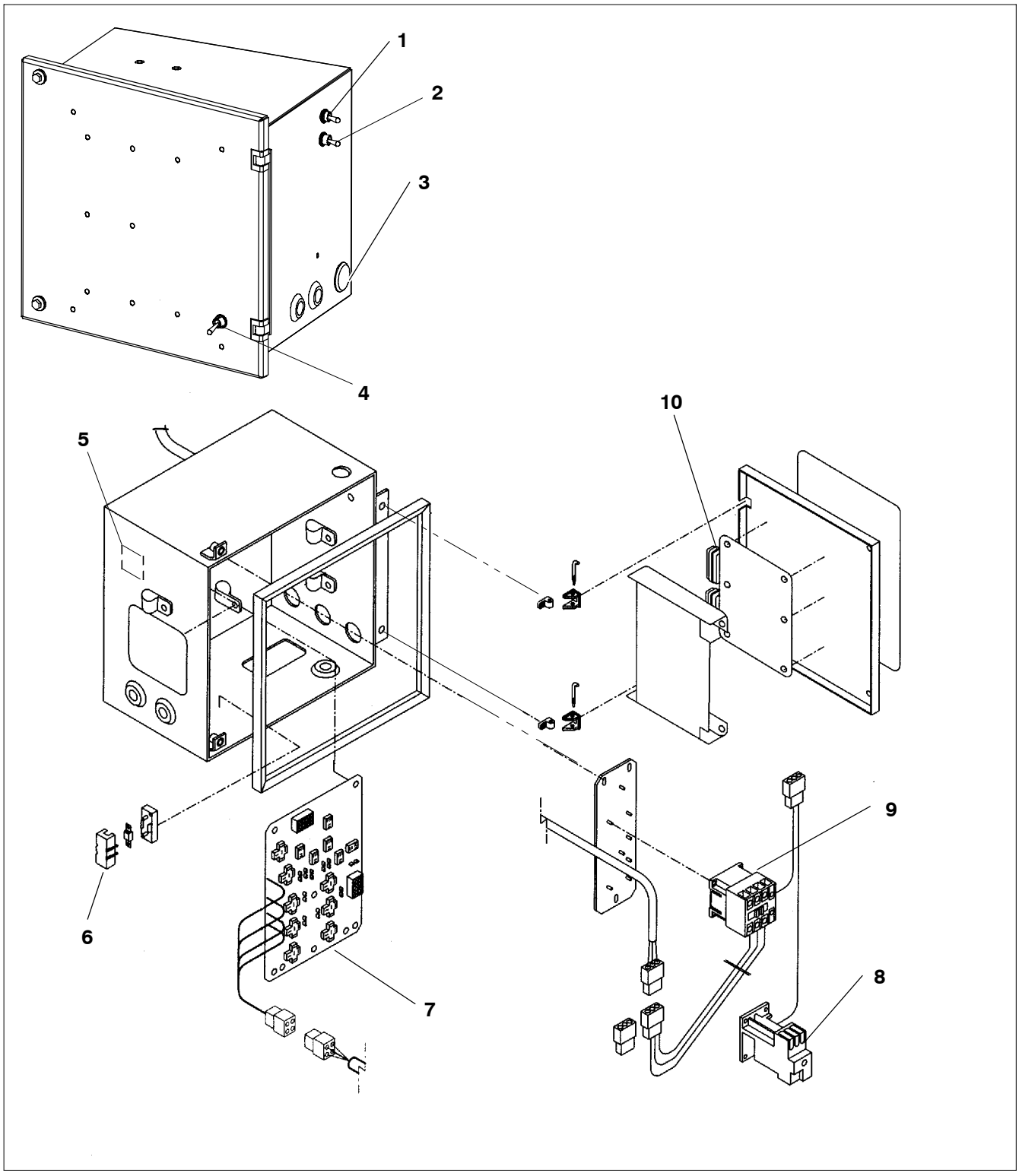
1. Fuel Filter
2. Model/Serial Number Plate
3. Speed and Run Solenoids
4. Oil Filter
5. Air Cleaner

Figure 1-2. Unit Curbside View



1. Receiver Sight Glasses
2. Electrical Box (See Figure 1-4)
3. Evaporator
4 Relay/Fuse Board
5. Standby Board
6. Manual Glow/Crank Switch (MGC – If Equipped)
7 RUN/STOP Switch (RSS)

Figure 1-3. Unit Roadside View



1. Manual RUN/STOP Switch
2. Manual Glow/Crank Switch (If Equipped)
3. Warning Buzzer
4. Summer/Winter Switch **(EWHS Only)**
5. Fuel Heater Relay (FHR – Option)
6. Main Fuse (F1, 80 amp)
7. Relay/Fuse Board (See Table 1-9 & Figure 1-5)
8. Motor Overload Relay (MOL)
9. Standby Motor Contactor (MC) **(Located in plug box on 950)**
10. Microprocessor Module

Note: See Figure 2-1 for Cab Command

Figure 1-4. Electrical Box

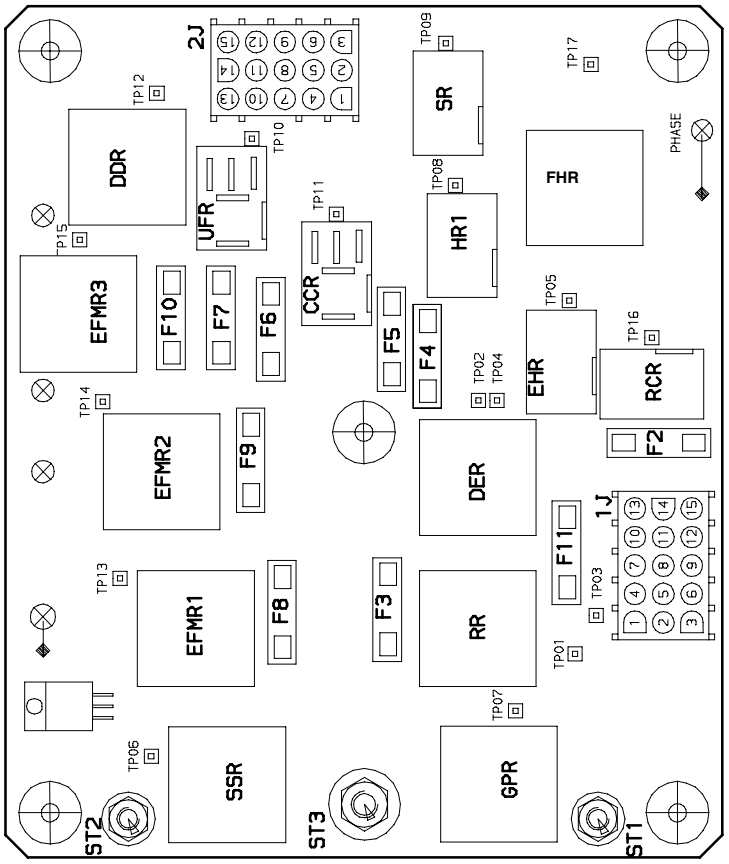


Figure 1-5. Relay/Fuse Board (With All Optional Components)

Table 1-3. Fuse Identification

Desig.	Item	Amps
F1	Main Fuse (See Figure 1-1)	80A
F2	RCR Fuse	5A
F3	Run Relay Fuse	15A
F4	Heat Relay Fuse	3A
F5	Speed Relay Fuse	10A
F6	Unloader Fuse (850 & 950)	5A
F7	Defrost Damper Relay Fuse (Option) (950 Only)	15A
F8	Electric Fan Motor Fuse	20A
F9	Electric Fan Motor Fuse	20A
F10	Electric Fan Motor Fuse	20A
F11	Fuel Pump Fuse	5A
F12	Fuel Heater Fuse (Option)	25A

Table 1-4. Relay Identification

Desig.	Item
SSR	Starter Solenoid Relay
EFMR1	Electric Fan Motor Relay
EFMR2	Electric Fan Motor Relay
EFMR3	Electric Fan Motor Relay
DDR	Defrost Damper Solenoid Relay (Option)
UFR	Unloader Front Relay (850 & 950)
CCR	Compressor Clutch Relay
SR	Speed Relay
HR1	Heat Relay 1
DER	Diesel Electric Relay
RR	Run Relay
GPR	Glow Plug Relay
RCR	Run Control Relay
EHR	Evaporator Heater Relay
FHR	Fuel Heater Relay (Optional)

Table 1-5.Test Point Identification

Test Point #	Circuit
TP1	RR NO Output
TP2	DER NC Output
TP3	F11 Output
TP4	DER NO Output
TP5	EHR NO Output
TP6	SSR NO Output
TP7	GPR NO Output
TP8	HR1 NO Output
TP9	SR NO Output
TP10	UFR NO Output
TP11	CCR NO Output
TP12	DDR NO Output
TP13	EFMR1 NO Output
TP14	EFMR2 NO Output
TP15	EFMR3 NO Output
TP16	RCR NO Output
TP17	DPS 12 Volt Input

1.2 GENERAL DESCRIPTION

The Supra models are self contained one-piece refrigeration/heating units designed for truck applications. The units consist of a condenser section, located outside the truck body, and an evaporator section which extends inside the body. Two types of drives may be included:

Road Operation

Both the TDB and TDS model units are equipped with an engine. In the Road Operation mode, the compressor and alternator are driven by the engine. TDB units do not have standby motors. A standby motor shell is installed (without the motor winding) to allow the same belt arrangement for both units.

Standby Operation

TDS units are equipped with an internal combustion diesel engine and an electric standby motor. In Standby Operation, the compressor and alternator are driven by the electric standby motor.

1.3 CONDENSING SECTION

The condensing section (see Figure 1-1, Figure 1-2 & Figure 1-3) contains the drive equipment, alternator and the high side refrigeration system equipment. The engine radiator and refrigerant condenser are incorporated into a single condenser/radiator assembly.

1.3.1 Drive Equipment

The drive equipment includes the engine, engine mounted clutch, air cleaner, muffler, coolant overflow bottle, drive belts and standby motor.

a. Engine

The engine (Figure 1-1, item 3) is a TriVortex diesel manufactured by Kubota. Engine operation is controlled by a Run Solenoid and a Speed Solenoid. The engine is cooled by a radiator which is integral with the refrigerant condenser. The cooling system is fitted with a coolant overflow reservoir. Engine air cleaners are dry type.

b. Clutch Assembly

The clutch assembly is mounted on the engine crankshaft. All units have centrifugal type clutches.

c. Standby Motor

The standby motor operates on nominal 460v-3ph-60Hz or 230v-3ph-60Hz power. An overload and short cycle protection is provided along with automatic reset. Units are also equipped with a remote mounted power receptacle.

d. Alternator/Regulator

⚠ 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 supplies power for operation of the system controls, evaporator fan motors and for charging of the unit battery, if equipped.

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

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

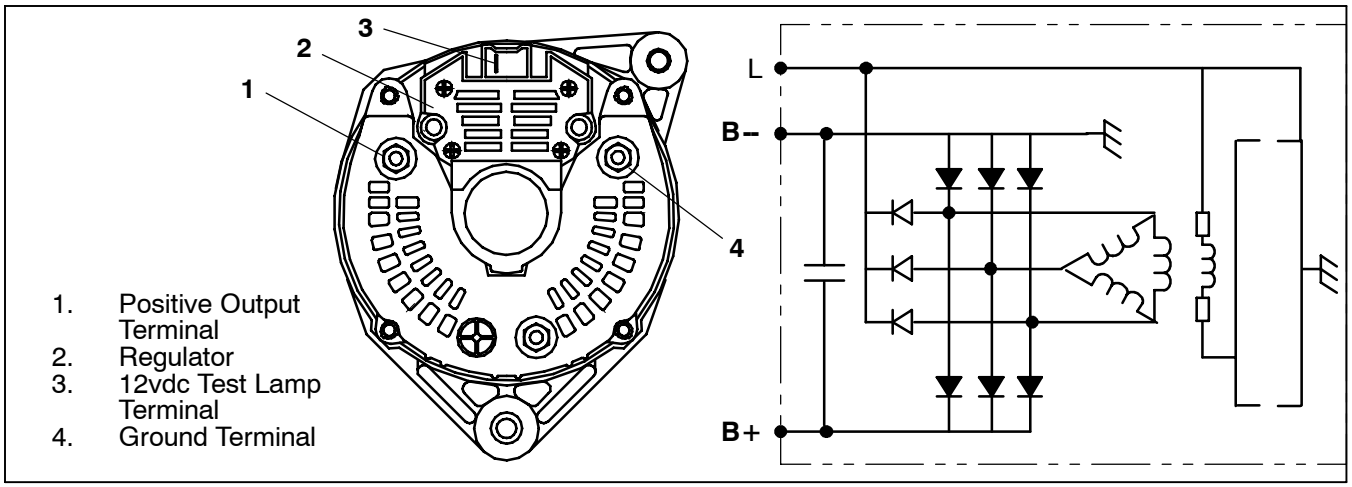


Figure 1-6. 70 Amp Alternator (P/N 30-60050-04)

1.3.2 Condensing Section Refrigeration System

The condensing section mounted refrigeration system equipment includes the compressor, condenser/subcooler, accumulator, defrost air switch, filter drier, receiver, hot gas (three way) valve, hot gas bypass valve (except for 950) and compressor pressure regulating valve.

a. Compressor

The compressor assembly includes the refrigerant compressor, suction and discharge service valves, high pressure switch, unloader(s) (850 and 950 only) and the suction pressure transducer. The compressor draws refrigerant gas from the evaporator and delivers it to the condenser at an increased pressure. The pressure is such that refrigerant heat can be absorbed by the surrounding air at ordinary temperatures.

b. Compressor Unloader (850 and 950 Only) (Refer to Section 3.1.7 for detailed information on unloader temperature control)

The Supra 850 and 950 unit compressors are fitted with one electric unloader valve. The capacity controlled cylinder is easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid is energized two cylinders are unloaded. The unloaded cylinders operate with little or no pressure differential, consuming very little power. A description of unloader operation is provided in the following steps.

Unloaded Operation

Pressure from the discharge manifold (Figure 1-7, 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.

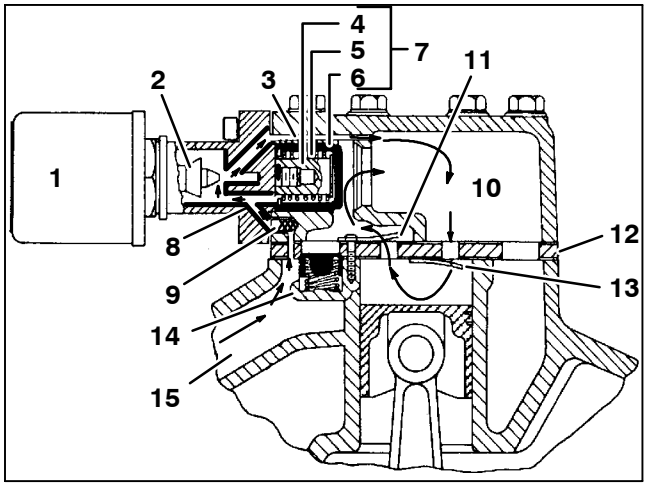
With the solenoid valve (1) *energized* the solenoid valve stem (2) will *open* the gas bypass port (3).

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 1-7. Cylinder Head - Unloaded

Loaded Operation

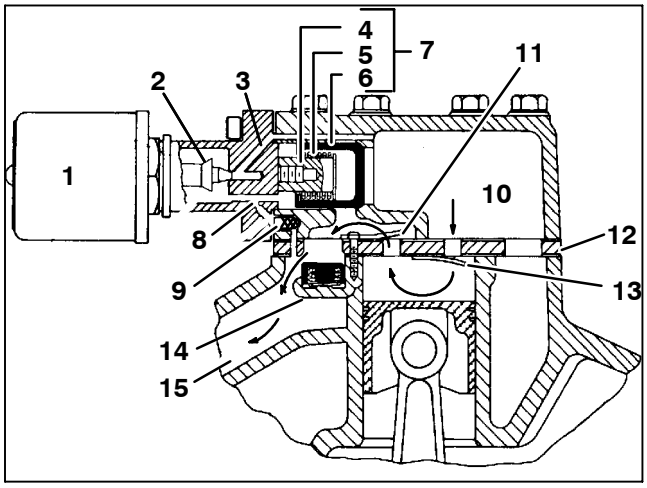
Discharge pressure bleeds from the discharge manifold (Figure 1-8, item 15) through the strainer (9) and (8) bleed orifice to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

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 1-8. Cylinder Head – Loaded

c. Condenser/Subcooler

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

A portion of the condenser is occupied by the subcooler. Refrigerant leaving the receiver is passed through the subcooler where additional heat is removed. Removal of this additional heat helps to ensure that only liquid refrigerant enters the thermal expansion valve.

d. Accumulator

The accumulator is a refrigerant holding tank located in the suction line between the evaporator and compressor. The purpose of the accumulator is to prevent entry of any liquid refrigerant into the compressor.

Refrigerant vapor leaves the accumulator outlet pipe at a point well above any liquid level thus preventing the entrance of liquid. The outlet pipe is equipped with an orifice that controls oil return to the compressor and prevents accumulation of oil within the tank.

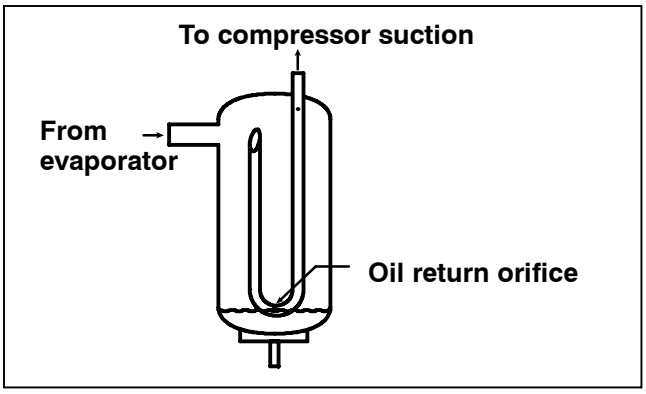


Figure 1-9 Accumulator

e. Compressor Pressure Regulating Valve (CPR)

This adjustable regulating valve regulates the suction pressure entering the compressor. The suction pressure is controlled to avoid overloading the electric motor or engine during high box temperature operation.

f. Hot Gas Solenoid Valve (Three-Way Valve)

The Hot Gas Valve (HGS1) directs flow of refrigerant through the system. With the solenoid coil de-energized the valve is in the cool mode and the compressor discharge gas is delivered to the condenser. In the cool mode, heat is removed from the air inside the truck body and rejected to the surrounding air. With the solenoid coil energized the valve is in the heat mode and the compressor discharge gas is diverted to the evaporator. In the heat mode, heat is removed from the air surrounding the truck body and rejected to the air inside the truck body. A description of valve operation is provided in the following sub-paragraphs.

Cooling Operation (See Figure 1-10.)

With the solenoid coil de-energized the valve is in the cool operating mode and the refrigerant gas is diverted to the condenser. The volume directly above the piston assembly is open to suction pressure through the external pilot connection and the volume underneath the piston assembly is open to discharge pressure through the compressor discharge connection. This difference in pressure across the piston assembly results in the piston assembly being shifted upward, shutting the heat and defrost port, opening the condenser port, and allowing refrigerant to flow to the condenser.

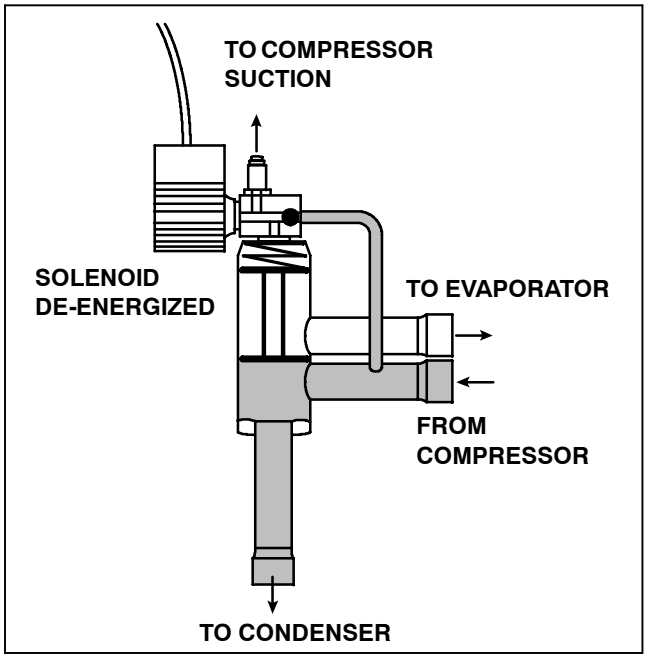


Figure 1-10. Hot Gas Valve - Cooling Flow

Heat and Defrost Operation (See Figure 1-11.)

When the hot gas solenoid coil is energized, discharge gas flows to the evaporator for heating or defrost. When energized, the solenoid plunger is lifted, allowing discharge gas to fill the volume above the piston assembly. Discharge gas is also allowed to fill the volume below the piston assembly through the compressor discharge connection. The pressure on both sides of the piston assembly is now equal and the piston spring exerts a force on top of the piston assembly and shifts it downward. The condenser port is now closed and the evaporator port is open. In both the energized and de-energized positions, the bypass of discharge gas to the suction port is prevented.

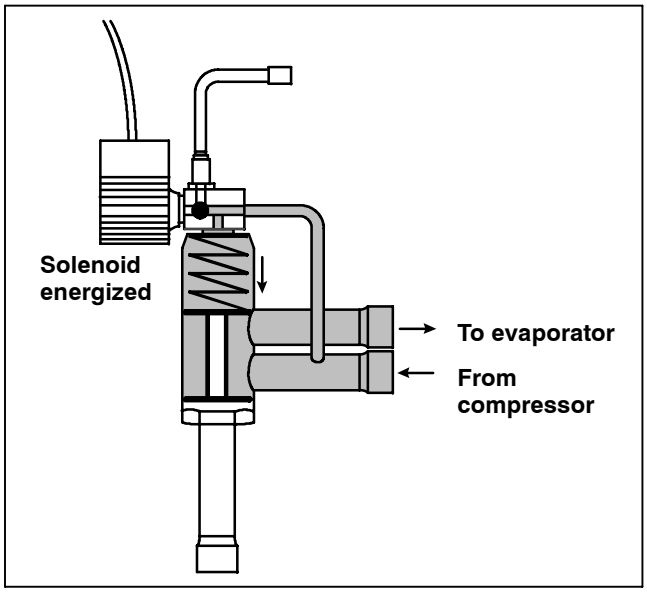


Figure 1-11. Hot Gas Valve - Heat and Defrost Flow

g. Hot Gas Bypass Solenoid Valve (except 950)

The hot gas bypass solenoid valve (HGS2) opens during heating and allows the compressor to draw vapor from the top of the receiver resulting in increased heating capacity.

h. Filter Drier

The drier is cylinder shell containing a drying agent and screen. It is installed in the liquid line and functions to keep the system clean and remove moisture from the refrigerant. A sight glass may also be installed downstream of the drier. The sight glass is fitted with a paper element that changes color to indicate moisture content.

i. Receiver

Liquid refrigerant from the condenser drains into the receiver. The receiver serves as a liquid reservoir when there are surges due to load changes in the system; as a storage space when pumping down the system and as a liquid seal against the entrance of refrigerant gas into the liquid line.
The receiver is provided with two bullseye sight glasses, for the observation of liquid level, and a pressure relief valve.

1.4 EVAPORATOR SECTION

The evaporator section contains the evaporator coil, expansion valve (TXV), heat exchanger, defrost termination thermostat(s) and electrical evaporator fan motors.

1.4.1 Thermal Expansion Valve

The thermal expansion valve is an automatic device which controls the flow of liquid to the evaporator according to changes in superheat to the refrigerant leaving the evaporator. The thermal expansion valve maintains a relatively constant degree of superheat in the gas leaving the evaporator regardless of suction pressure. Thus, the valve has a dual function; automatic expansion control and prevention of liquid return to the compressor.

1.4.2 Heat Exchanger

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

1.4.3 Evaporator Coil

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

1.4.4 Electric and Water Heat

The unit can be equipped with Electric Heat, Water Heat, and Electric/Water heat. See Figure 1-12. When the controller calls for heat, the heater contactor will close or valve will open and engage the heat system.

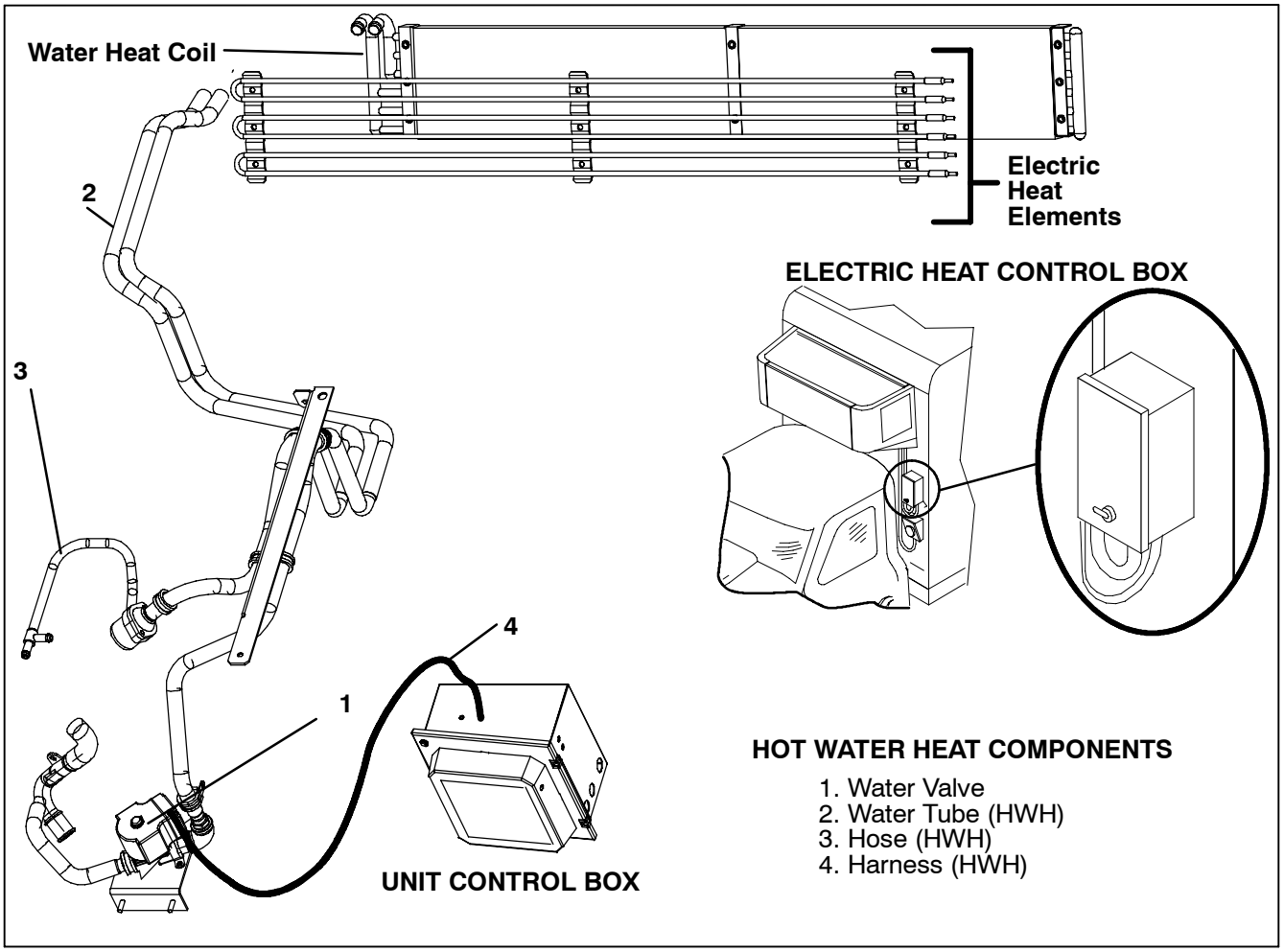


Figure 1-12. Water and Electric Heat Components

1.5 SYSTEM OPERATING CONTROLS AND COMPONENTS

The unit is furnished with a microprocessor control system. Once the set point is entered at the controller, 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.

Units also have a auto start/stop feature. Auto start/stop operation provides automatic cycling of the diesel engine or standby motor, which in turn offers an energy efficient alternative to continuous operation.

1.5.1 Switches And Controls

Manual control switches are located on the side of the electrical box. Components required for monitoring and controlling the diesel engine and refrigeration system are located on the engine, compressor or system piping.

1. RUN/STOP Switch (RSS)

This switch controls the supply of power to the microprocessor and cab command. The switch is placed in the ON position to allow manual or automatic unit operation. With the switch in the OFF position, the unit will be shut down and neither manual or automatic starting is allowed.

2. Manual Glow/Crank Switch (MGC) **If Equipped**

If the unit is equipped with a Manual Glow/Crank Switch, it is a three–position switch. This switch is held in the GLOW position to energize the glow plugs and pre-heat the combustion chamber. The switch is moved to the CRANK position to manually engage the engine starter. When the switch is released, it returns to the middle position to de-energize both components.

3. Oil Pressure Safety Switch (OP)

This switch will automatically stop the engine upon loss of oil pressure. The switch is located on the side of the engine.

4. Water Temperature Sensor (WTS)

The microprocessor will stop the unit when this sensor signals a high water temperature condition. The sensor is located on the engine cylinder head.

5. High Pressure Cutout Switch (HP1)

This switch will automatically stop the engine when compressor discharge pressure exceeds the set point. The switch is located on the compressor cylinder head.

6. High Pressure Cutout Switch (HP2) (850 Only)

This switch is used to unload the compressor in high ambient conditions.

7. Compressor Discharge Temperature Sensor (CDT) (except for 850)

The microprocessor will stop the unit when this sensor signals a high discharge temperature condition. The sensor is located on the compressor center head.

8. Compressor Suction Pressure Transducer (SPT)

The Compressor Suction Pressure Transducer signal is used by the microprocessor in the compressor protection logic to protect the compressor under excessive suction pressure conditions and under excessively low suction pressure conditions. The sensor is located on the compressor body for all units except 850. It is located in the suction line for 850 units.

9. Ambient Temperature Sensor (ATS) (950 Only)

The Ambient Temperature Sensor signal is used by the microprocessor in the compressor protection logic to determine expected conditions. It is located between the condenser and the front grille.

10. Temperature control sensors

Box temperature is controlled by one or two sensors:

•RAS: Measures return air to the evaporator

•SAS (optional): Measures supply air to the evaporator and is also used in heat option kits as an overtemperature safety sensor.

1.6 UNIT SPECIFICATIONS

1.6.1 Engine Data

Lubrication System

Lube Oil Viscosity: (API Classification CD)

Outdoor Temperature		**SAE**	**Delvac 1**
Fahrenheit	**Centigrade**		
Below 32°	Below 0°C	10W or 10W30	15W40
32° to 77°F	0° to 25°C	20W	
Over 77°F	Over +25°C	30W or 15W40	

Table 1-6 Engine Data For Supra 550		
Engine Model		**CT2-29TV (Z482)**
Displacement		29.2 in^3 (479 cc)
No. Cylinders		2
Horsepower		8.5 hp (6.3 kW) @2400rpm
Weight		117 lbs (53 kg)
Coolant Capacity		4.0 quarts (3.8 liters) **Without EWHS**
		4.5 quarts (4.3 liters) - **With EWHS**
		Use 50/50 to 60/40 ethylene glycol/water mix, standard or Shell Dexcool extended life antifreeze
Oil Capacity		6.0 quarts (5.7 liters) - **Without Bypass**
		7.0 quarts (6.6 liters) - **With Bypass**
Operating Speeds	**High**	2300 - 2350 rpm
	Low	1800 to 1850 rpm
Injection Setting		1991 to 2133 psig (135 to 145 Bars)
Oil Pressure Switch		Closes at: 18 ± 3 psig (1.2 ± 0.2 Bar)
Glow Plug		0.9 ohms at 11 volts.
Fuel Heater Thermostat		Closes on temperature falls at 45± 6.5°F (7.2± 1.17° C) Opens on temperature rise at: 75± 6.5°F (24 ±1.17° C)

Table 1-7 Engine Data For Supra 650/750/850		
Engine Model		**CT3-44TV**
Displacement		43.9 in^3 (719 cc)
No. Cylinders		3
Horsepower		15.5 hp (11.6 kW) @2400rpm
Weight		139 lbs (63 kg)
Coolant Capacity		3.9 quarts (3.7 liters) - **Without EWHS**
		4.5 quarts (4.3 liters) - **With EWHS**
		Use 50/50 to 60/40 ethylene glycol/water mix, standard or extended life antifreeze
Oil Capacity		7.8 U.S. quarts (7.4 liters) – **Without Bypass**
		8.8 U.S. quarts (8.3 liters) – **With Bypass**
Operating Speeds	**High**	**650**: 2200 to 2250 rpm **750** Prior to Serial Number KFW90913748; 2200 – 2250. Beginning with Serial Number KFW90913748; 2400 – 2450 **850**: 2300 to 2350 rpm
	Low	1800 to 1850 rpm
Injection Setting		1991 to 2133 psi (135 to 145 Bars)
Oil Pressure Switch		Closes at: 18 +/– 3 psig (1.22 +/– 0.2 Bar)
Glow Plug		1.4 ohms at 11 volts.
Fuel Heater Thermostat		Closes on temperature falls at 45 +/– 6.5°F (7.2 +/–1.17° C) Opens on temperature rise at: 75 +/– 6.5°F (24 +/–1.17° C)

Table 1-8 Engine Data For Supra 950		
Engine Model		**CT3-69TV (D1105)**
Displacement		68.5 in^3 (1123 cc)
No. Cylinders		3
Horsepower		20hp (14.9kW) @ 2400rpm
Weight		214 lbs (97 kg)
Coolant Capacity		4.5 quarts (4.3 liters)
		Use 50/50 to 60/40 ethylene glycol/water mix, standard or extended life antifreeze
Oil Capacity		10 quarts (9.46 liters)
Operating Speeds	**High**	2200 to 2250 rpm
	Low	1800 to 1850 rpm
Injection Setting		1991 to 2133 psi (135 to 145 Bars)
Oil Pressure Switch		Closes at: 18 +/– 3 psig (1.2 +/– 0.2 Bar)
Glow Plug		0.9 ohms at 11 volts.
Fuel Heater Thermostat		Closes on temperature falls at 45 +/– 6.5°F (7.2 +/–1.17° C) Opens on temperature rise at: 75 +/– 6.5°F (24 +/–1.17° C)

1.6.2 Compressor Data

Model (Unit)	05K 012 (550/650/750)	05K 024 (850)	05G37 (950)
Displacement	12.2 in^3 (200 cc)	24.4 in^3 (400 cc)	37 in^3 (600 cc)
No. Cylinders	2	4	6
No. Unloaders	0	1	1
Weight	84 lbs (38 kg)	108 lbs (49 kg)	137lbs (62 kg)
Oil Charge	4.0 pints (1.9 L)	5.5 pts (2.6 L)	6.75 pts (3.2)

APPROVED COMPRESSOR OIL	
Refrigerant	**05G/05K**
R-404A	Mobile Arctic EAL 68
	Castrol Icematic SW-68C

a. High Pressure Cutout Switches

HP1

Cutout at: 465 +/- 10 psig (32.7 +/- 0.7 kg/cm^2)

Cut-in at: 350 +/- 10 psig (24.6 +/- 0.7 kg/cm^2)

HP2 850 Only

Cutout at: 367 +/- 12 psig (25 +/- 0.8 kg/cm^2)

Cut-in at: 440 +/- 10 psig (29.9 +/- 0.7 kg/cm^2)

b. Compressor Discharge Temperature Sensor (CDT)

This is a thermistor type sensor located (when installed) on the compressor discharge cover.

Unit shuts down:

- If ambient is less than 120°F (50°C) AND
  Temperature exceeds 310°F (154°C) for 3 min
- If ambient is greater than 120°F (50°C) AND
  Temperature exceeds 340°F (171°C) for 3 min
- Immediately shuts down in all ambients
  If temperature exceeds 350°F (177°C)

1.6.3 Refrigeration System Data

a. Defrost Timer

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

b. Defrost Thermostat

Opens at: 47° +/- 5°F (8° +/- 3°C)
Closes at: 37° +/- 5°F (3° +/- 3°C)

c. Defrost Air Switch Setting

550/650/750; Initiates at: 1.00 +/- .07 inch (25.4 ± 1.8 mm) wg

850/950; Initiates at: 0.70 +/- .07 inch (17.8 +/- 1.8 mm) wg

d. Refrigerant Charge

Refer to Table 1-1

e. Compressor Pressure Regulating Valve (CPR)

MODEL	CPR Setting psig	CPR Setting Bars
SUPRA 550	34 +/- 1	2.3 +/- 0.07
SUPRA 650	28 +/- 1	1.91 +/- 0.07
SUPRA 750	32 +/- 1	2.18 +/- 0.07
SUPRA 850/950	29 +/- 1	1.97 +/- 0.07

f. Thermostatic Expansion Valve Superheat

Setting at 0°F (-17.8°C) box temperature: 8-10°F (-13.3 to -12.2°C)

1.6.4 Electrical Data

a. Evaporator Fan Motors

Bearing Lubrication: Factory lubricated, additional grease not required

Horsepower	Operating Current	Speed	Voltage
0.13hp (100W)	10.8 amps	2800 to 3000 rpm	12 vdc

b. Standby Motors

Bearing Lubrication: Factory lubricated additional grease not required

Rotation Speed: 1760 rpm@ 60Hz/1500 rpm@ 50Hz

Voltage	Connection Type	Power	Full Load Amps
3ph, 60 Hz		HP	
SUPRA 550			
230	Δ	7.6	20
460	Y		14
SUPRA 650/750			
230	Δ	7.6	23
460	Y		13
SUPRA 850			
230	Δ	8.3	19.6
460	Y		9.8
SUPRA 950			
230	Δ	8.3	32
460	Y		23

c. Alternator: 70 amps

d. Standby Motor Overload

MODEL	SETTING	
	230V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz
650/750	20 AMPS	14 AMPS
850	21 AMPS	
950	32 AMPS	23 AMPS

1.6.5 TORQUE VALUES

Assembly	ft-lb	Nm
Power Tray to Frame	40	54.2
Standby Motor to Power Tray	22-28	30-44
Engine to Power Tray	50	67.8
Compressor to Power Tray	45-55	61-75
Standby Motor Pulley	175 inlbs	19.8
Engine Pulley	22	29.8
Compressor Pulley	22	29.8
Evaporator Fan Motor	13	17.6
Evaporator Fan Grille	7	9.5
Condenser Coil to Chassis	7	9.5
Tensioner to Power Tray	22	29.8
Engine Support	40	54.2
Run & Speed Solenoids	7	9.5
Condenser Fan Blade	18	24.4
Engine Clutch	40	54.2
Suction Service Valve	22-25	30-34

1.7 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions by automatically shutting down the unit when such conditions occur. This is accomplished by the safety devices listed in Table 1-9.

Table 1-9. Safety Devices – Microprocessor Controller

Unsafe Conditions	Safety Device	Device Setting
1. Low engine lubricating oil pressure	Oil pressure safety switch (OP) automatic reset	Opens below 18 ± 3 psig (1.2 ± 0.2 Bar)
2. High engine coolant temperature	Water temperature sensor (microprocessor)	Opens above 230 ± 5°F (110 ± 3°C)
3. Excessive current draw by glow plug circuit, control circuit or starter solenoid (SS)	Fuse (F1)	Opens at 80 amps
4. Excessive current draw by run control relay.	Fuse (F2)	Opens at 5 amps
5. Excessive current draw by run relay	Fuse (F3)	Opens at 15 amps
6. Excessive current draw heat relay	Fuse (F4)	Opens at 5 amps
7. Excessive current draw by speed relay	Fuse (F5)	Opens at 10 amps
7. Excessive current draw by unloader	Fuse (F6) **(850 and 950 Only)**	Opens at 5 amps
8. Excessive current draw by defrost damper relay	Fuse (F7) **(950 Only)**	Opens at 15 amps
8. Excessive current draw by evaporator fan motors	Fuse (F8, F9, F10)	Opens at 20 amps
9. Excessive current draw by fuel pump	Fuse (F11)	Opens at 5 amps
10. Excessive compressor discharge pressure	High pressure cutout switch (HP) automatic reset	Refer to Section 1.6.3.a.
11. Excessive compressor discharge temperature	Compressor discharge temperature sensor (CDT)	Shuts unit down above 310°F (154°C) for 3 minutes or 350°F (177°C)
12. Excessive current draw by fuel heater circuit (option)	Fuse (F12)	Opens at 25 amps

1.8 REFRIGERANT CIRCUIT

1.8.1 Cooling (See Figure 1-13)

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

In the cooling mode, the hot gas valve is de-energized. With the hot gas valve de-energized, flow through the valve is from the side discharge connection to the bottom condenser connection.

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air over the outside of the condenser tubes. Heat transfer is thus established from the refrigerant gas (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat. This removal of heat causes the refrigerant to liquefy; liquid refrigerant flows from the condenser and, except for the 950, through a check valve to the receiver.

The receiver stores the additional charge necessary for low ambient operation and for heating and defrost modes.

The refrigerant leaves the receiver and flows through a manual receiver shutoff valve (king valve) to the subcooler. The subcooler occupies a portion of the main condensing coil surface and gives off further heat to the passing air.

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

The refrigerant then flows 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 (TXV) which reduces the pressure of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

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

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize.

This low temperature, low pressure vapor passes 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 accumulator.

The compressor draws this vapor out of the accumulator through a pick-up tube which is equipped with a metering orifice. This orifice prevents the accumulation of oil in the accumulator tank. The metering orifice is calibrated to control the rate of oil flowing back to the compressor.

The vapor refrigerant then enters the compressor pressure regulating valve (CPR) which regulates refrigerant pressure entering the compressor, where the cycle starts over.

1.8.2 Heat And Defrost (See Figure 1-13)

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

When the controller calls for heating or defrost, the hot gas valve solenoid energizes, closing the port to the condenser and opening a port which allows heated refrigerant vapor to flow through the drainpan heater tube to the evaporator coil.

The hot gas bypass solenoid valve (not on 950) also opens during heating to provide additional refrigerant to the compressor from the receiver. This increases the amount of refrigerant in circulation, increasing heating capacity.

The main difference between heating and defrosting is that, when in heating all the evaporator fans continue to run, blowing the air over the heated coils to heat the product. When defrosting, the evaporator fans stop, allowing the heated vapor to defrost any ice build up there maybe.

The bypass line draws refrigerant from the receiver and injects it through a metered valve into the suction line past the compressor pressure regulator valve. This will raise the discharge pressure and temperature.

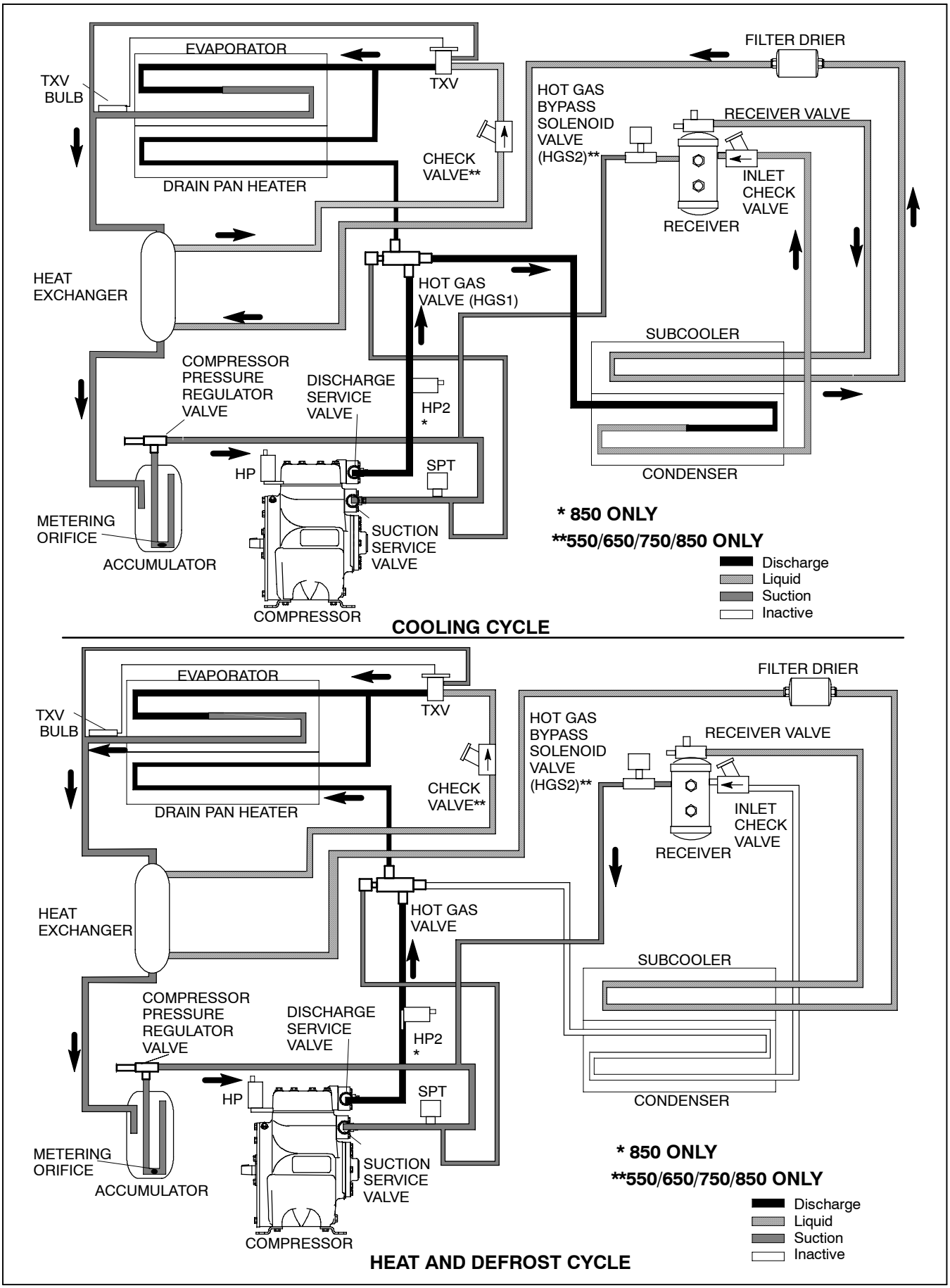


Figure 1-13. Refrigeration Circuit

SECTION 2

OPERATION

2.1 MICROPROCESSOR CONTROLLER

2.1.1 Introduction

⚠ 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.

The Microprocessor System consists of the microprocessor module (Item 10, Figure 1-4), relay/fuse board (Item 7, Figure 1-4), Cab Command Figure 2-1 and interconnecting wiring.

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

b. The Relay Board contains replaceable relays, diodes and fuses.

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

The Carrier Transicold Microprocessor System 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.

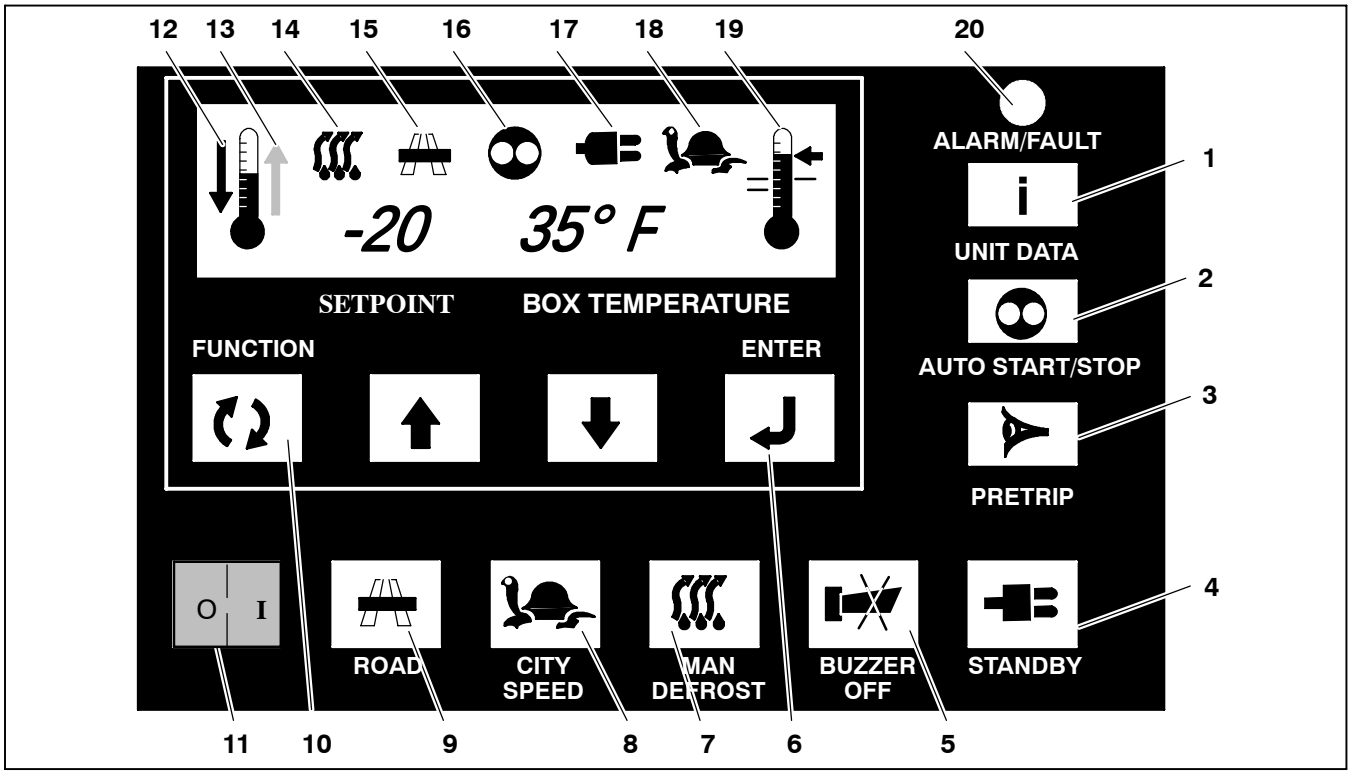
b. Default independent readouts of set point (at the left of the display) and actual supply or return air temperature (at the right).

c. Digital readout of unit data points such as pressures, temperatures and other microprocessor inputs.

d. Digital readout of selectable operating parameters (Function Codes) and the ability to change those settings.

e. Digital display of Alarm Indications.

f. A self-test check on program memory and data memory at start-up.



1. Unit Data Key
2. Auto Start/Stop - Continuous Run Key
3. Pretrip Key
4. Stand-by Key
5. Buzzer Off Key
6. Enter Key
7. Manual Defrost Key
8. City Speed Key
9. Road Key
10. Function Key
11. I/O Switch
12. Cool Mode
13. Heat Mode
14. Defrost Mode
15 Road Mode
16. Auto Start/Stop Mode
17. Stand-by Mode
18. City Speed Mode
19. Out-of-range
20. Fault Light

Figure 2-1. Cab Command

g. A Pre-Trip checkout of refrigeration unit operation.

h. An optional RS232 communication port 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 the Carrier Communication Protocol. The microprocessor will transmit a HUGHES protocol packet every hour. Transmission with the Carrier or QualComm protocol is by request.

2.2 MICROPROCESSOR CONFIGURATION

The microprocessor is configured in accordance with the equipment supplied on an individual unit and the requirements of the original purchase order. The configurations do not require change unless the unit has an equipment change or a change is required by the owner. Although the configurations may not be modified using the keypad, operational differences will be noted throughout the following descriptions and operating procedures. See NO TAG for list of microprocessor configurations.

Some microprocessor settings such as setpoint and functional parameters may be changed at the keypad and are described in the following sections.

2.3 DESCRIPTION OF MICROPROCESSOR COMPONENTS

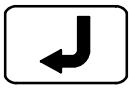
2.3.1 Keypad

The keypad (Figure 2-1) has 12 keys which allow the operator to initiate various functions, display operating data and change operating parameters.

Arrow Keys

The up and down ARROW keys are used to modify (increment or decrement) the displayed data. If the unit is in the default display these keys are pressed to change the setpoint selection.

Enter Key



The ENTER key is used to accept a change in function codes or a change in setpoint.

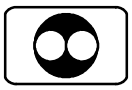
Manual Defrost Key

The MANUAL DEFROST key is used to initiate a defrost cycle. If the predetermined conditions for defrost are not met, the unit will not enter defrost and the display will return to the default screen.

Pretrip Check Key

The *PRETRIP* key is used to initiate a pretrip test cycle. If the predetermined conditions for pretrip are not met, the unit will not enter pretrip and the display will return to the default screen.

Auto Start/Stop - Auto Start/Continuous Run Key



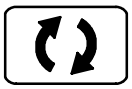
The AUTO START/STOP key is used to change the operating mode from "Continuous Run" to "Auto Start/Stop." Each push of the key will alternate the operating modes. The microprocessor retains the last entered setpoint in memory even if the unit is shut down or a power failure occures. The Auto Start/Stop indicator on the display will illuminate when Auto Stop/Start is enabled. If the indicator is not illuminated, the unit is in the Continuous Run Mode.

To start the unit in manual start mode, the auto start/-stop-continuous selection must be in continuous run mode and the Auto/Manual Start Operation function parameter set to "MAN OP" (FN10 OFF)

NOTE

When configuration CNF11 is "ON" and setpoint is 32 to 42° F (0 to 5.5°C) the unit is locked into continuous run. The AUTO START/STOP key is disabled.

Function Change Key



The FUNCTION CHANGE key is used to display the function codes. Each time this key is pressed the display will advance to the next code. This key, in conjunction with the ARROW and ENTER keys, will allow the user to change the Function Parameters. See Section 2.4.10 for more detailed information.

Unit Data Key

The UNIT DATA key is used to display the unit operating data. This key, in conjunction with the *ARROW* keys, will allow the user to display the unit's operating data values (i.e, coolant temperature, battery voltage, etc.) See Section 2.4.11 for more detailed information.

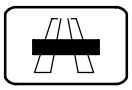
City Speed Key

The CITY SPEED key enables the city speed mode of operation. In the city speed mode, the unit will operate in low speed. Each push of the key toggles the operating mode. The microprocessor retains the last entered setpoint in memory even if the unit is shut down or a power failure occures. The city speed indicator on the display will illuminate when the city speed mode is enabled.

Buzzer Off Key

The BUZZER OFF key will disable the cab command buzzer. When not disabled by use of this key, the buzzer is activated whenever the alarm/fault indicator is illuminated. The buzzer off indicator on the display will illuminate when the buzzer is disabled.

Road Key

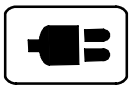


The ROAD key selects the diesel engine operating mode. The microprocessor retains the last entered setpoint in memory even if the unit is shut down or a power failure occures.

NOTE

When functional parameter "FN10" is set for time start, the unit optional auto diesel restart is active and the Road key will be flashing.

Stand-by Key



The STAND-BY key selects the electric motor operating mode. The microprocessor retains the last entered setpoint in memory even if the unit is shut down or a power failure occures. "NO POWER" will be displayed, if unit is switched to standby and power is not available.

2.3.2 Digital Display

The digital display (see Figure 2-1) has nine positions. The default display is setpoint on the left and actual supply or return air temperature on the right. The readout may be set to read in Degrees F or Degrees C.

The display also has symbol –type indicators for the following modes: Cool, Heat, Defrost, Road (diesel) Operation, Auto Start/Stop mode, Stand-By mode, City Speed mode and Out-Of-Range operation. The indicator is illuminated to indicate the mode or condition is active.

On each power-up, the microprocessor will perform a self test. Errors, if any, will be indicated on the display as an EER.# where "#" is a number corresponding to the number of the failed test.

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.

2.4 OPERATION

2.4.1 Pre-Trip Inspection

a. Pre-Trip Inspection - Before Starting

Before starting engine check the following points:

1. Drain water and sediment from fuel tank sump. Then fill tank with diesel fuel.
2. Drain water from fuel filter separator (if applicable).
3. Check radiator coolant level. Antifreeze should be adjusted for climate conditions, minimum 50/50 mixture, maximum 60/40 mixture.
4. Check condenser/radiator coil for cleanliness.
5. Check air cleaner and hoses.
6. Check Defrost Air Switch and hoses.
7. Check engine oil level.
8. Check condition and tension of all belts.
9. Check all fan and idler bearings.
10. Check door latches and hinges.
11. Check condition of condenser fan blades.
12. Check battery fluid level (if applicable)
13. Check battery cables and terminals
14. Check evaporator coil for cleanliness.
15. Check evaporator fan
16. Check air chute (if applicable)
17. Check bulkhead and return air screens (if applicable)
18. Check defrost water drains
19. Check glow plugs

b. Pre-Trip Inspection - Starting

Start the unit in continuous run. Refer to Sections 2.4.2 or 2.4.4

c. Pre-Trip Inspection - After Starting

After starting engine check the following points:

1. Check electric fuel pump.
2. Check fuel lines and filters for leaks.
3. Check oil lines and filters for leaks.
4. Check coolant hoses for leaks.
5. Check exhaust system for leaks.
6. Check condenser and evaporator fans for proper air flow.
7. Initiate Pre-Trip and monitor all operating modes. Check unloader operation (850 and 950).

d. After operating unit 15 minutes or more:

8. Check water temperature. Should be 160 to 175°F (72 to 80°C)
9. Check refrigerant level. (Refer to section 4.7)
10. Check compressor oil level. (Refer to section 4.9)
11. Put unit into manual defrost and monitor. Allow unit to terminate defrost automatically.

12 Change over to desired operating mode, enter set point and change functional parameters as required to match the requirements of the load.

2.4.2 Starting - Road Operation

Place the I/O Switch in the "I" position. If the unit has been used previously in the standby mode, press the road operation button. Under normal circumstances this is all that is required to start the unit. The unit will then perform a complete diagnostic check on the microprocessor controller, pre-heat for the required amount of time based on the engine temperature and start automatically.

2.4.3 Starting - Standby Motor Drive

⚠ WARNING

Make sure the power plug is clean and dry before connecting to any power source.

Do not attempt to connect or remove power plug or perform service and/or maintenance before ensuring the unit RUN/STOP Switch is in the STOP position and the I/O Switch is in the "O" position.

a. Place the I/O (Cab Command) and unit RUN/ STOP Switches in the ON position and press the STANDBY key. The microprocessor will perform a self-test (all display messages will appear in display window). Then setpoint and box temperature will be displayed.

"NO POWER" will be displayed if unit is switched to STANDBY and power is not available.

b. Enter Set Point and change Functional Parameters to match the requirements of the load.

2.4.4 Manual Start

a. To start a unit equipped with a Manual Glow/Crank Switch, place the unit RUN/STOP Switch in the RUN position and the I/O Switch (Cab Command) to "I" position.

b. Manual operation will only function if unit is in Continuous Mode. If the AUTO START/STOP indicator on the cab command is illuminated, press the AUTO START/STOP key to place the unit in continuous run mode (indicator will not be illuminated).

c. Press the FUNCTION key until AUTO OP or MAN OP appears on the display. If MAN OP appears, proceed to step d. If AUTO OP appears:

1. Press the *Enter key*.
2. Press the *Up Or Down Arrow key* to bring MAN OP on the display.
3. Press the *Enter key*. To place the unit in the MANUAL START mode.

⚠ WARNING

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

d. Use the MANUAL GLOW/CRANK Switch to start the unit. Refer to Table 2-1 for required glow times.

Table 2-1. Manual Glow Time

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

e. Enter Set Point and change Functional Parameters to match the requirements of the load.

2.4.5 Pre-Trip

Pre-Trip is a test sequence that the operator may initiate to check unit operation. During Pre-Trip, the microprocessor operates the unit in various modes allowing evaluation of unit operation. If a failure occurs during Pre-Trip, the microprocessor will generate an alarm. The following steps detail the sequence:

a. The unit is operated to bring box temperature below 40°F (4.4°C).

b. The operator presses the PRETRIP key. If the defrost thermostat (DTT) is closed, the microprocessor will display "PPPP" and the test is started. If DTT is open, the test will end.

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

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

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

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

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

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

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

2.4.6 Setpoint

NOTE

If configuration CNF3 is "ON" maximum setpoint is increased to 90°F.

Setpoints of -22°F to +86°F (-30°C to +30°C) may be entered via the keypad.

With the default screen showing on the display, the up or down ARROW key may be pressed to bring the set point to the desired reading. The display will flash to indicate that the reading being displayed is a non-entered value.

Depress the ENTER key to activate the new setting.

If the ENTER key is not pressed within five seconds after the last key stroke, the display will revert to the previous active setting. The microprocessor retains the last entered setpoint in memory even if the unit is shut down or a power failure occurs.

2.4.7 Start/Stop Operation

After start up, observe the AUTO START/STOP indicator. If it is illuminated, the unit is in the Auto Start/Stop mode. If not, press the Auto Start/Stop key to toggle the unit into Auto Start/Stop mode.

Automatic start/stop is provided to permit starting/restarting of the diesel-driven compressor as required. This gives the microprocessor automatic control of starting and stopping the diesel engine. The main function of automatic start-stop is to turn off the refrigeration system near the setpoint to provide a fuel efficient temperature control system and then restart the engine when needed. Start-Stop operation is normally used for frozen loads.

Enter Set Point and change Functional Parameters to match the requirements of the load.

Whenever the unit starts in Auto Start-Stop, it will run until:

•It has run for the predetermined minimum run time.

•The engine coolant temperature is above 122°F (50°C)

•The box temperature is at setpoint.

The controller will not shut off the engine if the battery voltage is not sufficient to restart it. Battery voltage above approximately 13.4 volts is required for shutdown. This varies depending on ambient. Look at battery voltage in data list to find out whether shutdown voltage has been reached. If there is a "+" in front of the number, the voltage is enough to shutdown and restart. If only the number appears, the voltage is still too low for shutdown.

The controller will restart the engine if any of the following criteria have been met:

•Box temperature has changed by +/- 11°F (+/- 6.1°C) for setpoints in the perishable range and +11° F (+6.1°C) for setpoints in the frozen range **DURING** minimum off time.

•Box temperature has moved away from setpoint by +/- 3.6°F (2.0°C) **AFTER** minimum off time for setpoints in the perishable range or +0.5°F (0.3°C) for setpoints in the frozen range.

•The battery voltage drops below 12.2 VDC Refer to Table 2-2 for unit data).

•The engine coolant temperature drops below 34°F (1°C).

To start the unit in manual start mode, the unit must be in continuous run mode and the Auto/Manual Start Operation function parameter set to "MAN OP" (FN10 OFF)

NOTE

When configuration CNF11 is "ON" and setpoint is 32 to 42° F (0 to 5.5°C) the unit is locked into continuous run. The AUTO START/STOP key is disabled.

NOTE

Auto Start-Stop operation may be tied to the setpoint ranges for frozen and perishable loads and the AUTO START/STOP key may be locked out.

2.4.8 Continuous Run Operation

After start up, observe the AUTO START/STOP indicator. If it is illuminated, the unit is in the Auto Start/Stop mode . If Continuous Run operation (unit will operate continuously after starting) is desired, press the Auto Start/Stop key to change the operation to Continuous Run.

In the Continuous Run mode, the diesel engine will run continuously providing constant air flow and temperature control to the product. Continuous Run operation is normally used for perishable loads.

Continuous operation may be tied to the setpoint ranges for frozen and perishable loads and the AUTO START/STOP key may be locked out.

The unit will remain in low speed for 10 minutes after engine start-up when the Continuous Run setpoint is below 10°F (-12°C).

Enter Set Point and change Functional Parameters to match the requirements of the load.

2.4.9 Defrost Cycle

Defrost is an independent cycle overriding cooling and heating functions to de-ice the evaporator as required.

For manual initiation, check that the box temperature is 40°F (4.4°C) or lower and press the MANUAL DEFROST key.

The microprocessor will displays "DF" on the right of the display during defrost mode . The left display will continue to display the setpoint. Defrost may be terminated in any of three ways; timer initiation, air switch initiation and manually.

Refer to Section 3.1.6 for a more detailed description of the defrost cycle.

2.4.10 Functional Parameters

NOTE

If configuration CNF11 is "ON" functional parameters are locked out and the ability to change functional parameters from keypad is disabled.

The Function Parameters control selected operating features of the unit. These parameters can be displayed by pressing the FUNCTION CHANGE key. When multiple choices are available, the display will show the function description on the left side with the corresponding function choice on the right side. The list can be scrolled through by pressing the FUNCTION CHANGE key or by using the *ARROW keys*. With each FUNCTION CHANGE key push, the list is advanced one. If the FUNCTION CHANGE key is pressed and held for one second, the list will scroll at a rate of one item every 0.5 seconds. Once the end of the list is reached the list will scroll back to the first entry.

With a function parameter displayed, the data choice can be changed by pressing ENTER then pressing either the up or down ARROW keys. The displayed choice will then flash to indicate that the choice has not been entered. Depress the ENTER key to activate the new choice. The display will stop flashing to indicate that the choice has been entered.

If the new choice is not entered in 5 seconds, the display will revert back to the last entered choice. All function parameters are retained in memory. Descriptions of the function parameters and operator choices are provided in the following paragraphs. A function parameter listing is also provided in Table 2-1.

Defrost Interval

The English display for Defrost Interval is "DEFR" the code display is "FN0." The choices are displayed with one decimal place and then the capital letter H for hours (i.e., DEFR 12.0H). The defrost choices are 1.5, 3, 6 or 12 hours.

Speed Control

The Speed Control parameter overrides the normal microprocessor speed control solenoid operation. Parameter English displays are "CITY SPD" or "HIGH SPD." The code displays are "FN1 ON" or "FN1 OFF." With "CITY SPD" or "FN1 ON" displayed the unit is locked into low speed. With "HIGH SPD" or "FN1 OFF" displayed, speed is under normal microprocessor control.

Minimum Off-Time

The auto start mode Minimum Off-Time parameter English display is "OFF T" the code display is "FN2." The choice for the off-time is displayed with two digits and then the capital letter M for minutes (i.e. OFF T 20M or FN2 20M). The off-time choices are 10, 20, 30, 45 or 90 minutes.

Minimum On-Time

The auto start mode Minimum On-Time parameter English display is "ON T." The code display is "FN3." The choice for the on-time is displayed with two digits and then the capital letter M for minutes (i.e. ON T4 M).The on-time choices are 1 or 4 minutes.

Controlling Probe

The Controlling Probe parameter English displays are "REM PROBE" or "SUP PROBE." The code displays are "FN4 A" or "FN4 B." With "REM PROBE" or "FN4 A" displayed, the microprocessor is set for operation with a single probe sensing return air temperature. With "SUP PROBE" or "FN4 B" displayed, the microprocessor is set for dual probe (supply air or return air) control.

Standard Units Select

The Standard Unit Select parameter allows selection of English or metric data display. The English display is DEGREES F or C. The code display is FN5. The choices are°C and °F. This parameter will also convert pressure readings to psig or bars.

Maximum Off Time

The auto start mode Maximum Off Time English display is "TIME START" or "TEMP START" the code display is "FN6 ON" or "FN6 OFF." With "TIME START" or "FN6 ON" displayed the engine will be started 30 minutes after shutdown. With "TEMP START" or "FN6 OFF" displayed the engine will be under normal microprocessor temperature control.

Diesel Backup Feature:

If the unit is in standby mode and AC power is lost for five minutes or more, the diesel engine will start and run until AC power is restored and applied for five minutes. The ROAD icon will blink once every second while the PLUG icon will stay on constantly to indicate that this feature is active.

When the five minute shutdown timer expires and AC power is present, the unit will shut down the diesel engine and restart the standby motor. If AC power is NOT present, the diesel engine will operate.

If the unit is set to "TEMP START" the standby diesel back up feature will be turned off and the unit will operate in normal standby mode.

MOP STD - Future Expansion

Used to add or subtract 5psig (0.34 Bar) to unloader equations. English display is "MOP STD." The code display is "FN7"

Compartment 2 Setpoint - N/A

English display is "2SET." The code display is "FN8"

Compartment 3 Setpoint - N/A

English display is "3SET." The code display is "FN9"

Auto/Manual Start Operation

The English displays for Auto/Manual Start Operation are "AUTO OP" and "MAN OP." The code displays are "FN10 ON" and "FN10 OFF." With "AUTO OP" or "FN10 ON" displayed the unit will be in the Auto Start/Stop Operation mode. With "MAN OP" or "FN10 OFF" displayed the unit will be in the Manual Start mode.

To start the unit in manual start mode, the Auto Start/-Stop - Continuous Run selection must be in "continuous run" mode.

Out-of-Range Tolerance

NOTE

If configuration CNF9 is "ON" the unit will shut down if an out of tolerance condition exists for over 45 minutes. If configuration CNF9 is "OFF" and an out of tolerance condition exists, the unit will continue to operate but generate Alarm 20 (RAS OUT).

The English display for Out-Of-Range Temperature Tolerance is "T RANGE." The code display is FN11. The choices are A, B or C. A = 3.6°F(2°C), B = 5.4°F(3°C) and C = 7.2°F (4°C).

When the out-of-range temperature is configured ON, the microprocessor 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 microprocessor 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 at or below +10°F (-12.2°C) *frozen range* the unit is only considered out-of-range for temperatures above set point.

Code Vs English Messages

The function descriptions, unit status and alarms can be displayed in English or codes through this function selection. The choices are displayed as "ENGLISH" or "CODES." Refer to Table 2-1 for a listing of the display readings when the English or Code choice is activated.

Manual Glow Override

The auto start glow time can be manually overridden through this function. The choices are displayed as "NORM GLOW" or "ADD GLOW." If the "ADD GLOW" selection is entered, the control will add additional glow time.

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. If "ALARM CLR" is displayed then there are no alarms present.

2.4.11 Unit Data

The UNIT DATA key can be used to display the microprocessor input data values. The display will show the description of the input on the left side with the actual data on the right side. The unit data list can be scrolled through by pressing the UNIT DATA key. With each successive key push, the list is advanced one. If the UNIT DATA, or an ARROW key is held for one second, the list will scroll at a rate of one item every 0.5 seconds. Once the end of the list is reached, the list will scroll back to the first entry. The display will revert back to the default display if no keys are pressed for 5 seconds.

If the ENTER key is pressed, the display time will be increased to 30 seconds. A description of the unit data readings is provided in the following paragraphs. A Unit Data listing is provided in Table 2-2.

Table 2-1. Functional Parameters

CODE	ENGLISH	DATA
FN0	DEFR	Defrost Interval
FN1 ON	CITY SPD	Low Speed
FN1 OFF	HIGH SPD	High Speed
FN2	OFF T	Minimum Off-time
FN3	ON T	On-time
FN4 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	Unloader control
FN8	2SET	N/A
FN9	3SET	N/A
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 RST = Alarm Reset Required Alarm CLR = No Alarm Active		

TABLE 2-2. 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	N/A
CD17	3RA	N/A
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 English display for Suction Pressure is “SUCT,” the code display is “CD1.” The English units are designated by a “P” (psig) following the reading while the metric are designated by a “B” (bars). English readings below 0 are in inches of mercury. The display range is -0.7 to 29.4 Bar (-20 hg to 420 psig).

Engine Hours

The English display for Engine Hours is “ENG,” the code display is “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 English display for Engine Temperature is “WT,” the code display is “CD3.” The English units are designated by an “F” following the reading (i.e, WT 185.0F or CD3 185.0F) while the metric are designated by a “C” (i.e, WT 85.0C or CD3 85.0C). The display range is 10°F to 266°F (-12°C to 130°C).

Return Air Temperature

The English display for Return Air Temperature is “RAS,” the code display is “CD4.” The English units are designated by an “F” following the reading (i.e, RAS 35.0F or CD4 35.0F) while the metric are designated by a “C” (i.e, RAS 1.7C or CD4 1.7C). The display range is 10°F to 266°F (-12°C to 130°C).

Supply Air Temperature

The English display for Supply Air Temperature is “SAS,” the code display is “CD5.” The English units are designated by an “F” following the reading (i.e, SAS 35.0F or CD5 35.0F) while the metric are designated by a “C” (i.e, SAS 1.7C or CD5 1.7C). The display range is -36°F to 158°F (-38°C to 70°C). The data will be displayed only if the SUP PROBE is selected in the controlling probe functional parameter.

Remote Air Temperature

The English display for Remote Air Temperature is “REM,” the code display is “CD6.” The English units are designated by an “F” following the reading (i.e, REM 35.0F or CD6 35.0F) while the metric are designated by a “C” (i.e, REM 1.7C or CD6 1.7C). The display range is -36°F to 158°F (-38°C to 70°C). The data will be displayed only if the REM PROBE is selected in the controlling probe functional parameter.

Ambient Temperature

The English display for Ambient Air Temperature is “ATS,” the code display is “CD7.” The English units are designated by an “F” following the reading (i.e, ATS 85.0F or CD7 85.0F) while the metric are designated by a “C” (i.e, ATS 29.4C or CD7 29.4C). The display range is-36°F to 158°F (-38°C to 70°C).

EVP - Future Expansion

This unit data is not used at this time. The English display is “EVP.” The code display is CD8.

Compressor Discharge Temperature

The English display for Compressor Discharge Temperature is “CDT,” the code display is “CD9.” The English units are designated by an “F” following the reading (i.e, CDT 185.0F or CD9 185.0F) while the metric are designated by a “C” (i.e, CDT 85.0C or CD9 85.0C). The display range is -40°F to 392°F (-40°C to 200°C).

Battery Voltage

The English display for Battery Voltage is “BATT,” the code display is “CD10.” The reading is displayed 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 acceptable for shut down and auto start mode.

Standby Hours

The English display for Standby Motor Hours is “SBY,” the code display is “CD11.” The data is displayed with 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 English display is “MOD V.” The code display is CD12.

Software Revision

The English display for the Eeprom Software Revision is "REV." The code display is "CD13." The actual Eeprom software revision number is displayed on the right. If the ENTER key is depressed for three seconds while the Eeprom Software Revision is displayed, the display will revert to the Board Mounted Software display. The English display will change to "REV U2" on the left and the actual board mounted software revision number will be displayed on the right.

Serial Number Low

The English display for the Low Serial Number of the Eeprom is "SERL" The code display is "CD14." The lower 3 digits of the Eeprom serial number will be displayed on the left. (i.e, SERL 504 or CD14 504).

Serial Number Upper

The English display for the Upper Serial Number of the Eeprom is "SERU" The code display is "CD15." The upper 3 digits of the Eeprom serial number will be displayed on the left. (i.e, SERH 001 or CD14 001).

Compartment 2 Air Temperature - N/A

The English display for the Second Compartment Air Temperature is "2RA," the code display is "CD16."

Compartment 3 Air Temperature

The English display for the Third Compartment Air Temperature is "3RA," the code display is "CD17."

Maintenance Hour Meter 1

The English display for the Maintenance Hour Meter 1 is "MHR 1," the code display is "CD18." The data is displayed with units designator H (i.e, MHR 1 5040H OR CD18 5040H). The display range is 0 to 99999. 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 English display for the Maintenance Hour Meter 2 is "MHR 2," the code display is "CD19." The data is displayed with units designator H (i.e, MHR 2 5040H OR CD19 5040H). The display range is 0 to 99999. 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 Switch On Hour Meter displays the total operating hours (engine & standby) on the unit. The English display for the Switch On Hour Meter is "SON," the code display is "CD20. The data is displayed with units designator H (i.e, SON 5040H OR CD20 5040H). The display range is 0 to 99999.

2.4.12 Alarm Display

When an alarm is generated, the display will alternate between the default display (setpoint/air temperature) and the active alarm(s). Each item will be displayed for 3 to 10 seconds and the display will continue to scroll through the items until the alarms are cleared. Refer to Section 2.4.10-Alarm Reset for the procedure on resetting alarms.

The fault light (FL) will be illuminated when selected alarms are generated. An alarm listing with indication of which alarms are accompanied by the fault light is provided in Table 2-2. A description of the alarms is provided in the following paragraphs.

Table 2-3. Alarm Display

ALARM DISPLAY ✓ = FAULT LIGHT ON		
CODE	ENGLISH	DESCRIPTION
AL0	ENG OIL	✓ Low Oil Pressure
AL1	ENG HOT	✓ High Coolant Temperature
AL2	HI PRESS	✓ High Discharge Pressure
AL3	STARTFAIL	✓ Auto Start Failure
AL4	LOW BATT	✓ Low Battery Voltage
AL5	HI BATT	✓ High Battery Voltage
AL6	DEFR FAIL	Defrost Override
AL7	ALT AUX	✓ No Alternator Auxiliary Output
AL8	STARTER	✓ Starter Motor Fault
AL9	RA SENSOR	✓ Return Air Sensor Fault
AL10	SA SENSOR	Supply Air Sensor Fault
AL11	WT SENSOR	Coolant Temperature Sensor
AL12	HIGH CDT	✓ High Discharge Temperature
AL13	CD SENSOR	Discharge Temperature Sensor Fault
AL14	SBY MOTOR	✓ Standby Motor Fault
AL15	FUSE BAD	✓ Fuse Open
AL16	SYSTEM CK	✓ Check Refrigeration System
AL17	DISPLAY	Display
AL18	SERVICE 1	Maintenance Hour Meter 1
AL19	SERVICE 2	Maintenance Hour Meter 2
AL20	RAS OUT	✓ Main Compartment Out-of--Range
AL21	2RA OUT	✓ Remote Compartment 2 Out--of-Range
AL22	3RA OUT	✓ Remote Compartment 3 Out--of-Range
AL23	NO POWER	No AC Power When Unit Is In Standby

Low Oil Pressure Alarm

The English display for the Low Oil Pressure alarm is “ENG OIL.” The code display is “AL0.” This alarm is generated if the microprocessor senses low oil pressure any time after a short delay allowed at startup. When this alarm is generated, the fault light will illuminate and the engine will shut down.

High Coolant Temperature Alarm

The English display for the High Coolant Temperature alarm is “ENG HOT.” The code display is “AL1.” This alarm is generated if the microprocessor senses coolant temperature above 230°F (110°C). When this alarm is generated, the fault light will illuminate and the engine will shut down.

High Pressure Alarm

The English display for the High Pressure alarm is “HI PRESS.” The code display is “AL2.” This alarm is generated if the high pressure switch opens. When this alarm is generated, the fault light will illuminate and the engine will shut down.

Start Failure Alarm

The English display for the Start Failure alarm is “STARTFAIL.” The code display is “AL3.” This alarm is generated if the start sequence has completed and the engine has failed to start. When this alarm is generated, the fault light will illuminate.

If function parameter MAN OP (FN10 OFF) is selected the start failure alarm will be generated if the engine is not started in five minutes.

Low Battery Voltage Alarm

The English display for the Low Battery Voltage alarm is “LOW BATT.” The code display is “AL4.” This alarm is generated if the battery voltage falls below 10 VDC. When this alarm is generated, the fault light will illuminate.

High Battery Voltage Alarm

The English display for the High Battery Voltage alarm is “HIBATT.” The code display is “AL5.” This alarm is generated if the battery voltage rises to 17 VDC. When this alarm is generated, the fault light will illuminate and the engine will shut down.

Defrost Override Alarm

The English display for the Defrost Override alarm is “DEFR FAIL.” The code display is “AL6.” This alarm is generated if the defrost has been terminated by the 45 minute timer. The fault light will not be illuminated by this alarm.

Alternator Auxiliary Alarm

The English display for the Alternator Auxiliary alarm is “ALT AUX.” The code display is “AL7.” This alarm is generated if the alternator auxiliary signal is not present with the engine running. When this alarm is generated, the fault light will illuminate.

Starter Motor Alarm

The English display for the Starter Motor alarm is “STARTER.” The code display is “AL8.”This alarm is generated if the starter motor input signal is not present with starter solenoid energized. When this alarm is generated, the fault light will illuminate.

Return Air Sensor Alarm

The English display for the Return Air Sensor alarm is “RA SENSOR.” The code display is “AL9.” This alarm is generated if the return air sensor is open or shorted.

If the microprocessor is set to allow operation on a second sensor, it will switch control to that sensor. If the unit is not fitted with a second sensor or if the microprocessor is not set to allow control on the second sensor, one of two actions will be taken.

1. If the unit is operating in the perishable range, the unit will shut down.
2. If the unit is operating in the frozen range, the unit will switch to low speed cool.

When this alarm is generated, the fault light will illuminate.

Supply Air Sensor Alarm

The English display for the Supply Air Sensor alarm is “SA SENSOR.” The code display is “AL10.” This alarm is generated if the supply air sensor is open or shorted.

This alarm will be disabled if the REM PROBE (FN4 A) is selected in the controlling probe functional parameter. The fault light will not be illuminated by this alarm.

Coolant Temperature Sensor Alarm

The English display for the Coolant Temperature Sensor alarm is “WT SENSOR.” The code display is “AL11.” This alarm is generated if the coolant temperature sensor is open or shorted. The fault light will not be illuminated by this alarm.

Compressor Discharge Temperature Alarm

The English display for the Compressor Discharge Temperature alarm is “HIGH CDT.” The code display is “AL12.” This alarm is generated if the microprocessor senses discharge temperature above 310°F (155°C) for 3 minutes. When this alarm is generated, the fault light will illuminate.

If the discharge temperature exceeds 350° F (177°C), the fault light will illuminate and the engine will be shut down immediately.

Compressor Discharge Temperature Sensor Alarm

The English display for the Compressor Discharge Temperature Sensor alarm is “CD SENSOR.” The code display is “AL13.” This alarm is generated if the sensor is open or shorted. The fault light will not be illuminated by this alarm.

Standby Motor Overload Alarm

The English display for the Standby Motor Overload alarm is “SBY MOTOR.” The code display is “AL14.” This alarm is generated if the MOL is open and the diesel/electric relay is energized (indicating standby mode).

Fuse Alarm

The English display for the Fuse alarm is “FUSE BAD .” The code display is “AL15.” This alarm is generated when the FUSE input is sensed low. When this alarm is generated, the fault light will illuminate.

System Check Alarm

The English display for the System Check alarm is “SYSTEM CK.” The code display is “AL16.” This alarm is generated when refrigerant system pressure is low. The fault light will be illuminated by this alarm.

Display Alarm

The English display for the Display alarm is “DISPLAY.” The code display is “AL17.” This alarm is generated when no communications exist between the main board and the display. The fault light will not be illuminated by this alarm.

Maintenance Hour Meter 1 Alarm

The English display for the Maintenance Hour Meter 1 alarm is “SERVICE 1.” The code display is “AL18.” This alarm is generated when the designated hour meter is greater than maintenance hour meter 1. The fault light will not be illuminated by this alarm.

Maintenance Hour Meter 2 Alarm

The English display for the Maintenance Hour Meter 2 alarm is “SERVICE 2.” The code display is “AL19.” This alarm is generated when the designated hour meter is greater than maintenance hour meter 2. The fault light will not be illuminated by this alarm.

Out-Of-Range Alarm

The English display for the Out Of Range alarm is “OUT RANGE.” The code display is “AL20.” This alarm is generated when the main compartment temperature is outside the designated range from set point. When this alarm is generated, the fault light will illuminate.

Remote Compartment 2 Out-of-range Alarm

The English display for the Remote Compartment 2 alarm is “2RAS OUT.” The code display is “AL21.” This alarm is generated when the second compartment temperature is outside the designated range from set point. When this alarm is generated, the fault light will illuminate.

Remote Compartment 3 Out-of-range Alarm

The English display for the Remote Compartment 3 alarm is “3RAS OUT.” The code display is “AL22.” This alarm is generated when the second compartment temperature is outside the designated range from set point. When this alarm is generated, the fault light will illuminate.

No Power for Standby Alarm

The display for the No Power alarm is “NO POWER.” This alarm is generated when the unit is placed in the Standby mode and there is no power to the power supply detector

2.4.13 Stopping Instructions

To stop the unit, from any operating mode, place the I/O (Cab Command) or RUN/STOP Switch in the OFF position.

SECTION 3

CONTROL LOGIC AND TEMPERATURE CONTROL

3.1 MODES OF OPERATION

The operational software responds to various inputs. These inputs come from the temperature and pressure sensors, the temperature set point, the settings of the configuration variables and the function code assignments. The action taken by the operational software will change if any one of the inputs changes. Overall interaction of the inputs is described as a "mode" of operation. The modes of operation include cooling, heat and defrost. Refer to Section 1.8 for a description of the refrigerant circuit.

If the unit is operating in AUTO START/STOP, a fourth mode is added. This is the null mode. In the null mode, the unit shuts down until further cooling or heating is required.

The cooling mode is further divided into the perishable (chill) range operation and frozen range operation. At setpoints above 10°F (–12°C) the unit will operate in the perishable range. In perishable range, all modes of operation are available to the microprocessor. At a setpoint of 10°F (–12°C) or below, the unit will operate in the frozen range. In frozen range, heat is locked out and only the cool and defrost modes are available to the microprocessor. Heat lockout can be overridden by setting CNF4 to "ON." See Table 4-4.

3.1.1 Startup and Pull Down – Engine Operation

At startup, the unit operates in high speed heat (with unloaders energized for 850 and 950 units). After 45 seconds the microprocessor checks to see if City Speed is activated. If City Speed is activated, high speed is locked out. The unit will be brought to low speed and the following operations will all take place in low speed. Also, the unit is locked in cooling during the oil pressure delay. If heating is required, the unit will switch to heating after the oil pressure delay time has expired.

If City Speed is not activated, the unit will remain in high speed heat or cool for the selected minimum run time (Function Code FN3).

As box temperature is reduced, the microprocessor will switch to low speed at 2.2°F (1.2°C) above set point. The microprocessor will switch from cool to heat at setpoint. If box temperature rises when in low speed pulldown, the microprocessor will switch back to high speed at 2.7°F (1.5°C) above set point.

After completing the pulldown, switching points are no longer at a fixed temperature point. The microprocessor will monitor the rate of temperature reduction or increase, and switch operation as required to limit overshoot. This greatly increases the accuracy of the microprocessor.

The microprocessor will continue to monitor changes in temperature and switch the unit between high speed cool, low speed cool, low speed heat and high speed heat as required to maintain desired temperature. If AUTO START/STOP is activated, the microprocessor will add a null mode at or near setpoint and shut down the unit when conditions allow. See Figure 3-3.

The microprocessor will monitor temperature while in the null mode and restart the unit following the same procedures used to prevent overshoot when switching to other modes. The length of time the unit will remain in the null mode is also dependent on Function Code settings. Function Code FN2 will control the minimum off time after shut down, Code FN3 will control the minimum on time before the null mode can be entered again, Code FN6 will control the maximum off time or allow temperature based restarting. Refer to Section 2.4.10 for Functional Parameter descriptions.

3.1.2 Startup and Pull Down – Standby Operation

Operation in standby follows the same sequence as operation on the engine except the standby motor operates at a single speed. The microprocessor will monitor changes in temperature and switch the unit between the cool mode, null mode and heat mode. The microprocessor will add the null mode at or near setpoint and de–energize the motor when conditions allow.

3.1.3 Null Mode Overrides

When in the null mode two conditions will override normal microprocessor off time and/or temperature control. If the unit is in the Engine Drive or Standby mode and battery voltage falls below 11 volts, the engine or motor will be restarted to allow the alternator to recharge the battery. If the unit is in the Engine Drive mode and the engine coolant temperature drops below 34°F (1°C) the engine will be restarted.

3.1.4 Dual Probe Operation

The microprocessor is fitted with a connection for a second thermistor. This thermistor is installed in the supply air stream and activated using Function Code FN4. With Function Code FN4 set to “FN4 ON” or “REM PROBE” the microprocessor is set for dual probe control.

With the microprocessor set for dual probe control, the microprocessor will select the supply air probe for control when in Perishable Range operation and the return air probe when in Frozen Range operation. Operating on the supply air probe in the Perishable Range minimizes top freezing while operating on the return air probe in the Frozen Range keeps the product at or slightly below setpoint.

In the event of a probe failure on a single probe unit, the unit will be shut down if operating in the Perishable Range or switched to low speed cooling if operating in the Frozen Range. When operating in the Frozen Range and on standby, the unit continues to operate in cooling. An alarm will be generated to advise the operator of the probe failure.

With dual probe control, the microprocessor will switch over to the other probe in the event of an “active” probe failure. This allows continued “normal” operation. The appropriate alarm will be generated to advise the operator of the probe failure.

3.1.5 Fuel Heater Operation

Energizing the heater relay provides a circuit to the fuel heater thermostat (FHT). A thermostat (FHT), internal to the fuel filter bowl, closes to energizes the fuel heater (FH) at temperatures below the cut in setting.

3.1.6 Defrost Mode

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.

Defrost may only be initiated if the defrost termination thermostat (DTT) is closed. The DTT closes, on a temperature fall, at 37°F (3°C) to signal the microprocessor that the coil temperature is low enough to allow the build up of frost. Defrost is terminated when the DTT opens again, on a temperature rise, at 47°F (8°C) signaling the microprocessor that the coil has been warmed to the point that the frost buildup should have been removed.

During defrost the unit enters the heat mode and the evaporator fans are de–energized. This will prevent the circulation of warm air to the load. If the unit is shut down for any reason during a defrost cycle (run relay is de–energized) the microprocessor defrost cycle is terminated and the unit will restart normally.

For 950 units only, the defrost damper (if provided) is closed at defrost start and is kept closed for 90 seconds with heat on for 60 seconds after defrost has terminated.

a. Defrost Timer Initiation

Timed defrost is controlled by the setting of Functional Parameter FN0 and may be set for 1.5, 3, 6 or 12 hours. The microprocessor will place the unit into the defrost mode each time the timer expires. The defrost timer runs only when the defrost termination thermostat is closed also, it does not accumulate time when the unit is in the null mode. The defrost timer is reset to zero whenever a defrost cycle is initiated.

b. Defrost Air Switch Initiation

The Defrost Air switch is of the diaphragm type and it measures the change in air pressure across the evaporator coil. When the pressure differential is increased to set point, due to the formation of ice on the coil surface, the switch closes to signal the microprocessor to place the unit in the defrost mode.

c. Manual Defrost Initiation

Defrost may be initiated manually by pressing the MANUAL DEFROST key.

d. 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 microprocessor places the unit in the defrost override mode and the defrost cycle is terminated. The internal timer is reset for 1.5 hours, the Functional Parameter setting and Defrost Air switch 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.

3.1.7 Unloading in Temperature Mode

NOTE

The unloader relay is locked in for a minimum of 2 minutes once it is energized due to suction pressure.

There are two modes of unloader operation: temperature control and suction pressure control (950 Only).

Temperature Control

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

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

2. If in low speed cooling, unloader relays (UFR) may energize to unload compressor banks. Refer to Table 3-1

3. In low speed heating, front unloader relay (UFR) energizes to unload compressor bank.

Table 3-1. Unloading in Temperature Mode

SETPOINT BELOW 10°F (–12°C)	Cylinder	SETPOINT ABOVE 10°F (–12°C)	Cylinder
Supra 922/944			
Cool High Speed	6	Cool High Speed	6
		Cool Low Speed	4
		Heat Low Speed	4
Cool Low Speed	6	Heat Low Speed	6
Cool Low Speed	4	Heat High Speed	6

b. Perishable Cooling Unloader Control

Diesel

During perishable cooling the unloader is energized when the temperature approaches setpoint. If a supply probe is present the unloader is 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 unloader is 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. The return probe logic is disabled for ambient temperature higher than 90°F (32.2°C).

Standby

During perishable cooling the unloader is energized when the control temperature reaches less than 2°F (1.1°C) above setpoint. The unloader 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 unloader is energized when the control temperature increases to 1.5°F (0.8°C) below setpoint. The unloader will stay energized until the control temperature decreases to 2°F (1.1°C) below setpoint.

d. Frozen Unloader Control

Diesel

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.

Standby

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.

Suction Pressure Control (950 Only)

Diesel

The microprocessor will monitor suction pressure of the refrigeration system and ambient temperature and control the unloader to maintain a maximum operating pressure based on these two values (via a pressure transducer).

For each operating mode (high speed engine, low speed engine, standby) a specific varipower equation exists.

For a given ambient temperature, if the suction pressure is below the equation value the compressor will run on all cylinders. If not, two cylinders will be unloaded.

The unloader is energized during engine or standby motor start.

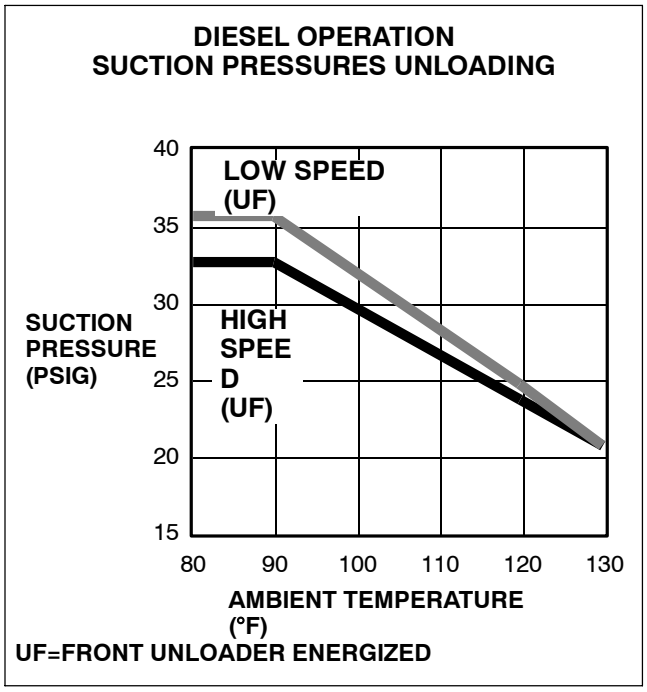
a. At ambient temperatures of 90_F (32.2_C) or below

When the system is operating at *high speed* and the suction pressure drops below 33 psig, the front bank is loaded.

When the system is operating at *low speed* and the suction pressure drops below 35 psig, the front bank is loaded.

b. 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.)



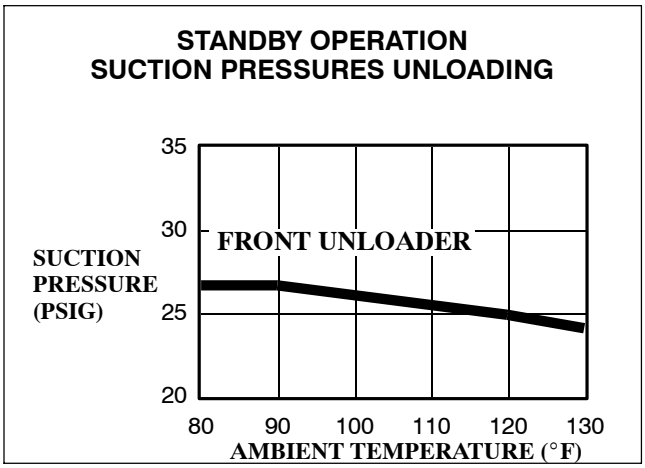
Standby

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

When the system is operating and the suction pressure drops below 26 psig, the front bank 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.)



High Ambient Control (850 Only)

The refrigeration system will control discharge pressure in both diesel and standby and will control the unloader in the following manner:

Diesel

At discharge pressures of 440 ±10 PSIG (30 ± 0.7 Bar) and higher the refrigeration system will be forced into unloaded operation until the discharge pressure is reduced to 367 ±12 PSIG (25 ± 0.8 Bar)

Standby

The refrigeration system is controlled by the Standby Unloader Front Relay (SUFR) and is always forced into unloaded operation.

3.1.8 Auto Diesel Restart (Option)

If AC power is lost for five minutes or more, configuration 10 is active and TIME START is enabled, the diesel engine will start and run until AC power is restored and applied for five minutes. When the five minute shutdown timer expires and AC power is present, the unit will shut down the diesel engine and restart the standby motor. If AC power is NOT present, the diesel engine will operate as required.

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

3.2 SEQUENCE OF OPERATION

3.2.1 Engine Drive

Refer to SECTION 6 for a schematic diagram of the unit controls. To facilitate location of the components referred to in the written text, the schematic has map coordinates added to the margins. These locations have also been added to the legend. In order to provide complete information, the following description is written as if all options are installed. Indications of specific unit applicability and optional equipment are provided on the schematic diagram. The microprocessor controls operation of the various relays and components by completing or by breaking the circuit to ground.

To start the unit, place the the RUN/STOP Switch (RSS) in the RUN position and the cab command I/O Switch in the ON position. Operation of the control circuit is the same for microprocessor or manual start except on units equipped with a Manual Glow/Crank Switch (MGC), the operator may use that switch to energize the glow plugs and crank the engine.

With the switches positioned, the ROAD key is pressed to begin the start process. Power flows from RSS through fuse F2 to the Run Control Relay (RCR). RCR is grounded by the microprocessor through the Door Switch Relay (DSR) and cab command to energize RCR. The RCR contacts close to provide power to the control relays. Power to the Run Relay (RR) is dependent on the High Pressure Switch (HPS) being closed. If the high pressure switch is open, power will not be applied to microprocessor terminal M1 and operation will not be allowed.

Energizing RR closes a set of contacts to supply power to the alternator (ALT), Run Solenoid (RS), Fuel Pump (FP) and Fuel Heater Relay (FHR). RS energizes to open the engine fuel rack, FP energizes to pump fuel to the injection pump and FHR energizes to close a set of contacts supplying power to the fuel heater thermostat. The fuel heater thermostat closes to energize the fuel heater at temperatures below the option setting. The engine is thus prepared for start up.

The microprocessor will now run the Auto Start Sequence (refer to Section 3.2.3) to start the engine. The Glow Plug Relay (GPR) is energized to close a set of contacts (SSC) and provide power to the Glow Plugs (GP) as required to preheat the engine cylinders. The Starter Solenoid Relay (SSR) will then be energized to close a set of contacts and energize the Starter Solenoid (SS). Energizing SS closes a set of contacts to energize the Starter Motor (SM) and crank the engine.

During cranking a signal is also supplied to microprocessor terminal L2. Once the engine starts and and the alternator begins to produce power, the microprocessor senses the power at terminal L3 and the start sequence is terminated. The microprocessor ignores the Oil Pressure Switch (OP) signal for 15 seconds to allow the engine time to develop sufficient pressure to close OP.

The unit will start in High Speed Heat with unloaders energized (850 and 950) and fans de-energized. After 30 seconds the unit will revert to normal temperature control.

Once the engine has started, the microprocessor will complete the Defrost Transistor (DT) circuit to energize the Electric Fan Motor Relays (EFMR 1 through 3) which close contacts to energize the Electric (Evaporator) Fan Motors (EFM1 through 3).

The microprocessor continues to monitor inputs to determine required modes of operation. The inputs include the Suction Pressure Transducer (SPT), Water temperature Sensor, Supply Air Sensor (SAS), and the Compressor Discharge Transducer (CDT).

As required, the microprocessor will take the following actions:

On Supra 850 and 950 units, when in the low speed mode, the microprocessor also energizes the Unloader Front Relay (UFR). Energizing UFR closes a set of contacts to energize the compressor unloader (UF) deactivating two cylinders.

For high ambient protection on Supra 850 units, the unloader is controlled through the Compressor Clutch Relay (CCR). CCR is energized through a second discharge pressure switch (HP2). If high pressure is below 367 psig (25 bar) the compressor is in 4 cylinder operation (2 cylinder for 950). If pressure is above 440 psig (30 Bar) the compressor is in 4 or 6 cylinder operation.

On call for heat, the Heater Relay (HR1) is energized to close a set of contacts and energize the hot gas bypass solenoid valve (HGS2) and the hot gas valve (HGS1) placing the unit in the heat mode. If the unit is equipped with hot water heat, the contactor will open the hot water heat solenoid valve. Units equipped with electric heat will energize the heater elements.

On call for defrost, the microprocessor energizes the hot gas bypass valve (HGS2) and the hot gas valve (HGS1) in the same manner as in heat. Also, DT is de-energized, stopping the evaporator fan motors.

3.2.2 Standby

Refer to SECTION 6 for a schematic diagram of the unit controls. To facilitate location of the components referred to in the written text, the schematic has map coordinates added to the margins. These locations have also been added to the legend. In order to provide complete information, the following description is written as if all options are installed. Indications of specific unit applicability and optional equipment are provided on the schematic diagram. The microprocessor controls operation of the various relays and components by completing or by breaking the circuit to ground.

To start the unit, place the RUN/STOP Switch (RSS) in the RUN position and the cab command I/O Switch in the ON position.

With the switches positioned, the STANDBY key is pressed to begin the start process. When the STANDBY key is pressed, the microprocessor provides a ground path to energize the Diesel Electric Relay (DER). Energizing DER opens a set to contacts to break the circuit to the engine drive controls and closes a set of contacts to allow power to the electric drive controls.

Power flows from RSS through fuse F2 to the Run Control Relay (RCR). RCR is grounded by the microprocessor through the Door Switch Relay (DSR) and cab command to energize RCR. The RCR contacts close to provide power to the control relays. Power to the Run Relay (RR) is dependent on the High Pressure Switch (HP1) being closed. If the high pressure switch is open, power will not be applied to microprocessor terminal M1 and operation will not be allowed.

Energizing RR closes a set of contacts to supply power through the motor Overload (OL) to the Motor Contactor (MC1). Energizing MC1 closes it's contacts to start the Standby Motor (SBM).

On Supra 850 units, power is also supplied from the DER contacts to energize the Standby Unloader Front Relay (SUFR). Energizing SUFR opens a set of normally closed contacts in the power line to the unloader preventing unloaded operation.

The unit will start in High Speed Heat with unloaders on and fans off. After 30 seconds the unit will revert to normal temperature control.

Once the motor starts the alternator begins to produce power. The microprocessor senses the power at terminal L3 and it will complete the Defrost Transistor (DT) circuit to energize the Electric Fan Motor Relays (EFMR 1 through 3). The relays close contacts to energize the Electric (Evaporator) Fan Motors (EFM1 through 3).

The microprocessor continues to monitor inputs to determine required modes of operation. The inputs include the Suction Pressure Transducer (SPT), Return Air Sensor(RAS), Supply Air Sensor (SAS), and the Compressor Discharge Transducer (CDT) .

As required, the microprocessor will take the following actions:

On call for heat, the Heat Relay (HR) is energized to close a set of contacts and energize the hot gas bypass solenoid valve (HGS2) and the hot gas valve (HGS1) placing the unit in the heat mode. In the heat mode the microprocessor also energizes the Evaporator Heat Relay (EHR). Energizing EHR closes a set of contacts to energize the Evaporator heat Contactor (EHC) which closes it's contacts to energize the Evaporator Heaters.

On call for defrost, the microprocessor energizes the hot gas bypass solenoid valve (HGS2) and the hot gas valve (HGS1) in the same manner as in heat. Also, DT is de-energized, stopping the evaporator fan motors.

3.2.3 Auto Start Sequence

Refer to SECTION 6 for a schematic diagram of the unit controls. To facilitate location of the components referred to in the written text, the schematic has map coordinates added to the margins. These locations have also been added to the legend. In order to provide complete information, the following description is written as if all options are installed. Indications of specific unit applicability and optional equipment are provided on the schematic diagram. The microprocessor controls operation of the various relays and components by completing or by breaking the circuit to ground.

The Auto Start Sequence will begin once conditions for engine starting have been established, and the Run Relay (RR) has been energized to provide power to the Run Solenoid (RS), Fuel Pump (FP) and Fuel Heater (FH). Refer to Section 3.2.1 for control circuit operation. The sequence consists of three start attempts each including a predetermined period with the glow plugs energized and operation of the starter motor (see Figure 3-1).

Five seconds after the run relay is energized, the microprocessor will start the sequence by energizing the glow plug relay (GPR) to supply power to the glow plugs. See Table 3-2 for glow times.

If the Manual Glow Override Function Parameter is set to "NORMAL," the glow time for the first start attempt will vary in duration based on engine coolant temperature as follows:

Table 3-2. Default Manual Glow Time

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

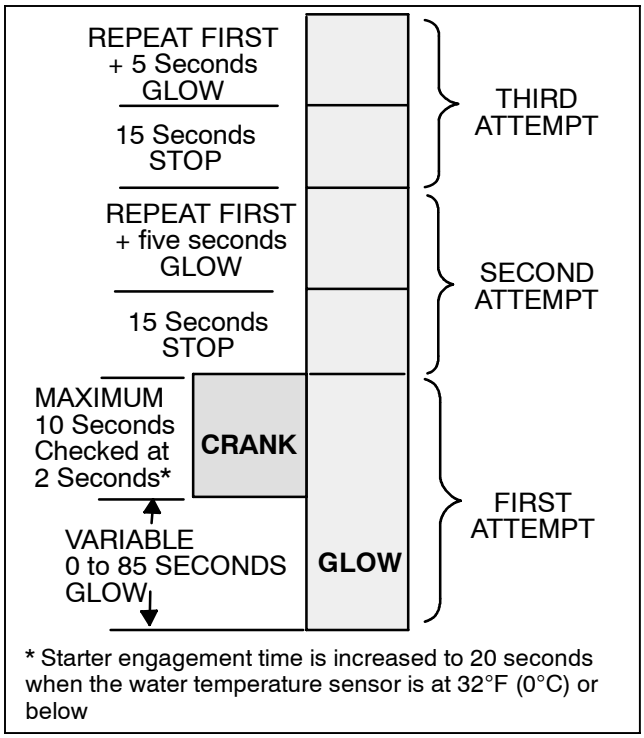


Figure 3-1. Auto Start Sequence

The second and third start attempts have a glow time that is five seconds greater than the table amount.

If the Manual Glow Override Function Parameter is set to “ADD GLOW” the additional time will be added to the first attempt. Actual time added to the second and third attempts will vary with ambient temperature.

After the glow time has expired, the starter solenoid (SS) is energized to crank the engine. The engine will crank for 10 seconds [20 seconds if engine coolant temperature is below 32°F (0°C)] or until engine operation is sensed by the microprocessor at alternator signal input at terminal L3.

If the engine has not started, a 15 second null cycle will elapse before subsequent start attempts. The run relay will remain energized during the null cycle.

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

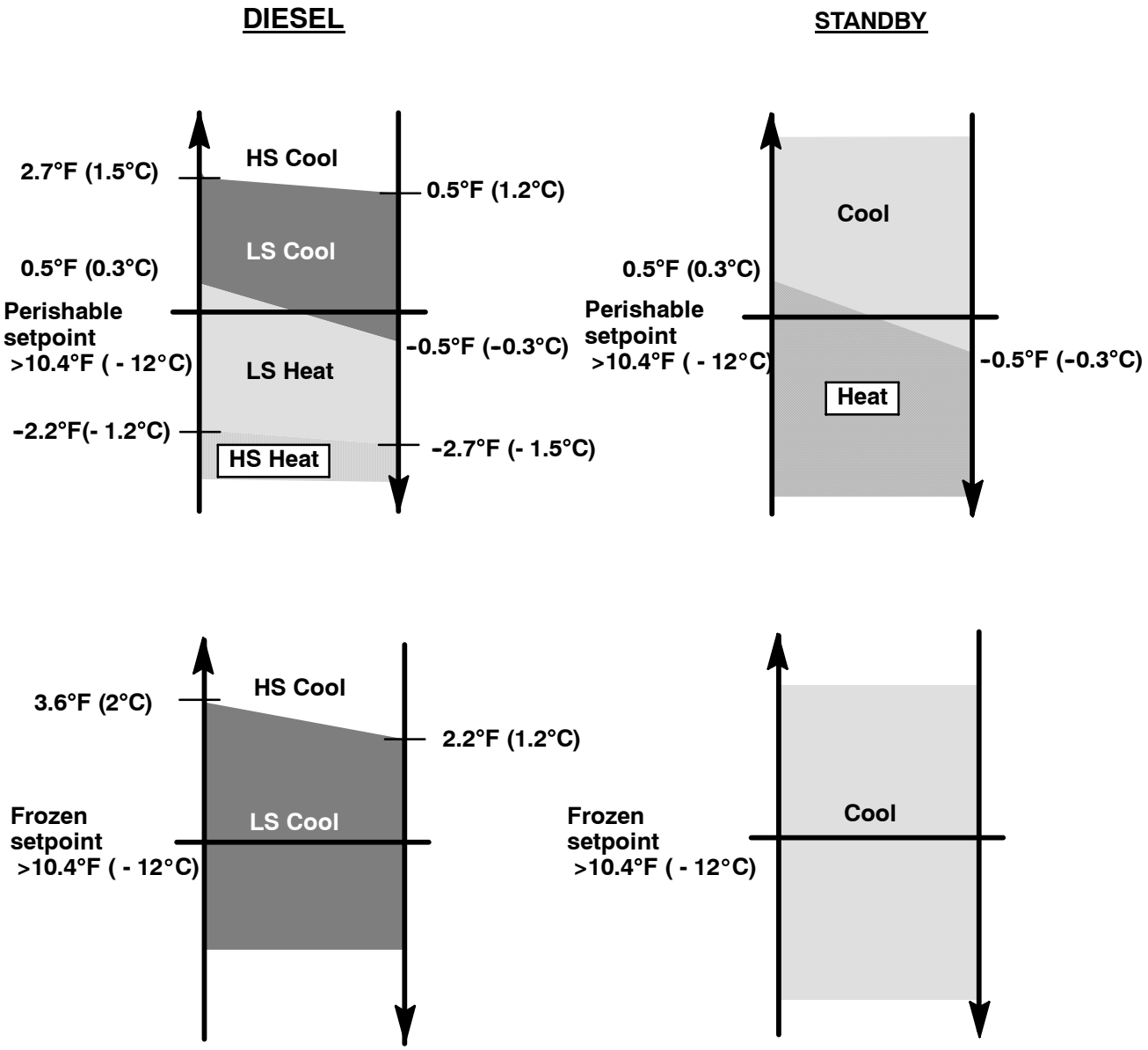
If battery voltage drops below 10 volts at any point during the Auto Start Sequence, the sequence will be stopped and the start failure alarm is activated.

The system is configured for cooling mode for engine or standby start (default mode). Once unit is considered running it will maintain setpoint temperature by switching between heat and cool.

When in the null mode two conditions will override normal microprocessor off time and/or temperature control. If the unit is in the Engine Drive or Standby mode and battery voltage falls below 11 volts, the engine or motor will be restarted to allow the alternator to recharge the battery. If the unit is in the Engine Drive mode and the engine coolant temperature drops below 34°F (1°C) the engine will be restarted.

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

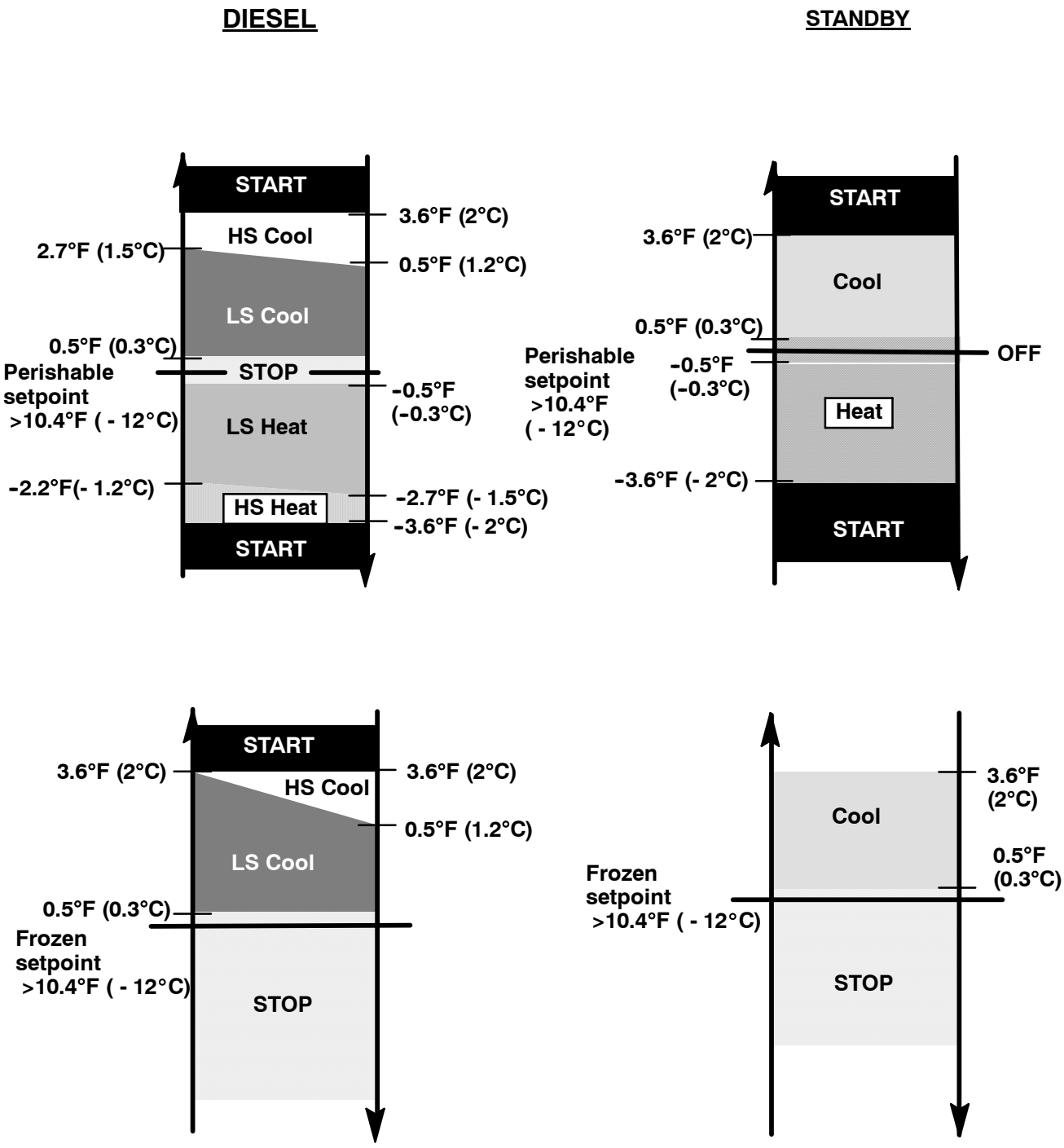
CONTINUOUS MODE



SUPRA 550/650/750/850

Figure 3-2 TEMPERATURE CONTROL SEQUENCE - CONTINUOUS MODE

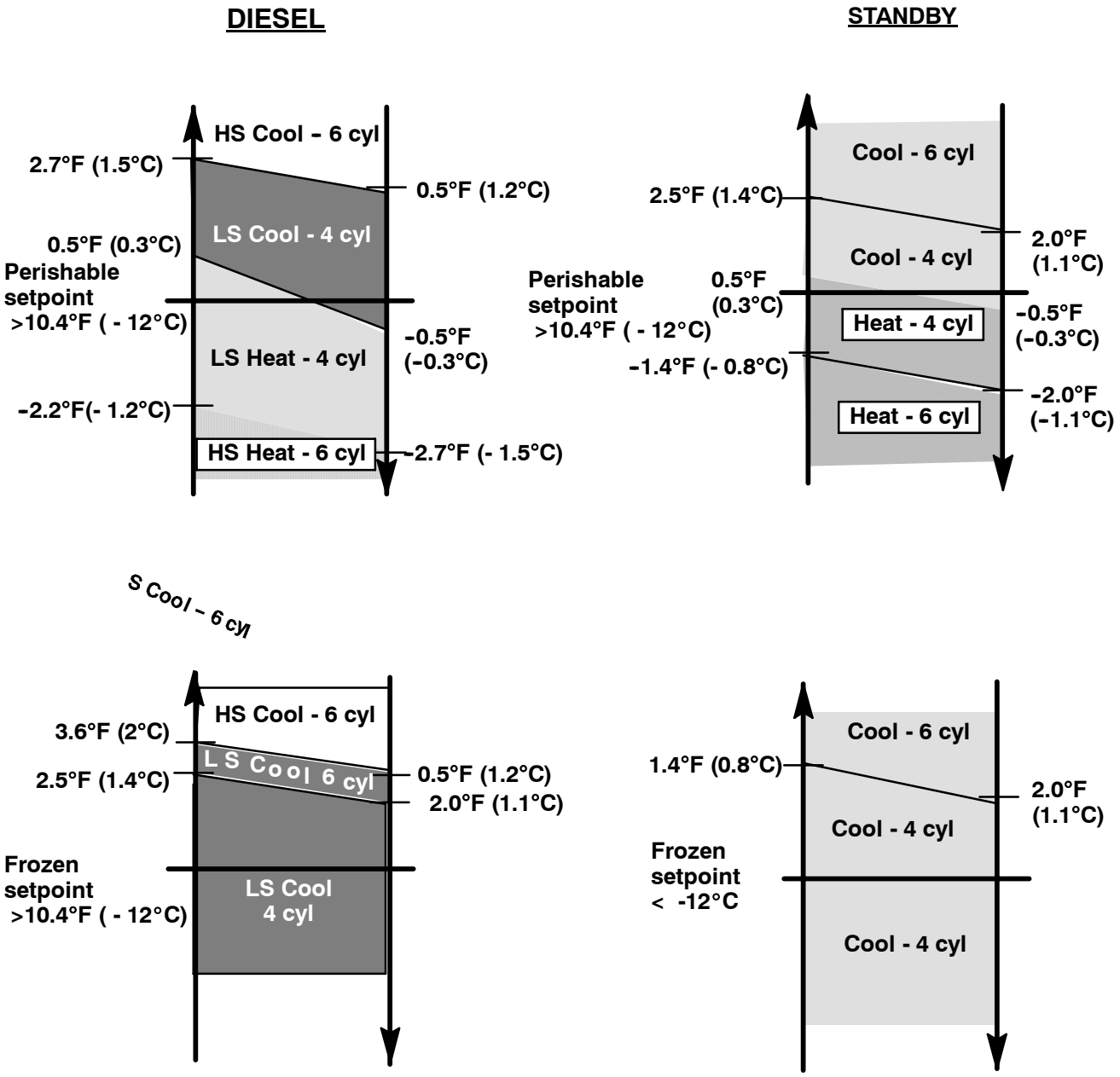
START / STOP MODE



SUPRA 550/650/750/850

Figure 3-3 TEMPERATURE CONTROL SEQUENCE – START / STOP MODE

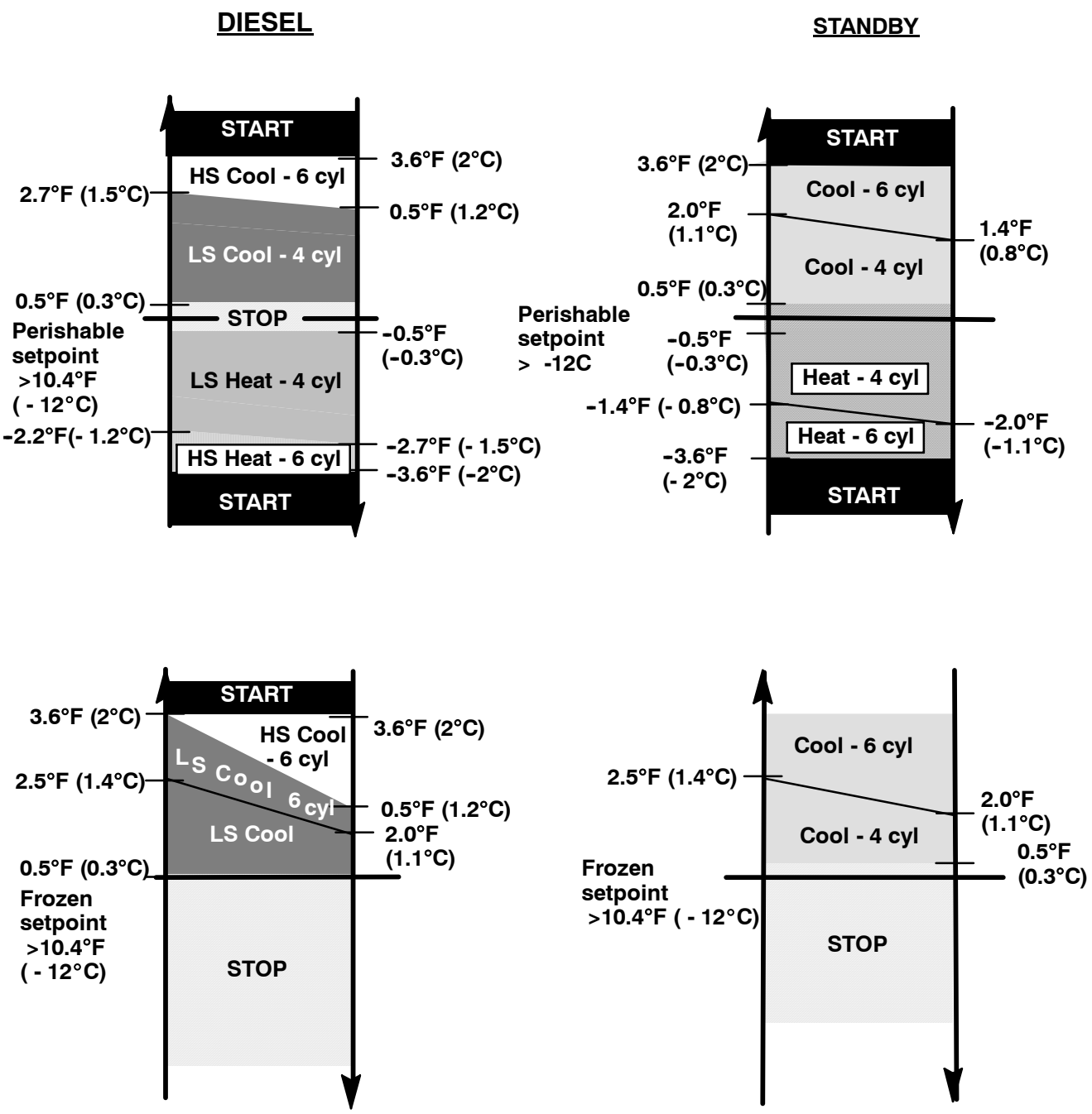
CONTINUOUS MODE



SUPRA 950

Figure 3-4 TEMPERATURE CONTROL SEQUENCE - CONTINUOUS MODE

START / STOP MODE



SUPRA 950

Figure 3-5 TEMPERATURE CONTROL SEQUENCE - START / STOP MODE

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 with R404A and POE oil, the use of inert gas brazing procedures is mandatory; otherwise compressor failure will occur. For more information see Technical Procedure 98-50553-00 Inert Gas Brazing

NOTE

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

MAINTENANCE SCHEDULE Supra 550 (see Table 4-1 for description of required service)

FILTER TYPE	REQUIRED SERVICE								
Petroleum OIl Without Bypass Oil Filter	A	B	B	BC	BD	B	BE	F1/F2	
Hours	250	500	1000	1500	2000	2500	3000	6000/ 12000	
Petroleum Oil With Bypass Oil Filter	A	B	B	C	B	D	B	BE	F1/F2
Hours	250	600	1200	1500	1800	2000	2400	3000	6000/ 12000
Synthetic OIl Without Bypass Oil Filter	A	B	C	BD	BE	F1/F2			
Hours	250	1000	1500	2000	3000	6000/ 12000			
Synthetic Oil With Bypass Oil Filter	A	B	C	D	B	E	F1/F2		
Hours	250	1200	1500	2000	2400	3000	6000/ 12000		

MAINTENANCE SCHEDULE Supra 650/ 750/ 850 (see Table 4-1 for description of required service)

FILTER TYPE	REQUIRED SERVICE						
Petroleum OIl Without Bypass Oil Filter	A	B	BC	D	B	BE	F1/F2
Hours	250	750	1500	2000	2250	3000	6000/12000
Petroleum Oil With Bypass Oil Filter	A	B	C	BD	BE	F1/F2	
Hours	250	1000	1500	2000	3000	6000/12000	
Synthetic OIl Without Bypass Oil Filter	A	BC	D	BE	F1/F2		
Hours	250	1500	2000	3000	6000/12000		
Synthetic Oil With By-pass Oil Filter	A	C	BD	E	B	F1/F2	
Hours	250	1500	2000	3000	4000	6000/12000	

MAINTENANCE SCHEDULE Supra 950 (see Table 4-1 for description of required service)

FILTER TYPE	REQUIRED SERVICE					
Petroleum OIl Without Bypass Oil Filter	A	B	C	BD	BE	F1/F2
Hours	250	1050	1500	2000	3000	6000/12000
Petroleum Oil With Bypass Oil Filter	A	C	BD	E	B	B/F1/F2
Hours	250	1500	2000	3000	4000	6000/12000

OIL CHANGE INTERVALS

	Unit Model		
Oil Type	**Supra 550**	**Supra 650/750/850**	**Supra 950**
Petroleum*	500 Hours	750 Hours	1000 Hours
W/Bypass Filter *	600 Hours	1000 Hours	N/A
Synthetic**	1000 Hours	1500 Hours	2000 Hours
W/Bypass Filter**	1200 Hours	2000 Hours	N/A

* Maximum oil drain interval is one year (12 months).

** Mobil Delvac1 is the only approved synthetic oil. Maximum oil drain interval is two years. Oil filter change required once a year (every 12 months).

Table 4-1 Service Category Descriptions

Service A	1.Check the engine cooling system 2. Check and clean air filter. 3. Check all belts. 4. Check all hardware and unit mounting bolts for tightness.
Service B	1. Change lube oil and filter(s) 2. Check engine cooling system. 3. Check and clean air filter. 4. Check all belts.
Service C	1 .Check fuel pump filter. 2. Replace air filter cartridge. 3. Check battery terminals and fluid level. 4. Check compressor oil level. Use polyol ester oil (POE) approved by CARRIER. 5. Check alternator brushes. Check in accordance with diesel hours PLUS standby hours. 6. Check engine thermostat for proper operation. 7. Check defrost: • Check timer setting and function. • Check refrigerant control valves for proper operation. • Check that fans stop. • Check defrost ends automatically. • Check water drainage from evaporator. 8. Check fan motor brushes. 9. Check and adjust rocker arms. 10. Replace belts as necessary.
Service D	1. Replace oil filter. 2. Clean radiator and condenser. 3. Check refrigerant level.
Service E	1. Change fan motor brushes. 2. Check and rebuild alternator. 3. Check engine speed: 550/850 High – 2300 to 2350 Low – 1800 to 1850 650/750/950 High: 2200–2250 Low: 1800 –1850
Service F1(Std. Coolant) F2 (Ext. Life Coolant)	1. Check all belt tension pulley bearings. 2. Change antifreeze and flush cooling system.* 3. Check bearings in clutch and electric motors. 4. Clean and adjust fuel injectors.**

NOTES:

* Do not mix standard coolant/antifreeze and extended life coolant/antifreeze. Verify coolant prior to adding any “make–up” coolant/antifreeze.

** Refer to the engine manual for correct procedure and settings.

4.1 SERVICING ENGINE RELATED COMPONENTS

4.1.1 Cooling System

The condenser and radiator can be cleaned at the same time. The radiator must be cleaned internally as well as externally to maintain adequate cooling. See Figure 4-1.

The condenser and radiator are incorporated into a single assembly. The condenser fans draw the air through the condenser and radiator coil. To provide maximum air flow the condenser fan belt should be checked periodically and adjusted if necessary to prevent slippage.

⚠ CAUTION

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

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

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

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

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

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

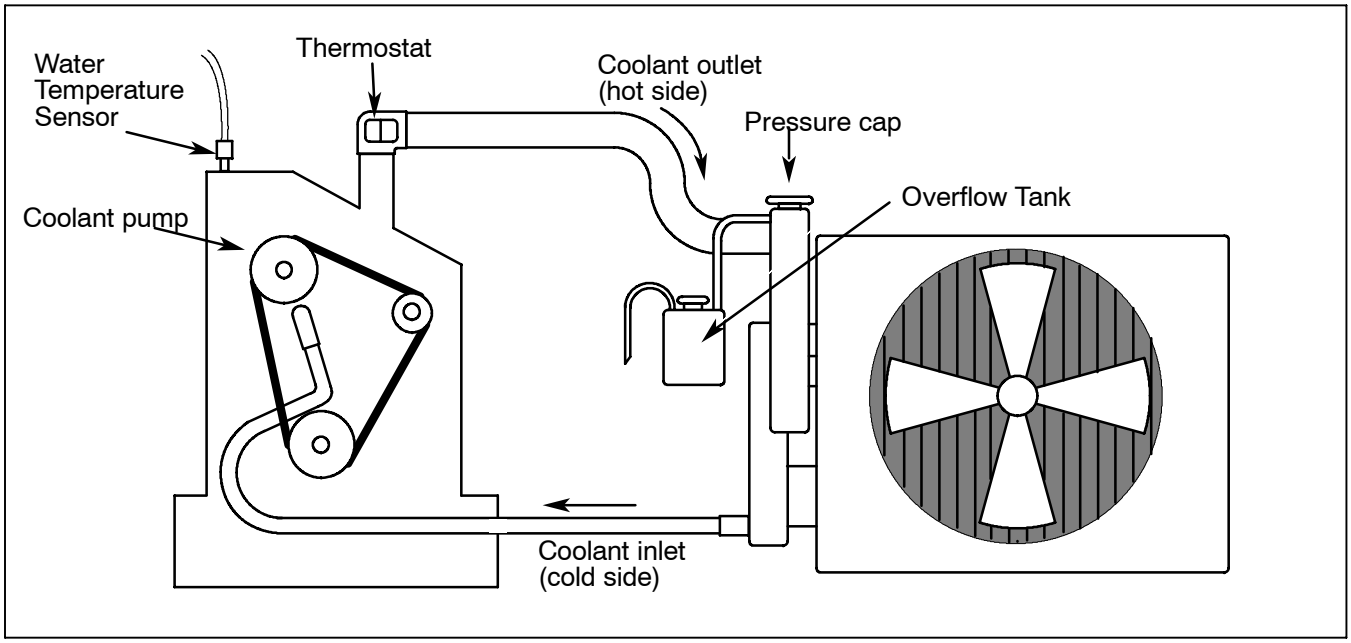


Figure 4-1. Coolant System

4.1.2 Changing Lube Oil and Lube Oil Filters

⚠ 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.

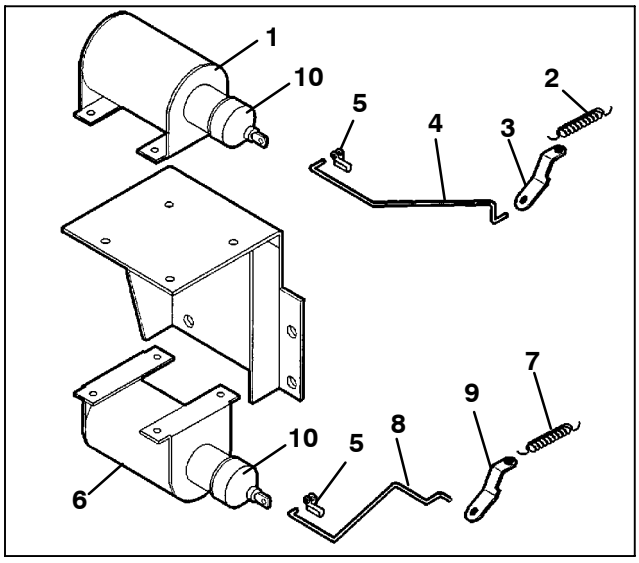
After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil.

Replace filter(s), lightly oil gasket on filter before installing and add lube oil. (Refer to section 1.6.1) Warm up engine and check for leaks.

4.1.3 Replacing the Speed and Run Control Solenoids

a. Run Solenoid (see Figure 4-2).

1. Remove spring (item 2) from the engine run lever.
2. Disconnect wiring to solenoid. Remove clip (item 5) from linkage rod (item 4). Remove mounting hardware and solenoid.
3. Attach linkage to new solenoid and install the clip to the linkage rod. Install the replacement solenoid and mounting hardware loosely. Connect the ground wire and spring.
4. Energize the solenoid with a jumper wire connected to a battery. Slide the solenoid far enough back on the bracket to set the engine run lever (item 3) against the stop. Tighten solenoid mounting hardware.
5. De-energize the solenoid. If the engine does not shut off, repeat step 4 and adjust the solenoid forward slightly. When operating correctly, tighten solenoid mounting hardware and reconnect the positive wire.



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

Figure 4-2. Speed and Run Control Solenoids

b. Speed Control Solenoid (see Figure 4-2).

1. Remove spring (item 7) from the engine speed lever (item 9).
2. Disconnect wiring to solenoid. Disconnect linkage rod (item 8) from solenoid. Remove mounting hardware and solenoid.
3. Attach linkage to new solenoid and install the clip (item 5) to the linkage rod. Install the replacement solenoid and mounting hardware loosely. Connect the ground wire and spring.
4. Energize the solenoid with a jumper wire connected to a battery. Slide the solenoid far enough back on the bracket to set the engine speed lever against the stop. Tighten solenoid mounting hardware.
5. Check engine speed. Speed may be verified using a strobe, Carrier Transicold P/N 07-00206.
6. Disconnect the jumper wire and start the engine. The engine is in low speed. Refer to section 1.6 for engine speed. Reconnect the jumper wire to energize the solenoid. The engine should increase to high speed. If engine speed is not correct (engine lever against stop), stop engine and move the solenoid forward slightly. Repeat procedure if adjustments need to be made.
7. When operating correctly, tighten solenoid mounting hardware and reconnect the positive wire.
8. If adjustment is not achieved by doing step 6, stop engine and remove linkage from solenoid. Remove boot (item 10) from solenoid and pull solenoid shaft out (far enough to loosen jam nut on solenoid shaft). Energize solenoid for maximum force (pull) and then turn shaft clockwise to shorten.
9. De-energize solenoid, tighten shaft jam nut and replace boot. Connect linkage and repeat steps 5 and 6.

4.1.4 Engine Air Cleaner

a. Inspection

The air cleaner, hose and connections should be inspected for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. If housing has been dented or damaged, check all connections immediately.

Stop engine, remove air filter. Install new air filter.

When inspecting air cleaner housing and hoses, check the connections for mechanical tightness and look for fractures in the inlet and outlet hoses. When leakage occurs and adjustment does not correct the problem, replace necessary parts or gaskets. Swelled or distorted gaskets must always be replaced.

4.1.5 Fuel Filter and Fuel Circuit

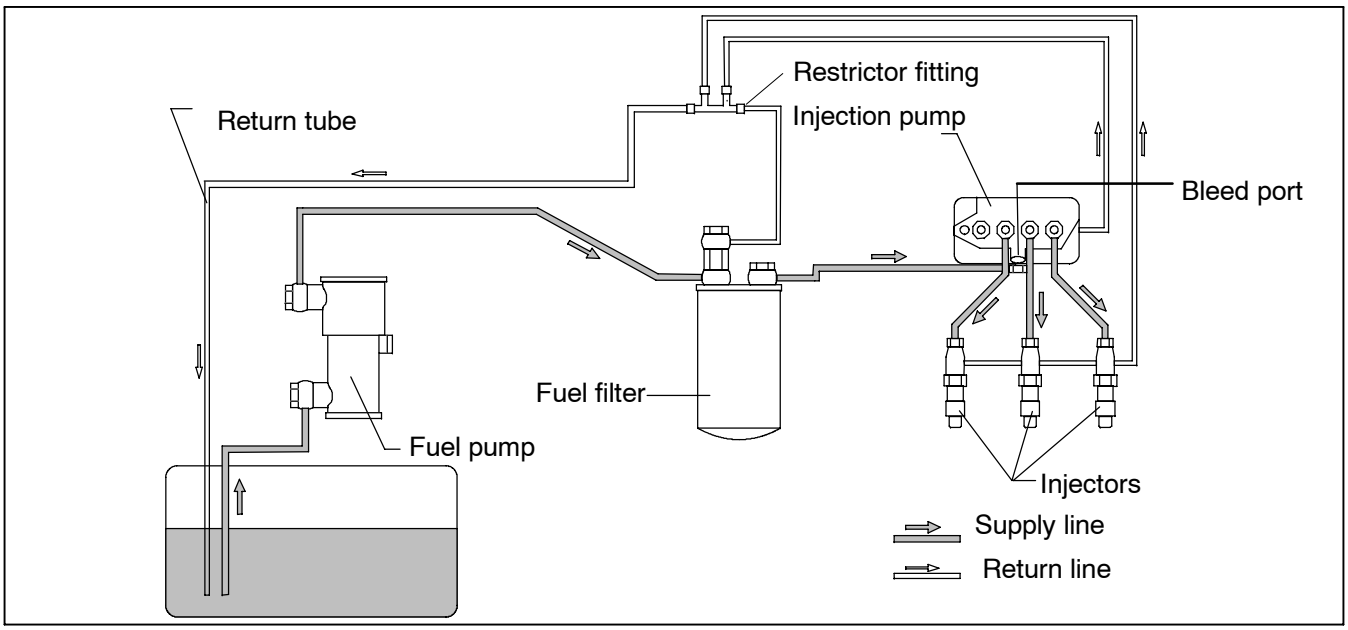


Figure 4-3. Fuel System

a. Checking fuel circuit

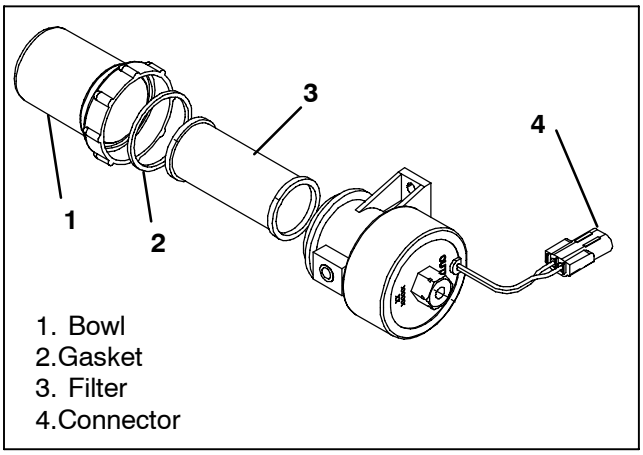
1. The engine must run with bleed port slightly unscrewed. This indicates that the injection pump pressure is greater than 1.47 psig (0.1 Bar). Check for air leakages and clean fuel lines if pressure isn't correct.
2. The electrical pump is designed to deliver 10.30 psig (0.7 Bar). The fuel circuit flow rate in the return line is about 1.32 Gal (5 liters) per hour.

b. Changing the fuel filter

⚠ CAUTION

When changing fuel filter, the new filter should be filled with clean fuel.

1. Remove cover, gasket and filter.
2. Wash filter in cleaning solvent and blow out with air pressure. Clean cover.
3. To Install reverse above steps.
4. After changing fuel filter, operate the electrical pump to bleed the fuel circuit properly before starting the engine.



1. Bowl
2.Gasket
3. Filter
4.Connector

Figure 4-4. Electric Fuel Pump

c. Verify fuel pump capability

1. Remove fuel pump from the system. Connect a manometer to pump outlet. Energize fuel pump with a small quantity of fuel.
2. At zero flow, the fuel pump should provide about 10.30 psig (0.7 Bar) of pressure at the pump outlet.

   •Pulsation frequency high – fuel circuit has low pressure drop/high flow

   •Pulsation frequency low (or null) – high pressure drop inside the circuit – low or zero flow Check for restriction inside the circuit.

4.1.6 Servicing Glow Plugs

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 6 to 11 ft-lb (0.8 to 1.5 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 amperage draw of 8 to 10 amps.

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.

4.1.7 Alternator

⚠ CAUTION

Observe proper polarity, reverse polarity will destroy the diodes. As a precaution, disconnect positive terminal when charging.

The alternator and regulator are housed in a single assembly. A diagram for alternator troubleshooting or replacement is provided below. See Figure 4-5.

a. Inspection

Verify tightness of connections. If excitation wire is disconnected the unit will display ALT AUX and battery will not recharge during unit operation.

b. Brushes (Maintenance Schedule and Table 4-1)

1. Make sure battery terminals and alternator exciter cable are disconnected.
2. Remove the two screws holding the regulator.
3. Replace the brushes.
4. Reassemble the regulator.

c. Voltage control

1. Power up the unit.
2. Press UNIT DATA until voltage measurement output is displayed.

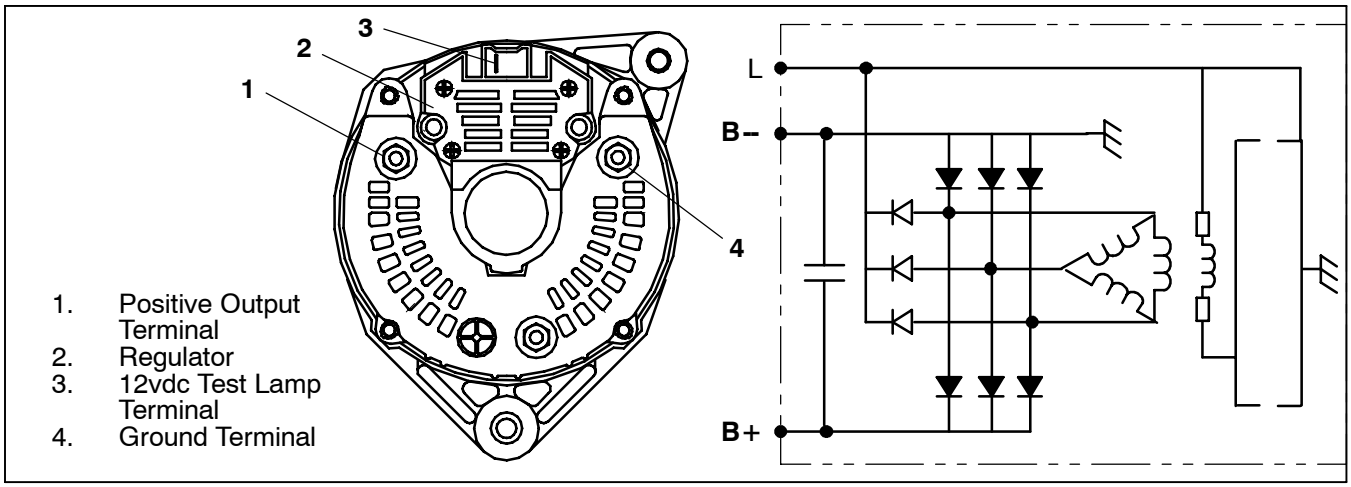


Figure 4-5. 70 Amp Alternator (P/N 30-60050-04)

4.2 SERVICING AND ADJUSTING V-BELTS

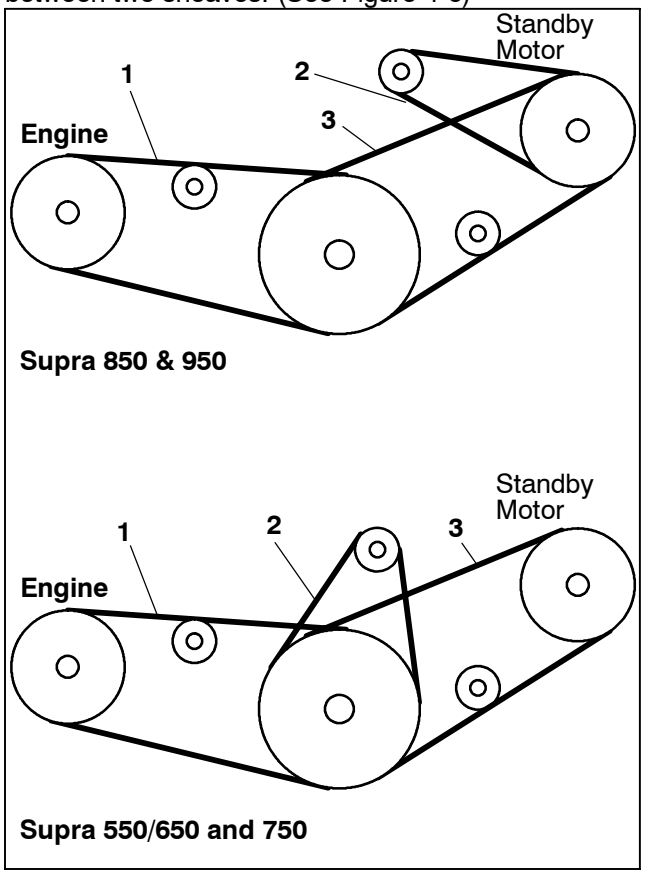
⚠ WARNING

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

4.2.1 Belt Tension Gauge

Use a belt tension gauge (Carrier P/N 07-00203, see Figure 4-7) when replacing or adjusting V-belts. The 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 4-6)



1 Engine to Compressor V-belt
2 Alternator V-belt
3 Standby Motor to Compressor V-belt

Figure 4-6. V-Belt Arrangement

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

When installing any new belts , preset the tension to the setting specified in the "New Install Tension column." After initial run in, check the tension; it should settle out to the setting specified in the "Running Tension" column. If the run tension is below the "Running Tension" range, re–tighten the belt to a value within this range. Refer to Table 4-2.

Table 4-2. Belt Tension (See Figure 4-7)

BELTS	New Install Tension (ft./lbs)	Running Tension (ft./lbs)
Water pump	30 to 50	
Engine to Compressor	90	80 to 90
Alternator	50	40 to 50
Standby Motor to Compressor	90	80 to 90

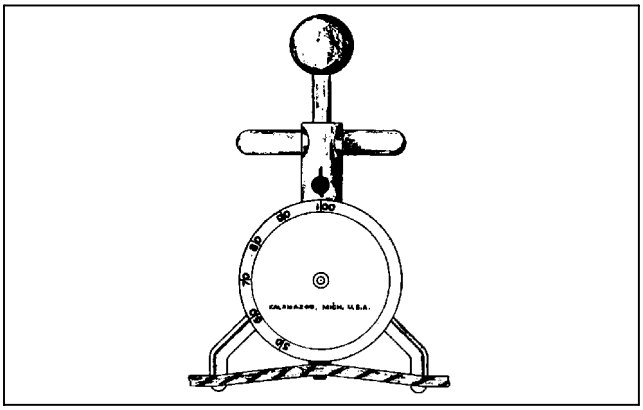


Figure 4-7 Belt Tension Gauge (Part No. 07-00203)

4.2.2 Alternator V-Belt

a. Make sure negative battery terminal is disconnected.

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

c. 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 4-2. Tighten pivot and adjustment bolts.

4.2.3 Water Pump Belt Tensioner

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

To change the water pump belt, proceed as follows:

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

b. After replacing V-belt, remove the bolt to release the spring to return the idler to it's correct tension.

4.2.4 Standby Motor-Compressor V-Belt

a. Remove alternator V-belt. (Refer to Section 4.2.2)

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

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

4.2.5 Engine-Compressor V-Belts

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

b. Remove alternator V-belt. (Refer to Section 4.2.2)

c. Remove the standby motor-compressor V-belt. (Refer to Section 4.2.4)

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

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

4.3 INSTALLING MANIFOLD GUAGE SET

A manifold gauge/hose set is required for service of models covered within this manual. The manifold gauge/hose set is available from Carrier Transicold. (Carrier Transicold P/N 07-00314-00, which includes items 1 through 4, Figure 4-8). To perform service using the manifold gauge/hose set, do the following:

4.3.1 Preparing Manifold Gauge/Hose Set For Use

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

b. Connect high and low side hoses to blank connections on back of manifold gauge set and midseat both hand valves.

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

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

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

4.3.2 Connecting Manifold Gauge/Hose Set

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

a. Remove service valve stem cap and check to make sure it is backseated. Remove access valve cap.

b. Connect the refrigeration hose (see Figure 4-8) to the access valve.

c. Read system pressures.

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

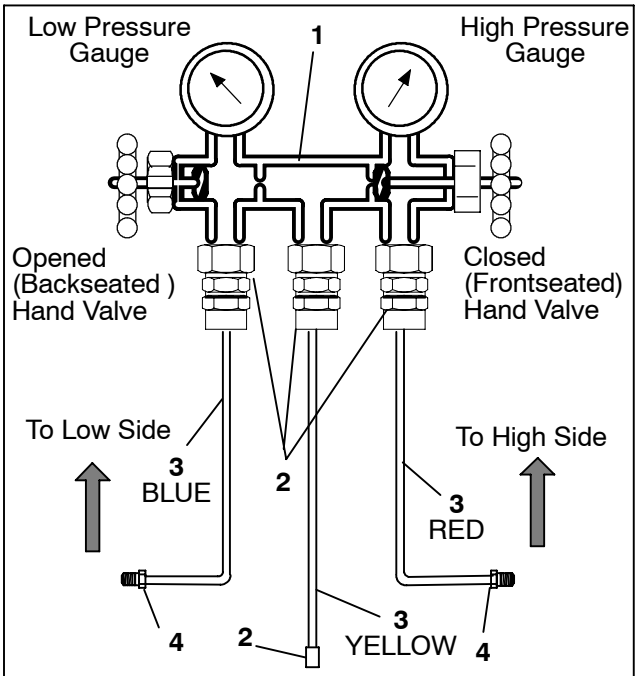
4.3.3 Removing the Manifold Gauge Set

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

⚠ CAUTION

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

3. Backseat the low side service valve. Frontseat both manifold set hand valves. Remove the refrigeration hoses from the access valves.
4. Install both service valve stem caps (finger-tight only).



1. Manifold Gauge Set
2. Hose Fitting
3. Refrigeration and/or Evacuation Hose)
4. Hose Fitting w/core depressor

Figure 4-8 Manifold Gauge Set

4.4 PUMPING THE UNIT DOWN OR REMOVING THE REFRIGERANT CHARGE

NOTE

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

a. Pumping the Unit Down

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

1. Backseat suction and discharge service valve (turn counterclockwise) to close off gauge connection and attach manifold gauges to valves.
2. Open valves two turns (clockwise). Purge gauge line.
3. Close the receiver outlet (king) valve by turning clockwise. Start unit and run in high speed cooling. Place RUN/STOP Switch in the STOP position when unit reaches 0.1 kg/cm^2 (1 psig).
4. Frontseat (close) suction service valve and the refrigerant will be trapped between the compressor suction service valve and the manual shutoff (King) valve.
5. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge.
6. When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.
7. When service has been completed. Open (backseat) King valve and midseat suction service valve.
8. Leak check connections with a leak detector. (Refer to section 4.5)
9. Start the unit in cooling and check for noncondensibles.
10. Check the refrigerant charge. (Refer to section 4.7.1)

NOTE

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

NOTE

Whenever the system is opened, it must be evacuated and dehydrated. (Refer to section 4.6)

b. Removing the Refrigerant Charge

Connect a refrigerant recovery system (Carrier p/n MVS-115-F-L-CT (115V) or MVS-240-F-L-CT (240V)) to the unit to remove refrigerant charge. Refer to instruction provided by the manufacture of the refrigerant recovery system.

4.5 REFRIGERANT LEAK CHECKING

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

a. The recommended procedure for finding leaks in a system is with an electronic leak detector (Carrier p/n 07-00295-00). Testing joints with soapsuds is satisfactory only for locating large leaks.

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

NOTE

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

c. Remove refrigerant using a refrigerant recovery system and repair any leaks. Evacuate and dehydrate the unit. (Refer to section 4.6) Charge unit with refrigerant. (Refer to section 4.7)

4.6 EVACUATION AND DEHYDRATION

4.6.1 General

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

4.6.2 Preparation

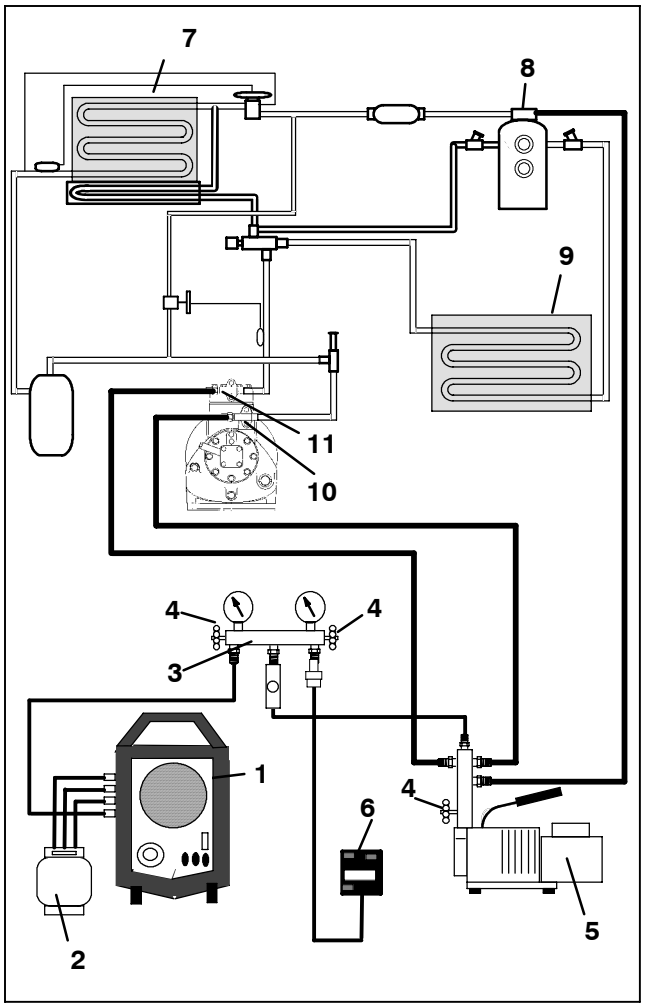
a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.5)

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). (Carrier p/n 0700414-00).

NOTE

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

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



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

Figure 4-9. Vacuum Pump Connection

4.6.3 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 4-9 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.

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 4.7)

4.7 CHARGING THE REFRIGERATION SYSTEM

⚠ CAUTION

Refrigerant R404A must be charged as a liquid. Refrigerant R404A is a blend. Charging as a vapor will change the properties of the refrigerant.

4.7.1 Checking the Refrigerant Charge

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

b. Partially block off air flow to condenser coil so discharge pressure rises to 210 psig (14.8 kg/cm^2).

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

4.7.2 Installing a Complete Charge (See Figure 4-10)

a. Dehydrate unit and leave in deep vacuum. (Refer to section 4.6)

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

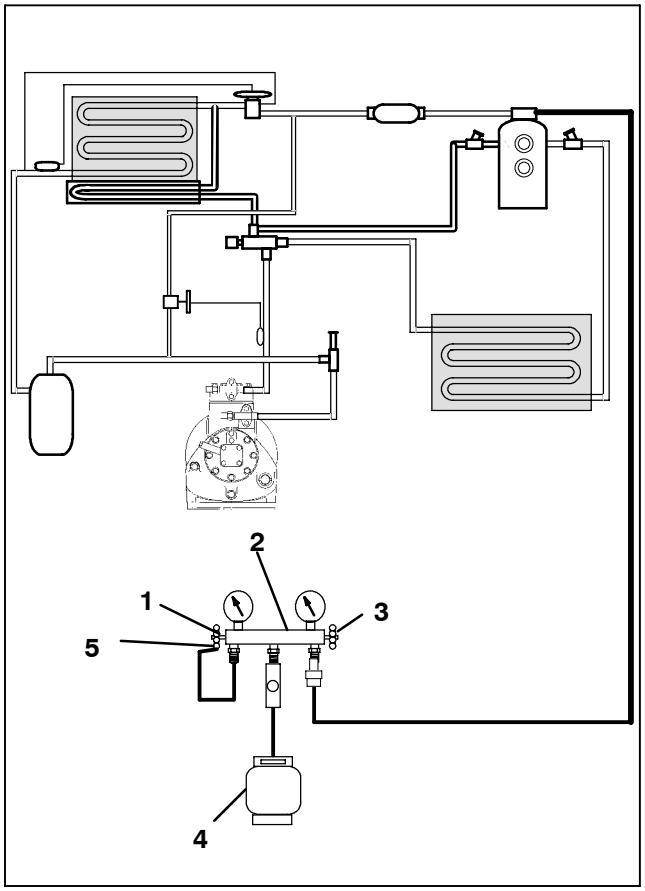
c. Note weight of refrigerant cylinder.

d. Open liquid valve on refrigerant cylinder. Open king valve half way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales. Correct charge will be found in section 1.3.

NOTE

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

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



1. Suction Valve (Low Side)
2. Manifold Gauge Set
3. Discharge Valve (High Side)
4. Refrigerant Cylinder
5. Dead Head Port

Figure 4-10. Procedure for Adding A Complete Charge

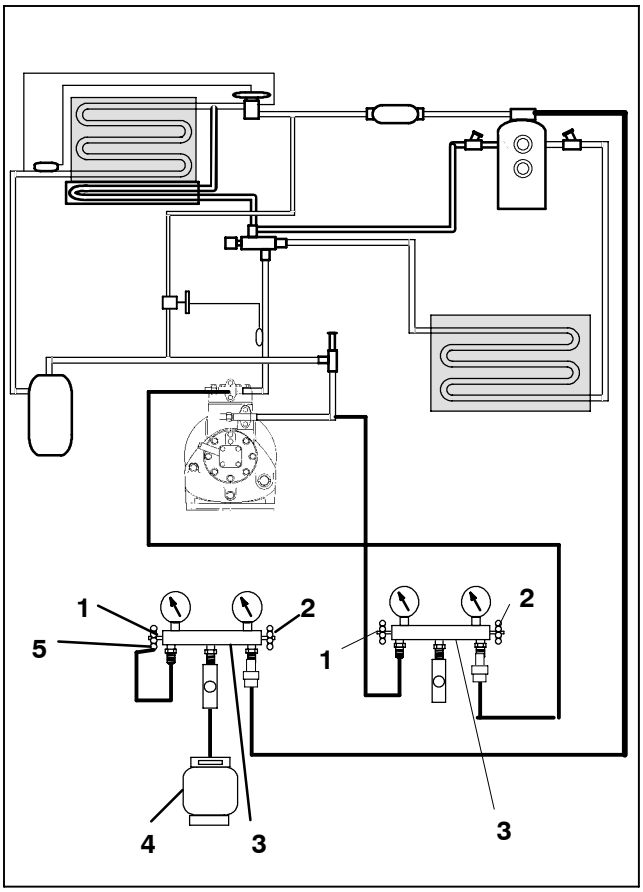
4.7.3 Adding A Partial Charge (See Figure 4-11)

⚠ CAUTION

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

NOTE

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



1. Suction Valve (Low Side)
2. Discharge Valve (High Side)
3. Manifold Gauge Set
4. Refrigerant Cylinder
5. Dead Head Port

Figure 4-11. Procedure for Adding A Partial Charge

a. Place drum of refrigerant on scale and note weight. Backseat discharge and suction service valves and install a manifold gauge set in order to monitor system. Purge lines. Connect the discharge gauge of a second manifold test set to the king valve. Connect the suction pressure hose to manifold dead head port. Connect a charging line between the center tap of the second gauge set and refrigerant drum. Midseat discharge knob. Open the liquid valve on drum and purge all hoses. Frontseat discharge knob. See Figure 4-11.

b. Start the unit with the road compressor turning at 2400 rpm.

c. Check the sight glass to determine charge. See Section 4.7.1. If undercharged, proceed with step d.

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

e. While monitoring the sight glass, carefully weigh refrigerant into the system. It is not possible to accurately determine when the system is full because unit is in discharge state; therefore, never allow more than 1 lb. (0.45 kg) of refrigerant into system at a time.

f. After monitoring 1 lb. (0.45 kg) of refrigerant into the system, close the valve of the manifold gauge set connected to the king valve. Open the king valve and allow the system to balance out to determine charge.

g. Follow the procedures of Section 4.7.1 and repeat above procedure as required to clear the sight glass.

h. Start unit and check for noncondensables.

4.8 REPLACING THE COMPRESSOR

⚠ WARNING

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

a. Removing

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

If compressor runs, pump down the unit. (Refer to section 4.4.a)

1. Slowly release compressor pressure to a recovery system.
2. Remove bolts from suction and discharge service valve flanges.
3. Disconnect wiring to compressor discharge temperature sensor (CDT), suction pressure transducer (SPT) and the wiring to the high pressure switch (HP).
4. Release idler pulleys and remove belts.
5. Remove the four bolts holding the compressor to the power tray. Remove the compressor from chassis.
6. Remove the pulley from the compressor.
7. Drain oil from defective compressor before shipping.

b. Installing

1. To install the compressor, reverse the procedure outlined when removing the compressor. Refer to section 1.6.5 for torque values.

NOTE

The service replacement compressor is sold without shutoff valves (but with valve pads). Customer should retain the original capacity control valves for use on replacement compressor. Check oil level in service replacement compressor. (Refer to sections 1.6.2, and 4.9)

2. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on both lines to pump.
3. Fully open (backseat) both suction and discharge service valves.
4. Remove vacuum pump lines and install manifold gauges.
5. Check refrigerant level (Refer to section 4.7.1)

NOTE

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

6. Check compressor oil level. (Refer to section 4.9) Add oil if necessary.
7. Check refrigerant cycles.

4.9 COMPRESSOR OIL LEVEL

4.9.1 Checking Oil Level

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. The correct level should be between bottom and 1/4 of the sight glass. If the level is above 1/4, oil must be removed from the compressor. To remove oil from the compressor, follow step 4.9.4. If the level is below sight glass, add oil to the compressor following 4.9.2.

4.9.2 Adding Oil with Compressor in System

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

Oil Pump Method

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

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

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

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.

4.9.3 Adding Oil to Service Replacement Compressor

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

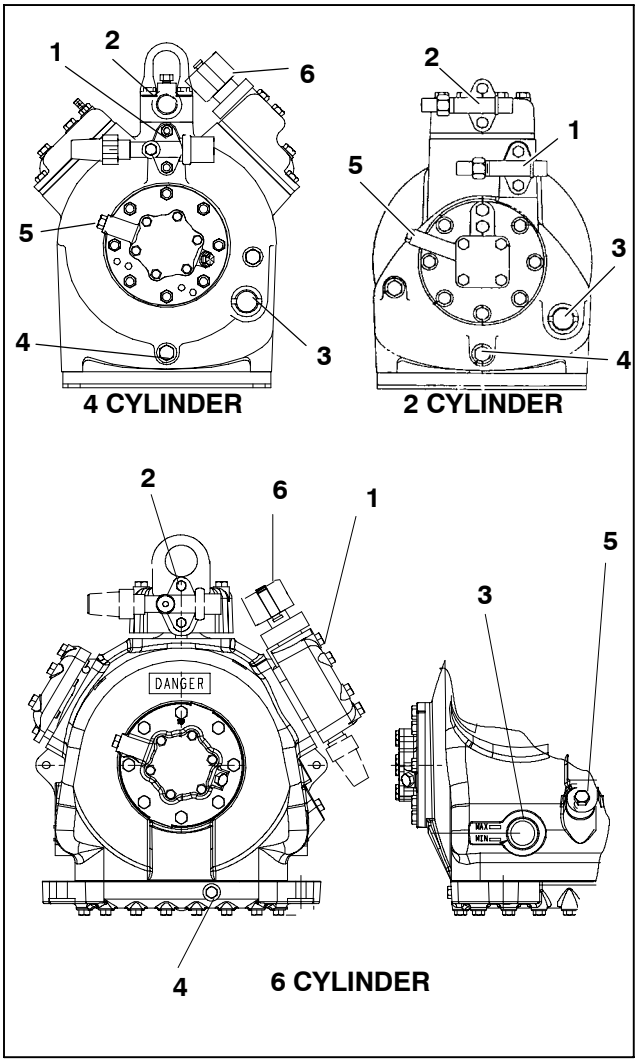
If compressor is without oil: Add correct oil charge (Refer to section 1.6.2) by removing the oil fill plug (See Figure 4-12)

4.9.4 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 compressor and drain the proper amount of oil from the compressor. Replace the plug securely back into the compressor.
3. Open service valves and run unit to check oil level, repeat as required to ensure proper oil level.

⚠ WARNING

Since refrigerant traps a certain quantity of oil, to avoid oil loss during maintenance, add 50 cc of POE oil to the refrigeration system when any evacuation is performed.



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

Figure 4-12. Compressor

4.10 COMPRESSOR UNLOADER VALVE (850 and 950 only)

The compressor unloader (located on the compressor cylinder head) is controlled by relay UFR and the temperature controller.

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 (unloader coil de-energized). Note suction pressure.
2. Remove wiring from the 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 coil will energize. Note suction pressure, a rise of approximately 3 psig (0.2 Bar) will be noted on the suction pressure gauge.
4. Reconnect wiring on the unloader.
5. Reverse the above procedure to check out compressor loading. Suction pressure will drop with this test.

NOTE

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

b. Solenoid Coil Replacement

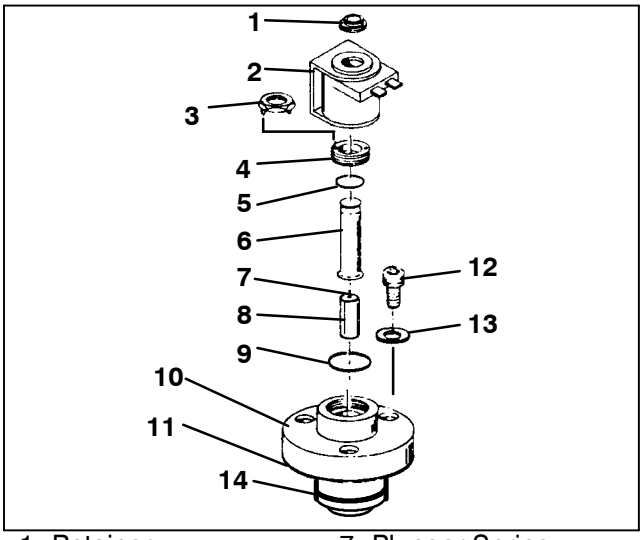
NOTE

The coil may be removed without pumping the unit down.

1. Disconnect leads. Remove retainer. Lift off coil. (See Figure 4-13)
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.

c. Replacing Solenoid Valve Internal Parts

1. Pump down the unit. Frontseat both service valves to isolate the compressor.
2. Remove coil retainer (see Figure 4-13), and coil.
3. Remove enclosing tube collar (item 4) 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.
8. Start unit and check unloader operation (Refer to section 4.10.a).



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 4-13. Unloader Solenoid Valve

4.11 CHECKING AND REPLACING FILTER-DRIER

To Check Filter

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 4.4. Remove bracket, then replace drier.

b. Check refrigerant level. (Refer to section 4.7.1)

4.12 CHECKING AND REPLACING HIGH PRESSURE SWITCH

4.12.1 Replacing High Pressure Switch

a. Pump down the unit. (Refer to section 4.4.a) Frontseat both suction and discharge service valves to isolate compressor.

b. *Slowly* release compressor pressure through the service valve gauge ports to refrigerant recovery device.

c. Disconnect wiring from defective switch. The high pressure switch is located near the top of the compressor. (See Figure 4-12)

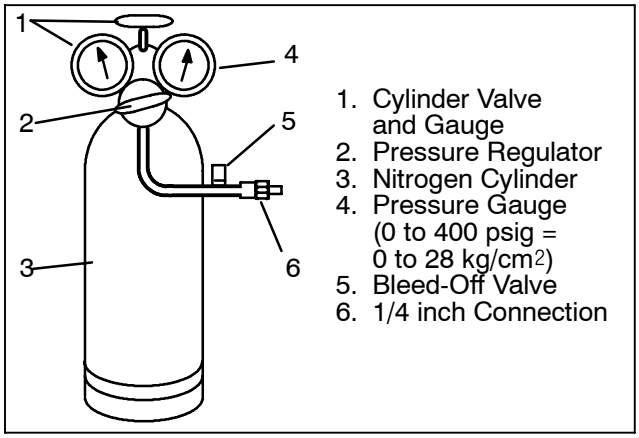
d. Install new cutout switch after verifying switch settings. (Refer to section 1.6.2)

e. Evacuate and dehydrate the compressor. (Refer to section 4.8)

4.12.2 Checking High Pressure Switch

⚠ 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 4-14)



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 4-14. Typical Setup for Testing High Pressure Switch

a. Remove switch as outlined in section 4.12.1.

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 4-14)

d. Set nitrogen pressure regulator higher than cutout point on switch being tested. Pressure switch cutout and cut-in points are shown in section 1.6.2.

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).

4.13 CHECKING CALIBRATION OF THE DEFROST AIR SWITCH

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 4-15)

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

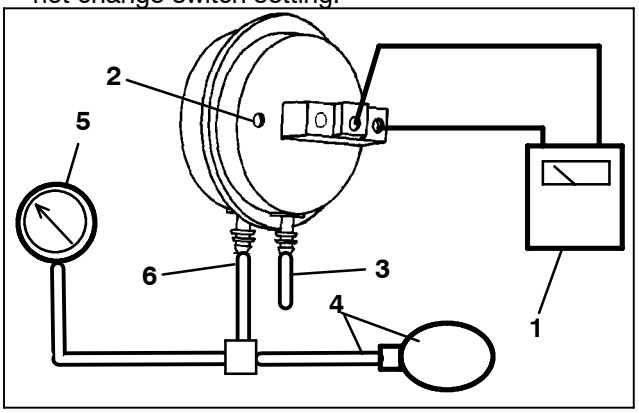
Use a hand aspirator (P/N 07-00177-01), since blowing into tube by mouth may cause an incorrect reading.

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 1.6.3 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 glycerol on the adjusting screw so that vibration will not change switch setting.



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 4-15. Defrost Air Switch Test Setup

4.14 CHECKING AND REPLACING EVAPORATOR FAN MOTOR BRUSHES & COMMUTATOR

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

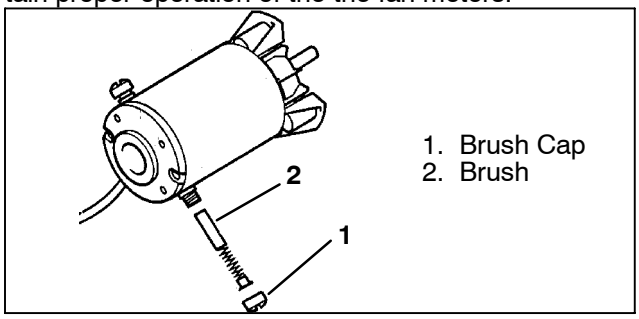


Figure 4-16. Fan Motor Brushes

To check brushes proceed as follows.

a. With unit off and battery disconnected, remove brush cap (item 1; 2 per motor). See Figure 4-16.

b. Remove brushes (item 2; 2 per motor) and check the length of the brush. If the length is less than 1/4 inch the brushes should be replaced (after checking commutator).

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

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

4.15 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.

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.

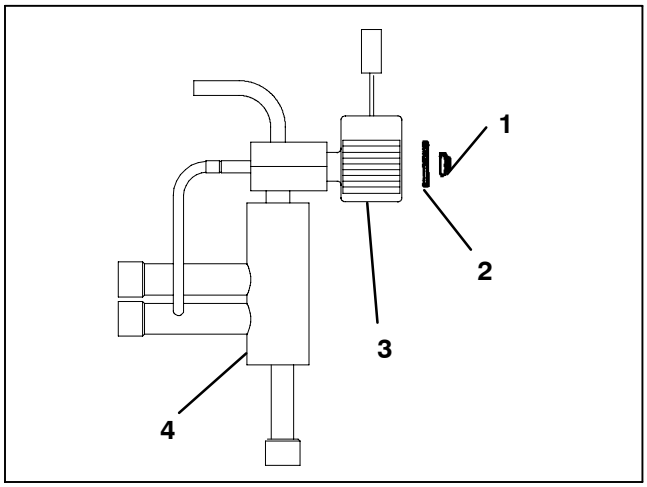
c. Run unit until defrost mode can be initiated to check for proper draining from drain pan.

4.16 CONDENSER COIL CLEANING

Refer to section 4.1.1

4.17 SOLENOID VALVES

4.17.1 Supra 550/650/750/850 3-Way Valve



1. Snap cap
2. Voltage plate
3. Coil assembly
4. Valve body assembly

Figure 4-17 HOT GAS (Three-Way) VALVE (Supra 550/650/750/850)

a. Replacing solenoid coil

It is not necessary to pump the unit down to replace the coil. (See Figure 4-17)

a. Remove snap cap to remove coil. Disconnect from harness.

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

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

d. Replacing solenoid valve internal parts

1 Remove and store the refrigerant charge in an evacuated container (Refer to Section 4.4).

2 Remove snap cap to remove coil.

3 Replace Valve Assembly

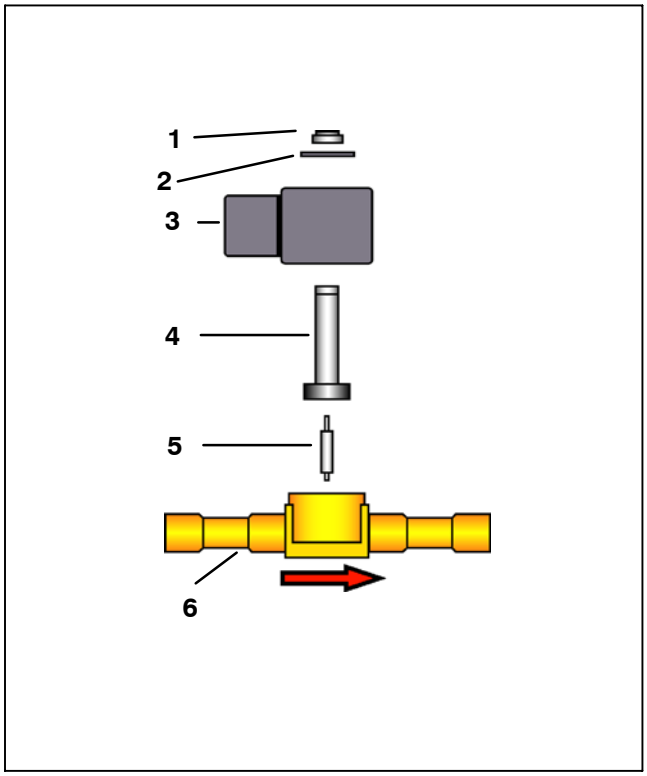
4 Install coil assembly, voltage plate and cap.

5 Leak check, evacuate and dehydrate the unit.

6 Install a complete refrigerant charge.

7 Start unit and check operation.

4.17.2 Hot Gas Valve (HGS2) and 3-Way Valve for Supra 950 (HGS2 not used on 950)



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

Figure 4-18 HOT GAS VALVE (HGS2) and Supra 950 3-Way Valve (HGS2 Shown)

a. Replacing solenoid coil

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

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

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

⚠ CAUTION

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

b. Replacing solenoid valve internal parts

If the valve is to be replaced or the internal parts serviced, the refrigerant charge must be removed.

1 Remove and store the refrigerant charge in an evacuated container (Refer to Section 4.4).

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

3 Check for foreign material in valve body.

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

5 Tighten enclosing tube assembly. If the valve has not been removed from the unit, leak check the valve.

6 Install coil assembly, voltage cover and cap.

7 Evacuate and dehydrate the unit.

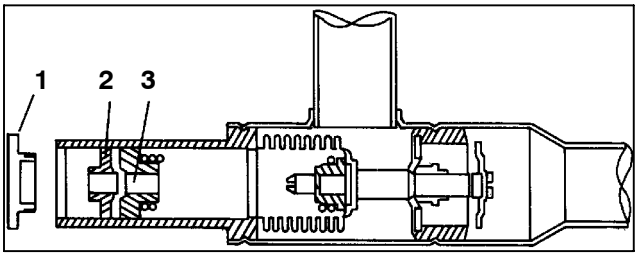
8 Install a complete refrigerant charge.

9 Start unit and check operation.

4.18 ADJUSTING THE COMPRESSOR PRESSURE REGULATING VALVE (CPR)

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

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



1. Cap
2. Jam Nut
3. Setting Screw

Figure 4-19. Compressor Pressure Regulating Valve

To adjust the CPR valve, proceed as follows:

a. Install a manifold gauge set.

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

c. With an 8 mm Allen wrench, loosen the jam nut (Figure 4-19, item 2).

d. Using the 8 mm Allen wrench, adjust the setting screw. To raise the suction pressure turn the setting screw (item 3) clockwise; to lower the suction pressure, turn the setting screw counterclockwise. Refer to section 1.6.3 for CPR valve setting.

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

4.19 THERMOSTATIC EXPANSION VALVE

The thermal expansion valve (see Figure 4-20) 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. During normal operation, the valve should not require any maintenance. If service is required, it should be performed only by trained personnel.

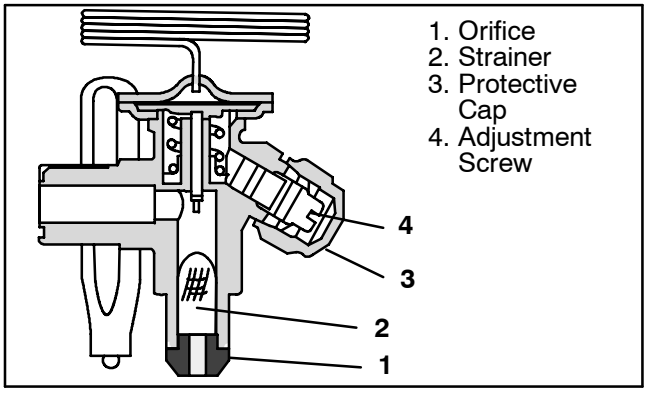


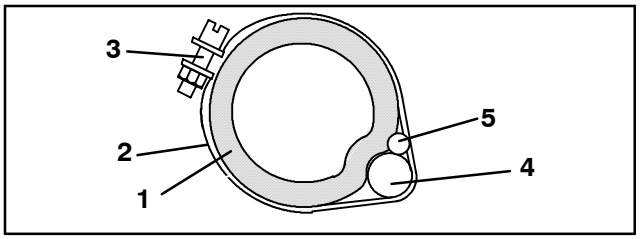
Figure 4-20. Thermostatic Expansion Valve

a. To Measure Superheat

NOTE

The expansion valve and bulb location are located on the road side of the evaporator.

1. Ensure charge level is correct (refer to section 4.7.1) and ensure CPR setting is correct (refer to section 4.18).
2. Remove insulation from expansion valve bulb and suction line. Ensure bulb and attachment area on suction line are clean.
3. Place thermocouple above (parallel to) TXV bulb and then secure clamps making sure both the bulb and thermocouple are firmly secured to suction line as shown in Figure 4-21. Reinstall insulation covering both bulb and sensor.
4. Connect an accurate gauge to the 1/4" port on the suction service valve.
5. In order to ensure the pressure at the expansion valve is stable enough for this procedure, operate the unit in high speed cooling until the box temperature is below 20°F (-6.7°C). Partially block off air flow to condenser coil to raise discharge pressure to 210 psig (14.8 kg/cm^2). Bring the setting to greater than 10 degrees below box temperature to ensure the unit remains in high speed cool with the unloaders de-energized.
6. Note the average temperature of the suction gas at the expansion valve bulb and average pressure on the gauge.
7. From the temperature/pressure chart, (Table 4-6) determine the saturation temperature corresponding to the suction pressure.
8. Subtract the saturation temperature determined in step 7 from the average temperature measured in step 6. The difference is the superheat of the suction gas. Refer to section 1.6.3. for required setting.



1. Suction Line
2. TXV Bulb Clamp
3. Nut and Bolt
4. TXV Bulb
5. Thermocouple

Figure 4-21. Thermostatic Expansion Valve Bulb and Thermocouple

b. Adjusting Superheat (See Figure 4-20)

1. Check superheat, refer to preceding step.
2. If superheat is too low, increase superheat by turning adjustment screw (see Figure 4-20) clockwise. Adjust in 1/4 turn increments (one complete turn equals approximately a seven degree change in superheat) and re-check superheat, repeating readings until they are consistent. Ensure maximum tolerance has not been exceeded.
3. If superheat is too high, decrease by turning adjustment screw (see Figure 4-20) counterclockwise. Adjust in 1/4 turn increments(one complete turn equals approximately a seven degree change in superheat) and re-check superheat, repeating readings until they are consistent. Ensure superheat is above minimum tolerance.
4. Replace valve if superheat cannot be adjusted to required setting.

c. Replacing Expansion Valve

1. Check superheat and adjust valve (if adjustable) in accordance with the preceding steps. If valve requires replacement, pump down the unit. (Refer to section 4.4.a)
2. Slowly loosen the nut at the base of the valve to relieve any remaining pressure. Pull the line away from the valve sufficient to remove the orifice and strainer (refer to Figure 4-20). Check condition of orifice and strainer, clean as necessary. If no foreign material is found, then proceed with replacing the valve. Retain orifice for reassembly.
3. Remove insulation from expansion valve bulb and then remove bulb from suction line.
4. Using inert gas brazing procedures (refer to Technical Procedure 98-50553-00), unbraze the equalizer line and, if required, distributor. Remove the strainer from the replacement valve and wrap in damp rags to prepare for brazing. Braze replacement valve in place. Install nut(s), orifice and strainer.
5. Strap thermal bulb to suction line and insulate both. It is recommended that the thermocouple required to check superheat be reinstalled at this time.
6. Leak check and evacuate low side by connecting at the suction and discharge service valve. Refer to sections 4.5 & 4.6 for general procedure.
7. Re-check superheat.

4.20 MICROPROCESSOR CONTROLLER

NOTE

The erasable, programmable, read only memory (EEPROM) chip (component U3 on the microprocessor logic board) has a label on it listing the revision level of the software.

⚠ 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 from Carrier (P/N 07-00304-00). It is recommended that these be worn whenever handling a microprocessor.

Table 4-3. Connection Point Voltage

Connection Point	Approximate Voltage
ATS, CDT, RAS, SAS, WTS	2.5 vdc (Variable)
MP23	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.

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 truck 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.

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 maintenance hourmeter which are set via the serial port. These maintenance hourmeter are compared to one of the hour meters (diesel, standby, or switch on). If the hour meter is greater than the maintenance hourmeter then the proper service alarm is triggered.

4.21 MICROPROCESSOR REPLACEMENT and CONFIGURATION

4.21.1 To Remove and Replace Microprocessor Logic Board:

1. Before removing the microprocessor, disconnect the negative battery cable and attach a grounded wrist strap (07-00304-00) to your wrist and ground it to a good unit frame ground.
2. Open the roadside side door of the unit and loosen the 4 bolts holding the cover / microprocessor onto the front of the control box.
3. Unplug the ribbon cable from the logic board but leave it connected to the cab command cable.
4. Take the new microprocessor from the anti-static bag and install in the control box, following steps 2–6 in reverse order.
5. Place the removed microprocessor back into the anti-static bag and part box for return.

NOTE

BEFORE STARTING THE UNIT: When replacing a microprocessor it is important to check that the configurations are compatible with the unit into which it will be installed.

4.21.2 To Reach The Configuration Fields From The Keypad:

1. Place the unit RUN/STOP Switch to the STOP position and the I/O Switch in the OFF position.
2. With the unit off, locate the serial port plug behind the control panel. Remove the protective cap 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 this wire to touch any ground.
3. Place the unit RUN/STOP Switch to the RUN position and the I/O Switch in the ON 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 cap***. The configuration screen will now remain available for five minutes. Scroll through the configuration list using the "FUNCTION" key and compare the settings with those shown in the table on the following page. If any of the configurations need to be changed, continue with step 4 below.
4. To change the configuration selection (refer to Table 4-4):
   A. Bring the configuration to be changed onto the display. Press the "ENTER" key to allow change access to the displayed configuration.
   B. Press either the "UP" or "DOWN" keys to display available selections for that configuration. Leave the correct selection on the screen. The selection display will flash, warning the operator that the displayed value has not been entered. Press the "ENTER" key to enter the new selection into memory. The display will revert to the original selection if no further action is taken for the next five seconds.
   C. Continue to scroll through the configuration list by pressing the "FUNCTION" key. Change any other configurations as required.
5. When finished, turn the RUN/STOP Switch to the STOP position, then back to the RUN position to start the unit.

4.22 CONTROLLER SENSOR CHECKOUT

An accurate ohmmeter must be used to check resistance values shown in Table 4-5 .

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 4-5.

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 4-4 Configuration Table

CONFIGURATION		DESCRIPTION	
CNF1 Note 1	ON (TV)	Short glow cycle 650, 750, 850 and 950 Prior to S/N YY0000	
	OFF (DI)	Long glow cycle All other units	
CNF2	OFF	CDT not used - 850 Only	
	ON	CDT used - 550, 650, 750 and 950	
***CNF3** Note 3	**OFF**	Max Set Point +86°F (All functions locked)	
	ON	Max Set Point +90°F (Modified function lock)	
CNF4	**OFF**	All units	
	ON		
CNF5	OFF	Units without unloaders (550, 650, 750 and 850)	
	ON	Units with unloaders - 950 Only	
CNF6	**OFF**		
	ON	All units	
CNF7	**OFF**	High Speed Start	Rev. 3.25 and higher only
	ON	Low speed only engine warm-up - Not recommended	Prior to Rev 3.25 Do Not Turn On
CNF8	**OFF**	950 Only	
	ON	550, 650, 750 and 850	
***CNF9** Note 2	**OFF**	Out-of-range alarm only	
	ON	Out-of-range alarm and unit shut down	
CNF10	**OFF**	Standby Diesel Backup is disabled.	Rev. 3.23 and higher only (CNF6 Must be ON)
	ON	Enables Standby Diesel Backup.	
***CNF11** Note 3	**OFF**	Functions changes normal	
	ON	Functions & Start Stop locked	
CNF12	OFF	550, 650, 750 and 850 Only	
	ON	950 Only	
CNF13	**OFF**	All units	
	ON	***Do Not Turn On!***	
CNF14	**OFF**	All units	
	ON	***Do Not Turn On!***	
* CNF15	OFF	TDS	Rev. 3.29 and higher only
	ON	TDB	

NOTES

* These settings are optional and can be set to customer specifications or left at default values. All other settings (not marked with *) **MUST** be set as shown for proper unit operation.

1. **CNF1** determines the length of the glow cycle, which varies depending on the type of engine in the unit. When CNF 25 is ON, the CNF1 setting is not used.

2. **CNF9** allows selection of how the unit will react under an Out-Of-Range condition. An Out-Of-Range condition is described as the box temperature having arrived at setpoint, then drifting away from setpoint. With this CNF in the OFF position, once the box temperature has been Out-Of-Range for 15 minutes, the ALARM light will be turned on and the alarm display "OUT RANGE" will be displayed alternately with the default display of the setpoint and box temperature. With this CNF in the ON position, once the box temperature has been Out_Of_Range for 45 minutes, the unit will shut down, and the same alarms as described above will be displayed.

3. **CNF3 & CNF11**
   Standard Function Lock allows the Function Key and the Start/Stop-Continuous Run Key to be locked so that no changes can be made.

   Modified Function Lock is the same as Standard Function Lock except that with the setpoint at or between +32 and +42°F (0 and 5.6°C), the unit will always operate in Continuous Run. If the setpoint is outside this range, either Start/Stop or Continuous Run can be selected.
   The maximum setpoint and function lock are controlled via a combination of CNF3 and CNF11:

   CNF11 OFF / CNF3 OFF: Maximum set point 86°F (30°C) - No function lock

   CNF11 ON / CNF3 OFF: Maximum set point 86°F (30°C) - Standard function lock

   CNF11 OFF / CNF3 ON: Maximum set point 90°F (32.2°C) - No function lock

   CNF11 ON / CNF3 ON: Maximum set point 90°F (32.2°C) - Modified function lock

4. **CNF20** allows the Fahrenheit / Celsius function to be locked. In order to change the units setting, CNF20 must be OFF. The units setting can then be changed in the functional parameters list. If CNF20 is ON the units setting cannot be changed from the functional parameters list.

Table 4-4. Configuration Codes (Continued)				
* CNF16	**OFF**	Alt Aux alarm only		
	ON	Alt Aux alarm shuts unit down		
CNF17	OFF	UltraFreeze disabled	Rev. 3.20 and higher only	
	ON	UltraFreeze control on.		
CNF18	OFF	SYSTEM CK alarm Off	Rev. 3.20 and higher only	
	ON	SYSTEM CK alarm On		
CNF19	OFF	All units		
	ON	***Do Not Turn On!***		
* **CNF20** Note 4	**OFF**	°F / °C Unlocked	Rev. 3.23 and higher only	
	ON	°F / °C Locked		
CNF21	OFF	All units		
	ON	***Do Not Turn On!***		
CNF22	OFF	For Future Use		
	ON	***Do Not Turn On!***		
CNF23	OFF	Set Point not Locked	Rev. 3.29 and higher only	
	OFF	Set Point Locked		
CNF24	**OFF**	WT Sensor Alarm is alarm only	Rev. 3.29 and higher only CNF6 Must be ON	
	ON	WT Sensor Alarm is Unit Shutdown		
* **CNF25**	**ON**	Tier 4i Engine with air heater.		
CNF26	**OFF**	For future use. Do not turn on.		
CNF27	**OFF**	For future use. Do not turn on.		
CNF28	**OFF**	For future use. Do not turn on.		
CNF29	**OFF**	For future use. Do not turn on.		
CNF30	**OFF**	For future use. Do not turn on.		
CNF31	**OFF**	For future use. Do not turn on.		
CNF32	**OFF**	For future use. Do not turn on.		

4.23 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.

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

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

Table 4-5. Sensor Resistance – Micro Units (ATS,CDT, RAS, SAS & WTS)

Temperature		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
325	163	–	1,358
350	177	–	1,202

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

Temperature		Pressure			Temperature		Pressure		
°F	°C	Psig	Kg/cm2	Bar	°F	°C	Psig	Kg/cm2	Bar
-40	-40	4.5	0.32	0.31	32	0	72.5	5.10	5.00
-35	-37	7.1	0.50	0.49	34	1	75.6	5.32	5.21
-30	-34	9.9	0.70	0.68	36	2	78.8	5.54	5.43
-25	-32	12.9	0.91	0.89	38	3	82.1	5.77	5.66
-20	-29	16.3	1.15	1.12	40	4	85.5	6.01	5.90
-18	-28	17.7	1.24	1.22	42	6	89.0	6.26	6.14
-16	-27	19.2	1.35	1.32	44	7	92.5	6.50	6.38
-14	-26	20.7	1.46	1.43	46	8	96.2	6.76	6.63
-12	-24	22.3	1.57	1.54	48	9	99.9	7.02	6.89
-10	-23	23.9	1.68	1.65	50	10	103.7	7.29	7.15
-8	-22	25.6	1.80	1.77	55	13	115.4	8.11	7.96
-6	-21	27.3	1.92	1.88	60	16	126.1	8.87	8.69
-4	-20	29.1	2.05	2.01	65	18	137.4	9.66	9.47
-2	-19	30.9	2.17	2.13	70	21	149.4	10.50	10.30
0	-18	32.8	2.31	2.26	75	24	162.1	11.40	11.18
2	-17	34.8	2.45	2.40	80	27	175.5	12.34	12.10
4	-16	36.8	2.59	2.54	85	29	189.6	13.33	13.07
6	-14	38.9	2.73	2.68	90	32	204.5	14.38	14.10
8	-13	41.1	2.89	2.83	95	35	220.2	15.48	15.18
10	-12	43.3	3.04	2.99	100	38	236.8	16.65	16.33
12	-11	45.6	3.21	3.14	105	41	254.2	17.87	17.53
14	-10	48.0	3.37	3.31	110	43	272.4	19.15	18.78
16	-9	50.4	3.54	3.47	115	46	291.6	20.50	20.11
18	-8	52.9	3.72	3.65	120	49	311.8	21.92	21.50
20	-7	55.5	3.90	3.83	125	52	332.9	23.41	22.95
22	-6	58.1	4.08	4.01	130	54	355.0	24.96	24.48
24	-4	60.9	4.28	4.20	135	57	378.1	26.58	26.07
26	-3	63.7	4.48	4.39	140	60	402.3	28.28	27.74
28	-2	66.5	4.68	4.59	145	63	427.6	30.06	29.48
30	-1	69.5	4.89	4.79	150	66	454.0	31.92	31.30

SECTION 5
TROUBLESHOOTING

CAUTION

**DO NOT attempt to service the microprocessor or the logic or display boards!
Should a problem develop with the microprocessor, contact your nearest Carrier Transicold dealer for replacement.**

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.1 DIESEL ENGINE		
5.1.1 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 5.1.3 Engine Manual 5.1.4 1.6
Starter motor cranks but engine fails to start	No fuel in tank Air in fuel system Water in fuel system Plugged fuel filters Plugged fuel lines to injector (s) Fuel control operation erratic Glow plug(s) defective Run solenoid defective Fuel pump (FP) malfunction	Check Check Drain Sump Replace Check Engine Manual 4.1.6 4.1.3 4.1.5
Starter cranks, engages, but dies after a few seconds	Engine lube oil too heavy Voltage drop in starter cable(s)	1.6 Check
5.1.2 Engine Starts Then Stops		
Engine stops after several rotations	Fuel supply restricted No fuel in tank Leak in fuel system Faulty fuel control operation Fuel filter restricted Injector nozzle(s) defective Injection pump defective Air cleaner or hose restricted Safety device open Open wiring circuit to run solenoid Fuel pump (FP) malfunction	Check Fill Tank Repair Engine Manual 4.1.5 Engine Manual Engine Manual 4.1.4 1.7 4.1.3 4.1.5
5.1.3 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 I/O or START/RUN Switch defective Engine lube oil too heavy	Check Check Replace Engine Manual Engine Manual Engine Manual Replace 1.6

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.1.3 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	I/O or START/RUN Switch defective Starter motor solenoid defective	Replace Engine Manual
Pinion does not disengage after engine is running	Defective starter	Engine Manual
5.1.4 Malfunction In the Engine Starting Circuit		
No power to starter motor solenoid (SS)	Battery defective Loose electrical connections	Check Tighten
Run solenoid does not energize or does not remain energized	Battery defective Loose electrical connections Oil pressure safety switch (OP) defective Run relay (RR) defective Water temperature safety switch open Water temperature sensor (WTS) defective Run solenoid defective I/O or START/RUN Switch defective	Check Tighten Replace Replace 1.6 Replace 4.1.3 Replace
5.2 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 4.2 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	4.2 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	4.2 Replace 4.2 Tighten

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3 REFRIGERATION		
5.3.1 Unit Will Not Cool		
Diesel engine	Malfunction(s)	5.1
Compressor malfunction	Compressor drive defective Compressor defective	4.8 4.8
Refrigeration system	Defrost cycle did not terminate Abnormal pressure Hot Gas (three-way) valve malfunction	5.3.5 5.3.6 5.3.11
5.3.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor valves defective Unloader malfunction	4.8 4.10
Refrigeration system	Abnormal pressure Expansion valve malfunction No or restricted evaporator airflow Unloader malfunction	5.3.6 5.3.10 5.3.9 4.10
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.1.3 5.1
5.3.3 Unit Operates Long or Continuously in Cooling		
Container	Hot Load Defective box insulation or air leak	Allow time to pull down Correct
Refrigeration system	Abnormal pressure Temperature controller malfunction	5.3.6 5.3.8
Compressor	Defective	4.8
5.3.4 Unit Will Not Heat or Has Insufficient Heating		
Refrigeration	Abnormal pressure Temperature controller malfunction Hot Gas (three-way) valve malfunction	5.3.6 5.3.8 5.3.11
Compressor	Compressor drive defective Compressor defective	4.8 4.8
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.1.3 5.1

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.5 Defrost Cycle Malfunction		
Will not initiate defrost automatically	Defrost air switch (DA) out of calibration Defrost thermostat (DTT) open or defective Defrost air switch (DA) defective Loose terminal connections Air sensing tubes defective or disconnected	4.13 Replace 4.13 Tighten Check
Will not initiate defrost manually	Microprocessor defective Loose terminal connections Defrost thermostat (DTT) open or defective	Replace Tighten Replace
Initiates but does not defrost	Hot Gas (three-way) valve malfunction Defrost relay (DR) defective Evaporator Clutch defective	5.3.11 Replace Replace
Frequent defrost	Defrost air switch (DA) out of adjustment Wet load	4.13 Normal
Does not terminate or cycles on defrost	Defrost thermostat (DTT) shorted closed Defrost air switch (DA) out of adjustment	Replace 4.13
5.3.6 Abnormal Pressure **5.3.6.1 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	Replace 4.16 Check 4.2 Replace Replace
Low discharge pressure	Compressor valves(s) worn or broken Hot Gas (three-way) valve malfunction	4.8 4.17
High suction pressure	Compressor valves(s) worn or broken Compressor gasket(s) defective Hot Gas (three-way) valve malfunction	4.8 4.8 4.17
Low suction pressure	Suction service valve partially closed King valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction No evaporator air flow or restricted air flow Excessive frost on coil	Open Open 4.11 4.7 5.3.10 5.3.9 Check
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective Hot Gas (three-way) valve malfunction	4.8 4.17

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.6.2 Heating		
High discharge pressure	Overcharged system Condenser fan defective V-belts broken or loose Noncondensibles in system	4.7.1 Check 4.2 Check
Low discharge pressure	Compressor valve(s) worn or broken Hot Gas (three-way) valve malfunction Low refrigerant charge	4.8 4.17 4.7
Low suction pressure	Refrigerant shortage Compressor pressure regulating valve malfunction Suction service valve partially closed	4.7 4.18 Open
5.3.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	Tighten 4.8 4.8 5.3.10 4.9
Condenser or evaporator fan	Loose or striking shroud Bearings defective Bent shaft	Check Check Check
V-belts	Cracked or worn	4.2
5.3.8 Control System Malfunction		
Will not control	Sensor defective Relay(s) defective Microprocessor controller malfunction Solid State controller malfunction	4.22 Check 4.20 Replace
5.3.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil Dirty coil Fan motor(s) malfunction	Check 4.15 4.14
No or partial evaporator air flow	V-belt broken or loose Clutch defective Evaporator fan loose or defective Evaporator fan rotating backwards Evaporator air flow blocked in trailer (box) Fan motor(s) malfunction	4.2 Replace Check 4.2 Check 4.14

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.10 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	4.5/4.7 Clean 4.6 4.19 4.19 Replace Replace 4.19
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	4.19 Open 4.6 Clean 4.19
Fluctuating suction pressure	Improper bulb location or installation Low superheat setting	4.19 4.19
High superheat	Broken capillary	4.19
5.3.11 Hot Gas (Three-Way) Valve Malfunction		
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 Temperature controller malfunction Movement of plunger restricted due to: a. Corroded or worn parts b. Foreign material lodged in valve c. Bent or dented enclosing tube	Check Check 4.17 4.17 4.17 Replace 4.17
Valve shifts but refrigerant continues to flow	Foreign material lodged under seat Defective seat	4.17 4.17
5.4 Standby Motor Malfunction		
Standby motor fails to start	Motor contactor (MC) defective Motor Overload (OL) open Improper power supply Oil pressure switch (OPS) open Cab Command defective	Replace Replace motor 1.6.4 Check Replace
Standby motor starts, then stops	Motor Overload (OL) open High amperage draw	1.6.4 Check

SECTION 6
ELECTRICAL SCHEMATIC WIRING DIAGRAM

INTRODUCTION

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

⚠ WARNING

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

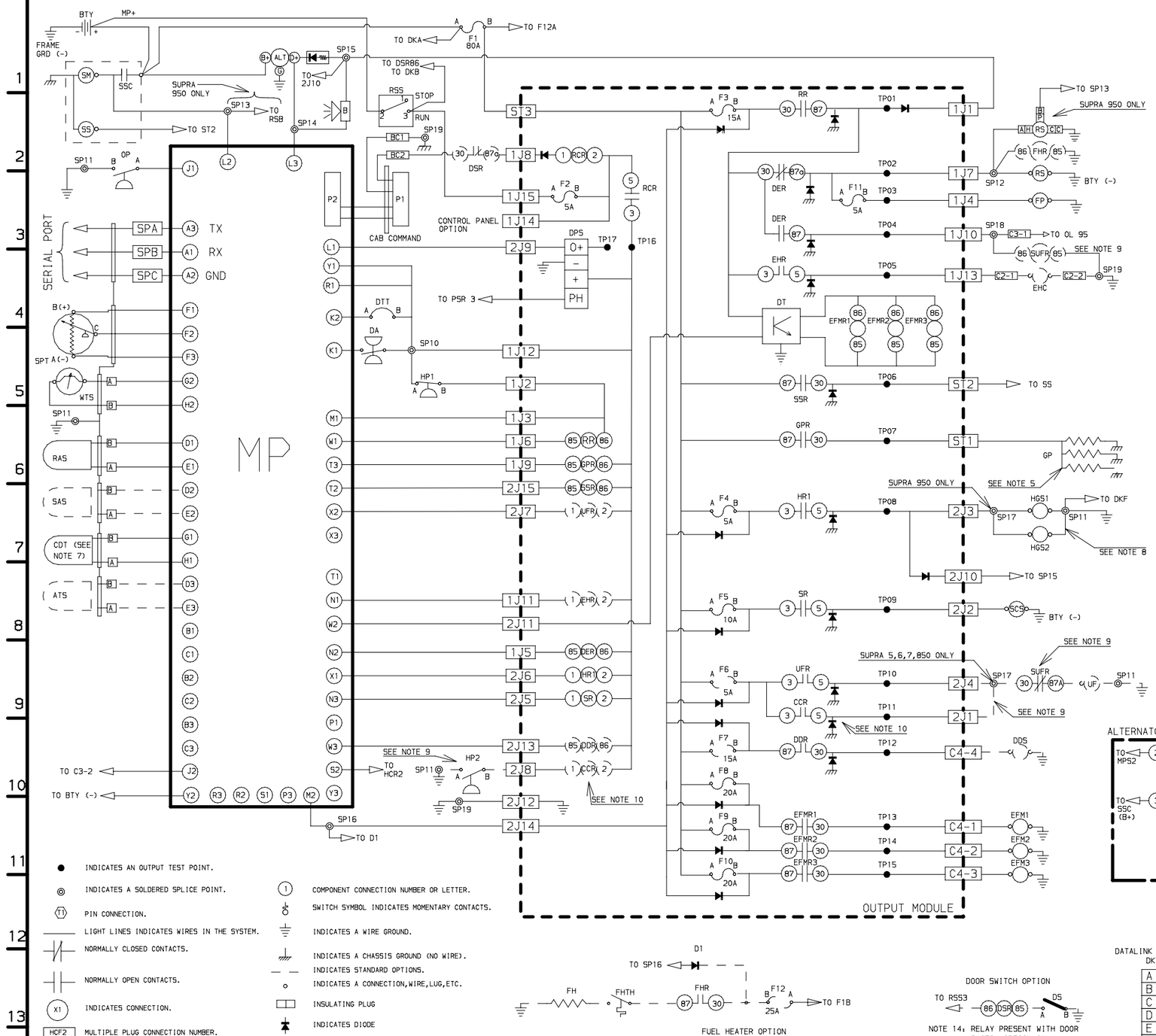
Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity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

⚠ CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the truck/trailer microprocessor.

SUPRA MICRO

SUPRA 550, 650, 750, 850, 950

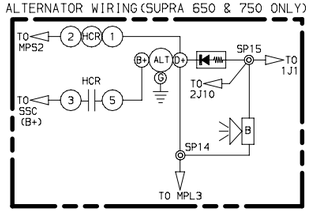


LOCATION	SYMBOL	DESCRIPTION	LOCATION
D-1/T-10	ALT	ALTERNATOR	MID FRAME
A-8	ATS	AMBIENT TEMPERATURE SENSOR	CONDENSER
E-1	B	BUZZER	CONTROL BOX
A-1	BTY	BATTERY	
R-10	CC	COMPRESSOR CLUTCH	COMPRESSOR
J-10/N-10	CCR	COMPRESSOR CLUTCH RELAY	CONTROL BOX
A-7	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR	COMPRESSOR
F-5	DA	DEFROST AIR SWITCH	FRAME
J-9/M-3	DER	DIESEL ELECTRIC RELAY	CONTROL BOX
R-10	DDS	DEFROST DAMPER SOLENOID (OPTION)	EVAPORATOR
J-10/N-10	DDR	DEFROST DAMPER RELAY (OPTION)	CONTROL BOX
R-13	DK	DATALINK CONNECTOR	CONTROL BOX
J-4	DPS	DETECTOR POWER SUPPLY	CONTROL BOX
Q13/H2	DSR	DOOR SWITCH RELAY	OPTION
R-13	DS	DOOR SWITCH	OPTION
J-8/M-4	DT	DEFROST THERMOSTAT	CONTROL BOX
F-4	DTT	DEFROST THERMOSTAT	EVAPORATOR
Q-12	EFM1,2,3	ELECTRIC FAN MOTOR	EVAPORATOR
O-5/M-12	EFMR1,2,3	ELECTRIC FAN MOTOR RELAY	CONTROL BOX
Q-4	EHC	EVAPORATOR HEAT CONTACTOR	CONTROL BOX
J-8/M-4	EHR	EVAPORATOR HEAT RELAY	CONTROL BOX
G-1	F1	FUSE 80A	CONTROL BOX
I-3/O-3	F2,F11	FUSE 5A	CONTROL BOX
L-2/L-10	F3,F7	FUSE 15A	CONTROL BOX
L-7	F4	FUSE 5A	CONTROL BOX
L-8	F5	FUSE 10A	CONTROL BOX
L-9	F6	FUSE 5A	CONTROL BOX
L-11	F8,F9,F10	FUSE 20A	CONTROL BOX
M-13	F12	FUSE 25A	CONTROL BOX
J-13	FH	FUEL HEATER (OPTION)	ENGINE
Q-2/M-13	FHR	FUEL HEATER RELAY (OPTION)	CONTROL BOX
K-13 OR S-2	FHTH	FUEL HEATER THERMOSTAT (OPTION)	ENGINE
R-3	FP	FUEL PUMP	FUEL TANK
R-6	GP	GLOW PLUG	ENGINE
J-6/N-6	GPR	GLOW PLUG RELAY	CONTROL BOX
S-10	HCR	HIGH CURRENT RELAY	FRAME
Q-7	HGS1,2	HOT GAS SOLENOID	FRAME
G-5	HP1	HIGH PRESSURE CUT OUT SWITCH	COMPRESSOR
G-10	HP2	HIGH PRESSURE CUT OUT SWITCH	COMPRESSOR
J-9/M-7	HR1	HEAT RELAY 1	CONTROL BOX
D-6	MP	MICROPROCESSOR BOARD	CONTROL BOX
P-1/N-2	MC1	MOTOR CONTACTOR (SEE 62-04083)	CONTROL BOX
O-1/P-2	OL	OVERLOAD PROTECTOR (SEE 62-04083)	CONTROL BOX
B-2	OP	OIL PRESSURE SAFETY SWITCH (NO)	ENGINE
F-3	P1	CAB COMMAND PLUG CONNECTOR	CONTROL BOX
E-3	P2	MICROPROCESSOR CAB COMMAND PLUG CONNECTOR	CONTROL BOX
M-2	P5R	POWER SUPPLY RECEPTACLE (SEE 62-04083)	
A-6	RAS	RETURN AIR SENSOR	EVAPORATOR
I-2/J-3	RCR	RUN CONTROL RELAY	ENGINE
J-6/M-2	RR	RUN RELAY	CONTROL BOX
Q-2	RS	RUN SOLENOID	ENGINE
F-2	RSS	RUN STOP SWITCH	CONTROL BOX
A-7	SAS	SUPPLY AIR SENSOR (OPTION)	EVAPORATOR
P-2	SBM	STANDBY MOTOR (SEE 62-04083)	FRAME
Q-8	SCS	SPEED CONTROL SOLENOID	ENGINE
A-1	SM	STARTER MOTOR	ENGINE
A-3	SP	SERIAL PORT RS232	CONTROL BOX
A-4	SPT	SUCTION PRESSURE TRANSDUCER	COMPRESSOR
J-9/N-8	SR	SPEED RELAY	CONTROL BOX
A-2/R-5	SS	STARTER SOLENOID	STARTER
C-1	SSC	STARTER SOLENOID CONTACTOR	STARTER
J-6/M-5	SSR	STARTER SOLENOID RELAY	CONTROL BOX
Q-3/R-9	SUFR	STANDBY UNLOADER FRONT RELAY	CONTROL BOX
J-7/N-9	UFR	UNLOADER FRONT RELAY	CONTROL BOX
R-9	UF	UNLOADER FRONT	COMPRESSOR
A-5	WTS	WATER TEMPERATURE SENSOR	ENGINE

NOTES :

1. UNIT SHOWN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
   COLOR: GREEN - DC CONTROL CIRCUITS
   BLACK - DC GROUNDS
   RED - AC CIRCUITS
   GREEN/YELLOW - AC GROUNDS
3. ADDRESS SYSTEM: EXAMPLE: HCD2-MPW2 INDICATES A WIRE BETWEEN PLUG HC-PIN D2 AND MICROPROCESSOR MP AND PIN W2.
4. VOLTAGE BELOW 12 VOLTS. REFER TO OWNERS MANUAL FOR TROUBLESHOOTING PROCEDURE.
5. ENGINE CT2-29 2 GLOW PLUGS
   ENGINE CT3-44 3 GLOW PLUGS
6. NO CONNECTION OF STANDBY PANEL (OL,MC) AND DPS
7. ONLY FOR VERSIONS: 550, 650, 750 AND 950
8. HGS2 ONLY FOR VERSIONS: 550, 650, 750, 850
9. HP2,CCR AND SUFR ONLY FOR SUPRA 850
10. FOR CCR: REFERENCE AS UFR2.

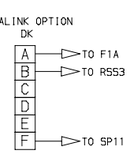
ALTERNATOR WIRING(SUPRA 650 & 750 ONLY)



- ● INDICATES AN OUTPUT TEST POINT.
- ◎ INDICATES A SOLDERED SPLICE POINT.
- (T1) PIN CONNECTION.
- LIGHT LINES INDICATES WIRES IN THE SYSTEM.
- NORMALLY CLOSED CONTACTS.
- NORMALLY OPEN CONTACTS.
- (X1) INDICATES CONNECTION.
- HCF2 MULTIPLE PLUG CONNECTION NUMBER.
- (1) COMPONENT CONNECTION NUMBER OR LETTER.
- SWITCH SYMBOL INDICATES MOMENTARY CONTACTS.
- INDICATES A WIRE GROUND.
- INDICATES A CHASSIS GROUND (NO WIRE).
- INDICATES STANDARD OPTIONS.
- INDICATES A CONNECTION,WIRE,LUG,ETC.
- INSULATING PLUG
- INDICATES DIODE

FUEL HEATER OPTION

NOTE 14: RELAY PRESENT WITH DOOR SWITCH OPTION ONLY.



Based on Drawing 62-04094 Rev A

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