OPERATION AND SERVICE MANUAL

TRUCK REFRIGERATION UNIT

SUPRA

750Mt°, 850Mt°, 950Mt°
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SECTION 1

SAFETY INSTRUCTIONS

This manual contains safety and service instructions to follow in order to prevent any accident. Stickers have been placed on the product for your SAFETY.

BEFORE USING THIS REFRIGERANT UNIT, read carefully all safety information explained in this manual and indicated on the product. Be sure that everybody who will use this refrigeration unit has been trained to use it in a safe way.

DURING THE USE OR MAINTENANCE OF THIS REFRIGERATION UNIT, the notes on safety are to be considered.

---

Personal Protective Equipment:
Always use adequate Personal Protective Equipment before doing anything on this refrigerant unit, as explained in this manual.

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Working at height:
Take all necessary safety precautions when accessing this refrigeration unit: use safe ladders, working platforms with appropriate guards.

---

Automatic start:
This refrigeration unit is equipped with Auto–Start/Stop, a valuable fuel saving feature. When this refrigeration unit is set for Auto–start/Stop operation it may start at any time and without warning.
Before servicing refrigeration unit, make sure the main power switch is on the OFF position. Ensure the unit will not restart.
Lock-out / Tag-out can be performed by disconnecting and enclosing:
- The negative battery cable in diesel mode;
- The electrical plug in electrical mode.
Belts and fans:
This refrigeration unit is equipped with Auto-start/stop, it may start at any time and without warning.
When the unit is running beware of belts and fans that are moving.
Before servicing refrigeration unit, make sure the main power switch is on the OFF position. Ensure the unit will not restart. Lock-out / Tag-out can be performed as described above.
When there is protective structure (fan grid or guard for example) make sure they are in place. Never removed them when the refrigeration unit is running.
Always keep your hands, body parts, clothes, hairs and tools far from moving parts.

Electricity:
When this refrigeration unit is running in electrical operation, some devices are powered up especially in the electrical control box.
Before servicing refrigeration unit, make sure the main power switch is on the OFF position. Ensure this refrigeration unit is disconnected from the local electrical network. Lock-out / Tag-out can be performed as described above.
Before working in the electrical control box, it is required to control the lack of tension.
WHEN IT IS NECESSARY TO WORK IN THE ELECTRICAL CONTROL BOX UNDER TENSION, PEOPLE MUST BE QUALIFIED FOR WORKS UNDER LOW OR HIGH VOLTAGE.
Always use adequate tools and Personal Protective Equipment when working on electrical devices: safety gloves and safety glasses.

Engine coolant:
This refrigeration unit is equipped with a pressurised cooling system. Under normal operating conditions, the coolant in the engine and radiator is under high pressure and very hot.
Coolant is very slippery. It can be harmful in case of ingestion.
Never remove the cap from a hot radiator when this refrigeration unit is running or immediately after.
If the cap must be removed, wait at least 10 minutes and then do so very slowly in order to release the pressure without spray.
In case of leakage, immediately clean the floor to prevent slipping.
Avoid contact with the skin and eyes. Always use Personal Protective Equipment when handling engine coolant: safety clothes, safety gloves and safety glasses.

Refrigerant:
The refrigerant contained in this refrigeration unit can cause frostbite, severe burns or blindness in case of projection and direct contact with the skin or eyes.
In contact with flame or heat refrigerant generate toxic gas.
Refrigerant handling must be done by qualified people.
Keep any flame, any lighted object or any source of sparks away from the refrigerant unit.
Always use Personal Protective Equipment when handling refrigerant: safety clothes, safety gloves and safety glasses.
Burning with hot and cold:
When this refrigeration unit is running or even after, different components can be very cold or hot (exhaust pipe, tubes, coils, receiver, accumulator or engine for example)
Beware when operating closed from cold or hot components.
Always use adequate safety gloves when doing any maintenance on this refrigeration unit.

Cuttings:
Beware when handling or operating closed from parts that could be sharp (coils, evaporators, clamps for example).
Always use adequate safety gloves when doing any maintenance on this refrigeration unit.

Battery:
This refrigeration unit may be equipped with a lead-acid type battery. When charging the battery normally vents small amounts of flammable and explosive hydrogen gas.
Projections of acids on the skin or eyes can cause severe burns.
Keep any flame, any lighted object or any source of sparks away from the battery elements.
Always use Personal Protective Equipment when handling and charging battery: safety clothes, safety gloves and safety glasses.

Environment:
Think about protection of environment during all the life of this refrigeration unit.
To prevent environmental damages NEVER release refrigerant in the atmosphere, NEVER throw coolant, oil, battery and chemicals in the nature. It must be recuperate and recycle according to current regulations.
When disposing this refrigerant unit do it in an environmentally sound way and in accordance with current regulations.

CAUTION
Under no circumstances should anyone attempt to repair the Logic or Display Boards. Should a problem develop with these component, contact your nearest Carrier Transicold dealer for replacement.
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.
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.
SECTION 2
DESCRIPTION

2.1 INTRODUCTION

**WARNING**

Beware of unannounced starting of engine or standby motor caused by the unit thermostat or the start/stop cycle.

**Personal Protective Equipment:** before doing anything on this product, as explained in this manual. Always use safety precautions before doing any maintenance on the unit.

- safety glasses
- gloves
- safety shoes
- safety clothes

**a. System**

This manual contains Operating Data, Electrical Data and Service Instructions for the refrigeration units listed in Table 2-1. Also Table 2-1 charts some significant differences between these models.

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

**b. Truck condensing units**

The Supra 750Mt°, 850Mt° and 950Mt° models are one piece condensing units designed for truck applications available for R404a refrigerant. They are equipped with an electric standby motor.

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

The control system is a microprocessor controller (Refer to section 2.8). Once the controller (remote Cab Command within the cab of the truck) is set at the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects high and low speed cooling or high and low speed heating as necessary to maintain the desired temperature.

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

A remote standby receptacle is standard with all units.

**c. Multitemperature evaporators**

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

For Multi-Temp applications, single discharge and double discharge evaporators are available. The evaporators are different in size, capacity and number of fans (see Table 2-2), but all work on the same principle and use the same single-phase 50Hz/60Hz fan assembly. The electrical heaters vary according to the type of condensing unit used and number of compartments. (see Figure 2-3 and Figure 2-4)

The evaporator is constructed with plastic profiles designed to meet the specific requirements of the transport industry. The air outlet profiles are designed to adjust to allow different airspeeds and velocity.

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

- 240 Volt Single phase backward curved impeller which supplies high air volumes at low noise levels;
- expansion valve;
- check valve;
- 12V hot gas solenoid;
- 12V liquid line solenoid;
- 12V water drain heater;
- electrical heater element;
- sensor (defrost termination sensor);
- safety heating thermostat.
### Table 2-1 Condensers Model Chart

<table>
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<th>Engine</th>
<th>Compressor</th>
<th>Standby Motor</th>
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<td>6.2</td>
<td>CT3-44TV</td>
<td>05K 2 Cylinders</td>
</tr>
<tr>
<td>SUPRA 850Mt</td>
<td>17.2</td>
<td>7.8</td>
<td>CT3-69TV</td>
<td>05G 6 Cylinders</td>
</tr>
<tr>
<td>SUPRA 950Mt</td>
<td>4</td>
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<td>refer to section 2.5.c.</td>
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### Table 2-2 Evaporators Model Chart

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<th>Length</th>
<th>Power (Watts)</th>
<th>Number of fans</th>
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<td>MTS 700 H06</td>
<td>Single</td>
<td>700 mm</td>
<td>600</td>
<td>1</td>
</tr>
<tr>
<td>MTS 700 H12</td>
<td>Single</td>
<td>700 mm</td>
<td>1200</td>
<td>1</td>
</tr>
<tr>
<td>MTS 700 H24</td>
<td>Single</td>
<td>700 mm</td>
<td>2400</td>
<td>1</td>
</tr>
<tr>
<td>MTS 1100 H12</td>
<td>Single</td>
<td>1100 mm</td>
<td>1200</td>
<td>2</td>
</tr>
<tr>
<td>MTS 1100 H24</td>
<td>Single</td>
<td>1100 mm</td>
<td>2400</td>
<td>2</td>
</tr>
<tr>
<td>MTS 1450 H12</td>
<td>Single</td>
<td>1450 mm</td>
<td>1200</td>
<td>2</td>
</tr>
<tr>
<td>MTS 2200 H24</td>
<td>Single</td>
<td>2200 mm</td>
<td>2400</td>
<td>3</td>
</tr>
<tr>
<td>MTD 700 H24</td>
<td>Double</td>
<td>700 mm</td>
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<td>Double</td>
<td>2200 mm</td>
<td>2400</td>
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### Table 2-3 Evaporators designation

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<th>M</th>
<th>T</th>
<th>S</th>
<th>07</th>
<th>H</th>
<th>24</th>
<th>3</th>
<th>A</th>
<th>3</th>
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</table>
Figure 2-1 Supra 750Mt° / 850Mt° Models

1. Muffler
2. Engine (refer to Table 2-1)
3. Compressor (refer to Table 2-1)
4. Alternator (12 V)
5. Electric Standby Motor
6. Fittings for Mt° evaporators
7. Compressor pressure regulating valve (CPR)
8. Filter drier
9. Condenser
10. Coolant bottle

TOP VIEW
CURBSIDE VIEW

1. Battery
2. Fuel Micro
3. Fuel lines
4. Battery
5. Serial/Model plate
6. Fuel filter
7. Speed & Run solenoid
8. Oil filter
9. Oil gauge
10. Air cleaner (dry air type)
11. Receiver sight glass
12. Moisture indication sight glass
13. Receiver
14. Electrical box

ROADSIDE VIEW
1. Muffler
2. Engine (refer to Table 2-1)
3. Compressor (refer to Table 2-1)
4. Alternator (12 V)
5. Electric standby motor
6. Fitting for Mt° evaporators
7. Compressor pressure regulating valve (CPR)
8. Filter drier
9. Condenser
10. Coolant bottle
1. Battery
2. + Micro
3. Fuel lines
4. + Battery
5. Serial/Model plate
6. Fuel filter
7. Solenoid
8. Oil filter
9. Oil gauge
10. Air cleaner (dry air type)
11. Receiver sight glasses
12. Moisture indication sight glass
13. Receiver
14. Electrical box
15. Air cleaner – Silent version
16. Muffler – Silent version
1. Evaporator Coil
2. Turbine fan (1, 2 or 3 according to the model)
3. RAS Sensor
4. Coil
5. Heaters
6. Expansion valve
7. Pressure tap

Figure 2-3 Evaporator MTS model
1. Evaporator Coil
2. Turbine fan (1, 2 or 3 according to the model)
3. RAS Sensor
4. Coil
5. Heaters
6. Expansion valve
7. Pressure tap

Figure 2-4 Evaporator MTD model
1. Capacitors
2. Standby motor contactor (MC)
3. Motor Overload relay (MOL)
4. Manual run/stop switch
5. EHR contactors
6. Main fuse (80 amps)
7. Buzzer
8. Capacitors
9. Relay and Fuse board
10. Regulation Bypass RBPR relay (Supra 850 Mt² only)
This control relay board allows a better maintenance using pin connections (TP01 to TP17).

With a multimeter, an output voltage can be measured, pin by pin, to check relays power supply.

**Figure 2-6 Control relay board view**

<table>
<thead>
<tr>
<th>Fuse Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rep.</strong></td>
</tr>
<tr>
<td>F1</td>
</tr>
<tr>
<td>F2</td>
</tr>
<tr>
<td>F3</td>
</tr>
<tr>
<td>F4</td>
</tr>
<tr>
<td>F5</td>
</tr>
<tr>
<td>F6</td>
</tr>
<tr>
<td>F7</td>
</tr>
<tr>
<td>F8</td>
</tr>
<tr>
<td>F9</td>
</tr>
<tr>
<td>F10</td>
</tr>
<tr>
<td>F11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relay Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rep.</strong></td>
</tr>
<tr>
<td>SSR</td>
</tr>
<tr>
<td>CAR</td>
</tr>
<tr>
<td>CR1,2,3</td>
</tr>
<tr>
<td>EHR1,2,3</td>
</tr>
<tr>
<td>FLR</td>
</tr>
<tr>
<td>UFR</td>
</tr>
<tr>
<td>FHR</td>
</tr>
<tr>
<td>SR</td>
</tr>
<tr>
<td>HGR1,2,3</td>
</tr>
<tr>
<td>DER</td>
</tr>
<tr>
<td>RR1,2,3</td>
</tr>
<tr>
<td>GPR</td>
</tr>
<tr>
<td>RCR</td>
</tr>
<tr>
<td>MHR</td>
</tr>
<tr>
<td>RBPR</td>
</tr>
</tbody>
</table>
## 2.2 ENGINE DATA

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>CT3-44TV (D722)</th>
<th>CT3-69TV (D1105)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used on</td>
<td>SUPRA 750Mt° / 850Mt°</td>
<td>SUPRA 950Mt°</td>
</tr>
<tr>
<td>Displacement</td>
<td>719 cc (43.9 in³)</td>
<td>1105 cc (67.5 in³)</td>
</tr>
<tr>
<td>No. Cylinders</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Horsepower</td>
<td>9.3 kw (12.5 hp) @2400rpm</td>
<td>14.9 kw (20 hp) @2400rpm</td>
</tr>
<tr>
<td>Weight</td>
<td>63 kg (139 lbs)</td>
<td>89 kg (214 lbs)</td>
</tr>
<tr>
<td>Coolant Capacity</td>
<td>3,7 liters (3.9 U.S. quarts)</td>
<td>4,7 liters (5.5 U.S. quarts)</td>
</tr>
<tr>
<td>Oil Capacity without oil bypass kit</td>
<td>8.1 liters (8.5 U.S. quarts)</td>
<td>9.4 liters (11 U.S. quarts)</td>
</tr>
<tr>
<td>Oil Capacity with oil bypass kit*</td>
<td>8.9 liters (9.4 U.S. quarts)</td>
<td>not available</td>
</tr>
<tr>
<td>Operating Speeds</td>
<td>High</td>
<td>SUPRA 750Mt° : 2200 rpm</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>1800 rpm</td>
</tr>
<tr>
<td>Injection Setting</td>
<td>140 to 150 kg/cm² (1991 to 2133 psi)</td>
<td>140 to 150 kg/cm² (1991 to 2133 psi)</td>
</tr>
</tbody>
</table>

*Quantity includes oil bypass filter volume

### 2.2.1 Cooling circuit

**Water temperature sensor (WTS)**

This a thermistor type sensor located on the engine cylinder head which measures the temperature of the coolant.

Unit shuts down:
- Ambient < 50°C (120°F)
- if temperature exceeds 110°C (230°F)
- Ambient > 50°C (120°F)
- if temperature exceeds 116°C (240°F) or if temperature stays between 110°C (240°F) and 116°C (230°F) for 5 min.

**Lubrication System**

Oil pressure switch (OP)

Closes above 1.05 bars (15 psi) ± 0.2 (3 psi)

Lube Oil Viscosity: (API classification CD minimum)

<table>
<thead>
<tr>
<th>Outdoor Temperature</th>
<th>SAE Centigrade</th>
<th>Fahrenheit</th>
<th>SAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
<td>Below 32°</td>
<td>0W30</td>
<td></td>
</tr>
<tr>
<td>0° to 25°C</td>
<td>32° to 77°F</td>
<td>10W30 or 15W40</td>
<td></td>
</tr>
<tr>
<td>Over +25°C</td>
<td>Over 77°F</td>
<td>10W30 or 15W40</td>
<td></td>
</tr>
</tbody>
</table>

### 2.3 COMPRESSOR REFERENCE DATA

<table>
<thead>
<tr>
<th>Model</th>
<th>05G</th>
<th>05K2</th>
<th>05K4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>600 cc / 664 cc (36.6 / 40.5 in³)</td>
<td>400 cc 24.4 in³</td>
<td>200 cc (12.2 in³)</td>
</tr>
<tr>
<td>No. Cylinders</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>No. Unloaders</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Weight</td>
<td>75 kg (165 lbs)</td>
<td>49 kg (108 lbs)</td>
<td>38 kg (84 lbs)</td>
</tr>
<tr>
<td>Oil Charge</td>
<td>3.8 L (6.90 pts)</td>
<td>2.6 L (4.75 pts)</td>
<td>1.9 L (3.45 pts)</td>
</tr>
</tbody>
</table>

### 2.4 REFRIGERATION SYSTEM DATA

**a. Defrost Timer**

1h30, 3h, 6h, or 12 hours

**b. Defrost Thermostat**

Opens at: 10° ± 3°C (50°F ± 5°F)
Closes at: 7° ± 3°C (45°F ± 5°F)
c. High Pressure Cutout Switch (HP1)
   Cutout at: 32.7 ± 0.7 bars (469 ± 10 psig)
   Cut-in at: 24.6 ± 0.7 bars (350 ± 10 psig)

d. High Pressure Cutout Switch (HP2)
   Cutout at: 27.5 ± 0.7 bars (393 ± 10 psig)
   Cut-in at: 23 ± 0.7 bars (330 ± 10 psig)

e. Refrigerant charge
   Refer to Table 2-1.

f. Compressor Pressure Regulating Valve (CPR) in heat mode

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CPR Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bars</td>
</tr>
<tr>
<td>SUPRA 750Mt°</td>
<td>1.7</td>
</tr>
<tr>
<td>SUPRA 850Mt°</td>
<td>1.8</td>
</tr>
<tr>
<td>SUPRA 950Mt°</td>
<td>1.9</td>
</tr>
</tbody>
</table>


g. Thermostatic Expansion Valve superheat
   Setting at −20°C (0°F) box temperature:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Units</td>
<td>8 to 10°F (4 to 6°C)</td>
</tr>
</tbody>
</table>

2.5 ELECTRICAL DATA

a. Evaporator Fan Motors

<table>
<thead>
<tr>
<th></th>
<th>Diesel high speed</th>
<th>Diesel low speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>230 V</td>
<td>230 V</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 HZ</td>
<td>50 HZ</td>
</tr>
<tr>
<td>Speed</td>
<td>2738 rpm</td>
<td>2541 rpm</td>
</tr>
<tr>
<td>Power</td>
<td>272 W</td>
<td>195 W</td>
</tr>
<tr>
<td>Current</td>
<td>1.19 A</td>
<td>0.86 A</td>
</tr>
</tbody>
</table>

No maintenance: Lubricated for life.

b. Generator (Single phase alternator)

<table>
<thead>
<tr>
<th>Power</th>
<th>SUPRA 750Mt°/850Mt°: 1.5 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volts</td>
<td>SUPRA 950Mt°: 2 kW</td>
</tr>
<tr>
<td>Speed</td>
<td>3000 / 3600 rpm</td>
</tr>
<tr>
<td>Cos ϕ</td>
<td>1</td>
</tr>
</tbody>
</table>

GENERATOR RESISTANCE VALUES (see section 2.10)

<table>
<thead>
<tr>
<th>Units</th>
<th>Voltage and frequency</th>
<th>Stator Auxiliary coil Stud 5 &amp; 2</th>
<th>Stator Main coil Stud 6 &amp; 1 Stud 3 &amp; 4</th>
<th>Rotor Auxiliary coil</th>
<th>Rotor Main coil</th>
<th>Capacitors 450V</th>
<th>Diodes (Qty: 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supra 750Mt°/850Mt°</td>
<td>110/220V - 50/60Hz</td>
<td>12.2Ω</td>
<td>1.7Ω</td>
<td>1.1Ω</td>
<td>5.6Ω</td>
<td>12µF</td>
<td>6A 1000V</td>
</tr>
<tr>
<td>Supra 950Mt°</td>
<td>110/20 V - 50/60Hz</td>
<td>6.15Ω</td>
<td>0.87Ω</td>
<td>1.42Ω</td>
<td>6.97Ω</td>
<td>16µF</td>
<td></td>
</tr>
</tbody>
</table>
c. Standby motors
Rotation speed: 1760 rpm @ 60 Hz / 1500 rpm @ 50 Hz

---

d. Alternator: 50 amps

---

e. Standby Motor Overload
The function of the motor overload is to protect the standby motor against high amperage draw. The overload provides an adjustable knob to set the maximum amperage draw.

The motor overload is also equipped with a reset button. This button has three positions: automatic reset, manual, and test. In the application, the button should remain in the automatic reset position.

---

<table>
<thead>
<tr>
<th>STANDBY MOTOR OVERLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>SUPRA 750Mt°</td>
</tr>
<tr>
<td>SUPRA 850Mt°</td>
</tr>
<tr>
<td>SUPRA 950Mt°</td>
</tr>
</tbody>
</table>

---

2.6 TORQUE VALUES

<table>
<thead>
<tr>
<th>Assembly</th>
<th>kg-m</th>
<th>ft-lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Tray to Frame</td>
<td>5.5</td>
<td>40</td>
</tr>
<tr>
<td>Standby Motor to Power Tray</td>
<td>5.5</td>
<td>40</td>
</tr>
<tr>
<td>Engine to Power Tray</td>
<td>7.0</td>
<td>50</td>
</tr>
<tr>
<td>Compressor to Power Tray</td>
<td>5.5</td>
<td>40</td>
</tr>
<tr>
<td>Standby Motor Pulley</td>
<td>4.5</td>
<td>32</td>
</tr>
<tr>
<td>Engine Pulley</td>
<td>3.0</td>
<td>22</td>
</tr>
<tr>
<td>Compressor Pulley</td>
<td>3.0</td>
<td>22</td>
</tr>
<tr>
<td>Evaporator Fan Motor</td>
<td>1.8</td>
<td>13</td>
</tr>
<tr>
<td>Evaporator Fan Grille</td>
<td>1.0</td>
<td>7</td>
</tr>
<tr>
<td>Condenser Coil to Chassis</td>
<td>1.0</td>
<td>7</td>
</tr>
<tr>
<td>Tensioner to Power Tray</td>
<td>3.0</td>
<td>22</td>
</tr>
<tr>
<td>Engine Support</td>
<td>5.5</td>
<td>40</td>
</tr>
<tr>
<td>Run &amp; Speed Solenoids</td>
<td>1.0</td>
<td>7</td>
</tr>
<tr>
<td>Condenser Fan Blade</td>
<td>2.5</td>
<td>18</td>
</tr>
<tr>
<td>Engine Clutch</td>
<td>5.5</td>
<td>40</td>
</tr>
</tbody>
</table>
2.7 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 2-4.

<table>
<thead>
<tr>
<th>Unsafe Conditions</th>
<th>Safety Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low engine lubricating oil pressure</td>
<td>Oil pressure safety switch OP automatic reset</td>
</tr>
<tr>
<td>2. High engine cooling water temperature</td>
<td>Water temperature sensor WTS</td>
</tr>
<tr>
<td>3. Excessive current draw by glow plug circuit, control circuit or starter solenoid (SS)</td>
<td>Fuse (F1)</td>
</tr>
<tr>
<td>4. Excessive current draw by controller</td>
<td>Fuse (F2)</td>
</tr>
<tr>
<td>5. Excessive current draw by control circuit</td>
<td>Fuse (F3)</td>
</tr>
<tr>
<td>6. Excessive current draw by speed control solenoid</td>
<td>Fuse (F4)</td>
</tr>
<tr>
<td>7. Excessive compressor discharge pressure</td>
<td>High pressure cutout switch HP automatic reset</td>
</tr>
<tr>
<td>8. Excessive compressor discharge temperature</td>
<td>Compressor discharge temperature sensor CDT</td>
</tr>
<tr>
<td>9. Excessive current draw by evaporator fan motors</td>
<td>Fuses (F21, F22, F23)</td>
</tr>
<tr>
<td>10. Heater over temperature</td>
<td>High temperature klixon</td>
</tr>
<tr>
<td>11. Excessive current draw by heaters</td>
<td>Fuses (F14 to F19, F30 to F32)</td>
</tr>
</tbody>
</table>
2.8 MICROPROCESSOR CONTROLLER

2.8.1 Introduction

The microprocessor controller is housed in the control box. This controller consists of 2 control boards and a relay module:

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

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

The Cab Command is remote mounted in the truck. The Cab Command includes the LCD display, keypad and keypad interface (see Figure 2-7).

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 Carrier Transicold microprocessor controller incorporates the following features:

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

b. Dual independent readouts of set point and supply or return air temperatures.

c. Digital readout and ability to select data. Refer to Table 2-5 for Function Codes and Table 2-7 for Unit Data.

d. For alarm digital display identification Refer to Table 2-8.

e. A self-test check on program memory and data memory. The self-test is executed each time the system is switched from “Stop” to “Start.” Errors, if any, shall be indicated on the display as a ERR.X, where X is a number corresponding to the number of the test. The unit shall display this error for 5 seconds and then reset the micro.

<table>
<thead>
<tr>
<th>ERROR</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR.1</td>
<td>Processor failure</td>
</tr>
<tr>
<td>ERR.2</td>
<td>Check chip installation or replace microprocessor</td>
</tr>
<tr>
<td>ERR.3</td>
<td></td>
</tr>
<tr>
<td>ERR.4</td>
<td>Display board to logic board communication failure. This can be caused by a defective ribbon cable or ribbon cable not plugged in properly.</td>
</tr>
</tbody>
</table>

### 2.8.2 Keypad

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

1. Display window: shows set-point, box temperature, operating mode, alarm displays, as well as data on the unit itself (battery voltage, water temperature etc.).

### Function Change key

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

### Arrows key

The UP ARROW and DOWN ARROW keys are used to alter the set-point. Press the up or down arrow keys until the desired setpoint is displayed on the left-hand side of the display window. When the correct set-point is displayed, press the ENTER key to confirm the setting.

The UP ARROW and DOWN ARROW keys are also used to change the unit functions and scroll through the FUNCTION and UNIT DATA screens.

### Enter key

The ENTER key confirms changes made to unit operation. It must be pressed to change the setpoint after using the arrow keys to adjust it. If the ENTER key is not pressed, the setpoint will revert to the previously entered setting.

The ENTER key must also be pressed whenever a FUNCTION setting is being altered. If this key is not pressed, the function will revert to its previous setting.

### RUN/STOP switch

The main unit RUN/STOP switch controls the unit operation. When switched to the Run (I) position, the unit will start in the operating mode last entered (Road or Standby). The set-point will be at the last set-point entered on the keypad.

### Road key

The ROAD key puts the unit into Road (or engine) operation when the unit has been previously operated in the Standby mode.

### City Speed key

The CITY SPEED key toggles the unit between high speed and low speed (diesel mode). When City Speed is selected, the unit will run only in low speed except during defrost cycles. This feature is useful in areas where noise is restricted.
Manual defrost key

The MANUAL DEFROST key places the unit in a defrost cycle. Under most conditions it is not necessary to defrost the unit manually as this is done automatically with the air switch or the defrost timer. Manual defrost may become necessary due to ice accumulated on the evaporator coil during frequent door openings in humid environments.

Buzzer Off key

The BUZZER OFF key temporarily turns off the FAULT ALARM buzzer. The red light “Fault alarm” remains illuminated on the command cab.

Standby key

The STANDBY key places the unit in Standby (or electric) mode when the previous mode of operation has been Road.

Pretrip Check key

Not used.

Auto Start/Stop Continuous key

The AUTO-START/STOP key toggles the unit operating mode between Auto-Start/Stop and continuous run. When the unit is set for Auto-Start/Stop operation, the unit will run until the box temperature reaches set point and then cycle off (after the minimum run time has been met) until further cooling or heating is necessary. When in the continuous mode, the unit will cycle between heat and cool as required to maintain the set temperature in the body. If the setpoint is below -12°C (10°F) the unit will not heat, it will run continuously in low speed cool.

Unit Data key

This key scrolls the display through the various operating condition displays, engine temperature or battery voltage, for example. A more complete description of the function is found later in this chapter.

Compartment 1 ON/OFF switch

When switched to (I) the unit and compartment 1 will start in the operating mode last entered (cooling or heating).

Compartment 2 ON/OFF switch

When switched to (I) the unit and compartment 2 will start in the operating mode last entered (cooling or heating).

Compartment 3 ON/OFF switch

When switched to (I) the unit and compartment 3 will start in the operating mode last entered (cooling or heating).

16. Fault Alarm led : illuminates when an alarm is detected.

2.8.3 Switches and controls

Components required for monitoring and controlling the diesel engine-refrigeration system are located in the electrical box.

Run/Stop switch

When placed in RUN position, this switch provides power to the microprocessor. To stop the unit or remove power from the microprocessor, move the Run/Stop switch to STOP.

2.8.4 Setpoint

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

The setpoint may be changed up or down in whole numbers until the desired setpoint is displayed. The display will flash to indicate that the setpoint reading being displayed is a non-entered value. Each time the up/down arrow key is pressed, the 5 second display timer will be reset.

Depressing the enter key will cause the new displayed setpoint value to become active. If the display is flashing and the new value is not entered, after 5 seconds of no keypad activity, the display will revert back to the active setpoint.
2.8.5 Digital Display

The digital display has 9 digits. The default display is setpoint on the left and controlled air temperature on the right. The readout is keypad selectable for Degrees C or Degrees F. (See Figure 2-7)

The display also has symbol indicators for the following modes: Cool, Heat, Defrost, Out-of-range, City Speed, Autostart/Stop, Stand-by, and Road (diesel operation).

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

2.8.6 Functional parameters

The functional parameters will control selected operating features of the unit. These parameters can be displayed by pressing the function change key.

**NOTE**

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

All functional parameters are retained in memory. The following sections describe the list of functions which can be modified via the keypad.

A description of the function is displayed on the left side with the corresponding data on the right side. The function parameter list can be scrolled through by pressing the function change key or by using the up/down arrow keys.

With each function change key push, the list is advanced one. If the function key is pressed and held for one second, the list will advanced one item at a time.

This list will circular, meaning once the end of the list is reached the list will go to the first entry. While the functional parameter is displayed, the data can be changed by pressing enter then pressing either the up or down arrow keys. If the value is changed, the displayed data will then flash to indicate that the value has not been entered. If the new value is not entered in 5 seconds, the display will revert back to the last entered value. If the enter key is pressed, the display will stop flashing to indicate that the value has been entered. The new value will continue to display for 5 seconds before reverting back to the default display. Each time a key is pressed, the 5 second delay will reset. To select a different functional parameter the function change key must be pressed first.

### Table 2-5 Function Parameters

<table>
<thead>
<tr>
<th>CODE</th>
<th>ENGLISH</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN0</td>
<td>DEFR</td>
<td>Defrost Interval</td>
</tr>
<tr>
<td>FN1 ON</td>
<td>CITY SPD</td>
<td>Low Speed</td>
</tr>
<tr>
<td>FN1 OFF</td>
<td>HIGH SPD</td>
<td>High Speed</td>
</tr>
<tr>
<td>FN2</td>
<td>OFF T</td>
<td>Minimum Off-time</td>
</tr>
<tr>
<td>FN3</td>
<td>ON T</td>
<td>On-time</td>
</tr>
<tr>
<td>FN4</td>
<td>DEGREES F OR C</td>
<td>Temperature Unit °C or °F</td>
</tr>
<tr>
<td>FN5 ON</td>
<td>TIME STRT</td>
<td>Maximum Off-time 30 Min.</td>
</tr>
<tr>
<td>FN5 OFF</td>
<td>TEMP STRT</td>
<td>Temperature Based Restarting</td>
</tr>
<tr>
<td>FN6</td>
<td>MOP</td>
<td>Bypass valve</td>
</tr>
<tr>
<td>FN 7 ON</td>
<td>AUTO OP</td>
<td>Auto Start Operation</td>
</tr>
<tr>
<td>FN 7 OFF</td>
<td>MAN OP</td>
<td>Manual Start Operation</td>
</tr>
<tr>
<td>FN 8</td>
<td>T RANGE</td>
<td>Out-of-Range Tolerance</td>
</tr>
</tbody>
</table>

Code / English = Code or English display format

Manual Glow Override = Normal or Add 30sec

Alarm RST = Alarm Reset Required

Alarm CLR = No Alarm Active

**FN0: Defrost interval**

The defrost interval is displayed with the description DEFR or FN0. The data for the interval is displayed with one decimal place and then the capital letter H for hours (i.e., DEFR 12.0H). The defrost intervals are 1 1/2, 3, 6 or 12 hours.

**FN1: Speed control selection**

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

**FN2: Minimum Off-Time**

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

**FN3: On-Time**

The on-time selection for the auto start mode is displayed with the description ON T or FN3. The on-times are 1 or 4 minutes. The data for the on-time is displayed with two digits and then the capital letter M for minutes (i.e. ON T4 M).
FN4: Standard Units Select

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

FN5: Maximum Off-Time

The description for the maximum off time is TEMP STRT OR TIME STRT. The code display is FN6 and the selections are “ON” or “OFF.” “ON” corresponds to TIME STRT. With the unit in time start, the control will force the engine to restart 30 minutes after shutoff.

FN6: MOP Bypass valve

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

<table>
<thead>
<tr>
<th>FN6 setting</th>
<th>Energized (Open)</th>
<th>De-energized (Close)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD</td>
<td>1.17</td>
<td>1.73</td>
</tr>
<tr>
<td>MOP−</td>
<td>1.04</td>
<td>1.86</td>
</tr>
<tr>
<td>MOP+</td>
<td>1.31</td>
<td>2</td>
</tr>
</tbody>
</table>

FN7: Auto/Manual Start Operation

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

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in “continuous run” mode.

FN8: Out-of-Range tolerance

The out-of-range temperature tolerance selection is displayed with the description T RANGE or code FN11. The selection are A, B and C.

\[ A = 2^\circ C \ (3.6^\circ F), \quad B = 3^\circ C \ (5.4^\circ F) \] and
\[ C = 4^\circ C \ (7.2^\circ F). \]

When the out-of-range temperature is configured ON, the controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 45 minutes. Also the unit will shut down.

When the out-of-range temperature is configured OFF, the controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 15 minutes. Also the unit will continue to operate.

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

Code / English Messages

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

Manual Glow Override

The auto start glow time can be manually overridden through this function. The message is displayed as NORM GLOW or ADD GLOW. If the ADD GLOW selection is entered, the control will add 30 seconds of glow to the glow times listed in section 2.8.11. This feature must be selected before the 3 start attempts have been completed. At higher ambients, this override will only affect the second or third start attempt. The add glow time is deselected when the engine starts or fails to start. This parameter will not change due to the Code vs English selection.

Alarm Reset

Alarms can be reset through this function. The messages are displayed as ALARM RST or ALARM CLR. If the ALARM RST is displayed then there is at least one alarm present. Pressing the enter key will clear all the alarms present. If the ALARM CLR is displayed then there are no alarms present. See section 2.8.8. This parameter will not change due to the code / English selection.

2.8.7 Unit Data

The unit data key can be used to display the unit operating data values. The data values are displayed for 5 seconds and then the display will revert back to the default display if no further action is taken. The following sections describe the list of data which can be displayed via the keypad. The description of the data is displayed on the left side with the actual data on the right side. The unit data list can be scrolled through by pressing the unit data key. With each successive key push, the list is advanced one. If the unit data, up or down arrow key is held for one second, the list will change at a rate of one item every 0.5 seconds. This list will circular, meaning once the end of the list is reached the list will go to the first entry. Each time the unit data key or the up/down arrow key is pressed, the display time will be reset to 5 seconds. If the enter key is pressed, the display time will be set to 30 seconds. The position in the unit data list will remain at the last selected value except if power is removed. If the display were to time out and revert to the
default display, the operator would only have to press the unit data key to display the same data again.

<table>
<thead>
<tr>
<th>CODE</th>
<th>ENGLISH</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD1</td>
<td>SUCT</td>
<td>Suction Pressure</td>
</tr>
<tr>
<td>CD2</td>
<td>ENG</td>
<td>Engine Hours</td>
</tr>
<tr>
<td>CD3</td>
<td>WT</td>
<td>Engine Temperature</td>
</tr>
<tr>
<td>CD4</td>
<td>1RA</td>
<td>Return Air Temperature C1</td>
</tr>
<tr>
<td>CD6</td>
<td>2DT</td>
<td>C2 defrost Thermistor sensor</td>
</tr>
<tr>
<td>CD7</td>
<td>3DT</td>
<td>C3 defrost Thermistor sensor</td>
</tr>
<tr>
<td>CD8</td>
<td>1DTS</td>
<td>C1 defrost Thermistor sensor</td>
</tr>
<tr>
<td>CD9</td>
<td>CDT</td>
<td>Discharge Temperature</td>
</tr>
<tr>
<td>CD10</td>
<td>BATT</td>
<td>Battery Voltage</td>
</tr>
<tr>
<td>CD11</td>
<td>SBY</td>
<td>Standby Hours</td>
</tr>
<tr>
<td>CD12</td>
<td>MOD V</td>
<td>Future Expansion</td>
</tr>
<tr>
<td>CD13</td>
<td>REV</td>
<td>Software Revision</td>
</tr>
<tr>
<td>CD14</td>
<td>SERL</td>
<td>Serial Number Low</td>
</tr>
<tr>
<td>CD15</td>
<td>SERU</td>
<td>Serial Number Upper</td>
</tr>
<tr>
<td>CD16</td>
<td>2RA</td>
<td>Compartment 2 Air Temperature</td>
</tr>
<tr>
<td>CD17</td>
<td>3RA</td>
<td>Compartment 3 Air Temperature</td>
</tr>
<tr>
<td>CD18</td>
<td>MHR1</td>
<td>Maintenance Hour Meter 1</td>
</tr>
<tr>
<td>CD19</td>
<td>MHR2</td>
<td>Maintenance Hour Meter 2</td>
</tr>
<tr>
<td>CD20</td>
<td>SON</td>
<td>Switch On Hour Meter</td>
</tr>
</tbody>
</table>

**CD1: Suction Pressure**

The suction pressure is displayed with the description SUCT or CD1. The data is displayed with the proper unit designator P (psig) or B (Bars) (i.e. SUCT 25P). The display is in inches of mercury for readings below 0 psig. The display range is -0.7 Bars to 6.9 Bars (-20 HG to 100 psig).

**CD2: Engine Hours**

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

**CD3: Engine Temperature**

The coolant temperature is displayed with the description WT or CD3. The data is displayed with the proper unit designator: Degree C or Degree F (i.e, WT 185F or CD3 185F). The display range is -50°C to 130°C (-58°F to 266°F).

**CD4: Compartment 1 Return Air Temperature**

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

**CD6: Compartment 2 Defrost Thermistor Sensor**

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

**CD7: Compartment 3 Defrost Thermistor Sensor**

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

**CD8: Compartment 1 Defrost Thermistor Sensor**

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

**CD9: Compressor Discharge Temperature**

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

**CD10: Battery Voltage**

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

**CD11: Standby Hours**

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

**CD12: Mod V - Future Expansion**

This unit data is not used at this time. The Code display is CD12.
CD13: Software Revision

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

CD14: Serial Number Low

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

CD15: Serial Number Upper

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

CD16: Compartment 2 Return Air Temperature

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

CD17: Compartment 3 Return Air Temperature

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

CD18: Maintenance Hour Meter 1

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

CD19: Maintenance Hour Meter 2

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

CD20: Switch On Hour Meter

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

### 2.8.8 Alarm Display

The fault light (FL) is turned on only for alarms that specify it. The default display will be overridden if a alarm is generated. When an alarm is generated, the display will alternate the default display (setpoint/air temperature) and the active alarm(s). Each item will be displayed for 3 to 10 seconds, and will continue to scroll through the list. See section 2.8.6 for the procedure on resetting alarms.

<table>
<thead>
<tr>
<th>CODE</th>
<th>ENGLISH</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL0</td>
<td>ENG OIL</td>
<td>Low Oil Pressure</td>
</tr>
<tr>
<td>AL1</td>
<td>ENG HOT</td>
<td>High Coolant Temperature</td>
</tr>
<tr>
<td>AL2</td>
<td>HI PRESS</td>
<td>High Pressure</td>
</tr>
<tr>
<td>AL3</td>
<td>START-FAIL</td>
<td>Start Failure</td>
</tr>
<tr>
<td>AL4</td>
<td>LOW BATT</td>
<td>Low Battery Voltage</td>
</tr>
<tr>
<td>AL5</td>
<td>HI BATT</td>
<td>High Battery Voltage</td>
</tr>
<tr>
<td>AL6</td>
<td>DEFRFAIL</td>
<td>Defrost Override</td>
</tr>
<tr>
<td>AL7</td>
<td>ALT AUX</td>
<td>Alternator Auxiliary</td>
</tr>
<tr>
<td>AL8</td>
<td>STARTER</td>
<td>Starter Motor</td>
</tr>
<tr>
<td>AL9</td>
<td>1RA SENSOR</td>
<td>Return Air Sensor Comp1</td>
</tr>
<tr>
<td>AL10</td>
<td>2RA SENSOR</td>
<td>Return Air Sensor Comp2</td>
</tr>
<tr>
<td>AL11</td>
<td>WT SENSOR</td>
<td>Coolant Temperature Sensor</td>
</tr>
<tr>
<td>AL12</td>
<td>HIGH CDT</td>
<td>High Discharge Temperature</td>
</tr>
<tr>
<td>AL13</td>
<td>CD SENSOR</td>
<td>Discharge Temperature Sensor</td>
</tr>
<tr>
<td>AL14</td>
<td>SBY MOTOR</td>
<td>Standby Motor Overload</td>
</tr>
<tr>
<td>AL15</td>
<td>FUSE BAD</td>
<td>Fuse Open</td>
</tr>
<tr>
<td>AL16</td>
<td>3RA SENSOR</td>
<td>Return Air Sensor Comp3</td>
</tr>
<tr>
<td>AL17</td>
<td>DISPLAY</td>
<td>Display</td>
</tr>
<tr>
<td>AL18</td>
<td>SERVICE 1</td>
<td>Maintenance Hour Meter 1</td>
</tr>
<tr>
<td>AL19</td>
<td>SERVICE 2</td>
<td>Maintenance Hour Meter 2</td>
</tr>
<tr>
<td>AL20</td>
<td>1RA OUT</td>
<td>Main Compartment Out-of-range</td>
</tr>
<tr>
<td>AL21</td>
<td>2RA OUT</td>
<td>Remote Compartment 2 Out-of-range</td>
</tr>
<tr>
<td>AL22</td>
<td>3RA OUT</td>
<td>Remote Compartment 3 Out-of-range</td>
</tr>
<tr>
<td>AL23</td>
<td>NO POWER</td>
<td>No Power for Standby</td>
</tr>
<tr>
<td>AL26</td>
<td>SYSTEM CK</td>
<td>Low suction pressure</td>
</tr>
</tbody>
</table>

✓ = FAULT LIGHT ON
AL0: Low Oil Pressure Alarm

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

AL1: High Coolant Temperature Alarm

The high coolant temperature alarm is displayed with the description ENG HOT or AL1. This alarm is generated if the control senses a high coolant temperature. The fault light (FL) is turned on and the engine will shut down. See Section 2.2.1.

AL2: High Pressure Alarm

The high pressure alarm is displayed with the description HI PRESS or AL2. This alarm is generated if the high pressure switch opens. The fault light (FL) is turned on and the engine will shut down. See Section 2.4c.

AL3: Start Failure Alarm

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

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

AL4: Low Battery Voltage Alarm

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

AL5: High Battery Voltage Alarm

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

AL6: Defrost Override Alarm

The defrost override alarm is displayed with the description DEFR FAIL or AL6. If after 45 minutes of defrost, the unit is still in defrost mode, the unit displays AL6 and switches to defrost override mode. The fault light (FL) is turned on.

AL7: Alternator Auxiliary Alarm

The alternator auxiliary alarm is displayed with the description ALT AUX or AL7. This alarm is generated if the alternator auxiliary signal is not present with the engine running. (See Section 2.8.12). The fault light (FL) is turned on.

AL8: Starter Motor Alarm

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

AL9: Compartment 1 Return Air Sensor Alarm

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

AL10: Compartment 2 Return Air Sensor Alarm

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

AL11: Coolant Temperature Sensor Alarm

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

AL12: Compressor Discharge Temperature Alarm

The compressor discharge temperature alarm is displayed with the description HIGH CDT or AL12. This alarm is generated if the temperature is sensed above 154°C (310°F) for three minutes. If the discharge temperature exceeds 177°C (350°F), the three minute timer is overridden and the unit shut down immediately. The fault light (FL) is turned on.

AL13: Compressor Discharge Temperature Sensor Alarm

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

AL14: Standby Motor Overload Alarm

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

AL15: Fuse Alarm

The fuse alarm is displayed with the description FUSE BAD or AL15. This alarm is generated when the FUSE input is sensed low. The fault light (FL) is turned on.
AL16: Compartment 3 Return Air Sensor Alarm

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

AL17: Display Alarm

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

AL18: Maintenance Hour Meter 1 Alarm

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

AL19: Maintenance Hour Meter 2 Alarm

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

AL20: Compartment 1 Out-of-Range Alarm

The out-of-range alarm is displayed with the description 1RA OUT or AL20. This alarm is generated when compartment 1 is out-of-range (refer to FN8 section 2.8.6). The fault light (FL) is turned on.

AL21: Compartment 2 Out-of-range Alarm

The out-of-range alarm is displayed with the description 2RA OUT or AL21. This alarm is generated when Compartment 2 is out-of-range (refer to FN8 section 2.8.6). The fault light (FL) is turned on.

AL22: Compartment 3 Out-of-range Alarm

The out-of-range alarm is displayed with the description 3RA OUT or AL22. This alarm is generated when Compartment 3 is out-of-range (refer to FN8 section 2.8.6). The fault light (FL) is turned on.

AL23: No Power for Standby Alarm

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

AL26: Suction Pressure Alarm

The system check alarm will be displayed with the description SYSTEM CK or AL26. The fault light (FL) is turned on. If the unit is in cool mode and the supply air temperature becomes 5°F (3°C) higher than the return air temperature for continuous minutes then the alarm will be activated. If the suction pressure becomes less than ~0.3 bars (~5 psi) for 120 continuous seconds while any compartment is in cool mode and while the return air temperature for the cooling compartment is > -17.8°C (0°F) and the ambient temperature is greater or equal to 4.4°C (40°F) the alarm will be activated.

2.8.9 Heat/Cool mode

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.

2.8.10 Defrost cycle

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

There is 2 ways of initiating a defrost.

Method one to initiate defrost is by pressing the Manual defrost key

Method two is that defrost may be initiated automatically at preset intervals by defrost timer in the microprocessor.

1. Automatic defrost initiation

A defrost will be initiated if the defrost time (entered via the keypad) is elapsed.

The defrost timer is reset to zero whenever a defrost cycle is initiated. The controller holds in memory the last entered defrost interval.

The defrost timer runs only when the defrost thermostat is closed (DTS)

2. Defrost function

After initiation, defrost mode terminates when the defrost termination thermostat (DTS) opens indicating that the evaporator is de-iced. The defrost cycle is complete. The defrost timer runs only when the DTS is closed. The timer does not accumulate time during defrost mode, during standby off cycles or auto-start off cycles.

The compressor operates at maximum capacity (engine forced in high speed) during defrost.

3. Fail safe defrost termination

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

2.8.11 Continuous or Start/Stop Operation

Micro units have two basic operating modes: continuous or start/stop. Selection is possible either in both engine or standby mode operation.

Continuous mode is adequate when load type required constant airflow for better conservation. Control of temperature is done by alternate cooling or heating of the supply air around setpoint.

Start/stop mode provides an energy efficient alternative to continuous operation by automatic cycling (off or on) the diesel engine or standby motor near setpoint.

a. Auto Start/Stop - Continuous

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>When configuration CNF11 is &quot;ON&quot; and setpoint is 32 to 42° F (0 to 5.5°C) the unit is locked into continuous run. Start/Stop Continuous key is disabled.</td>
</tr>
</tbody>
</table>

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

b. Auto Mode Indicator

The "Auto start/stop" light is lit to indicate the auto start/stop mode has been selected.

c. Auto Start failure

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

2.8.12 Optional control panel

User-friendly indicator and operator control panels clearly show individual compartment temperatures with easy-to-read displays.

These compact panels can be mounted to suit the individual operator's preferences.

(Example: on the front bulkhead, in the cab or in the refrigerated compartment – including mounting in the truck wall itself.)

- Control panel

| 1. Compartment ON/OFF key |
| 2. Control panel power on light |
| 3. Unit ON/OFF key |
| 4. Manual defrost key |
| 5. Control panel locking light |
| 6. Up and down arrow keys |
| 7. Heating operating mode light of a compartment |
| 8. Cooling operating mode light of a compartment |
| 9. Temperature indicated in °C or °F |

From this control panel (option) you can:

- switch on the unit
- check compartment 1, 2 or 3 temperatures
- change setpoints
- energize a manual defrost (refer to Section 1.8.11)
- The detailed control panel functioning is explained in Section 2.4.2

d. Auto Start Sequence (Engine mode)

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The unit is in Heat mode for the 30s prior to energising the start sequence and 30s after unit start, in engine standby mode.</td>
</tr>
</tbody>
</table>

When the starting conditions are met, the start sequence will begin by energizing the run relay, and after 5 seconds energize the glow plug relay (GPR) to supply power to the glow plugs, and 5 seconds later the starter is energized. On initial power-up, the control will delay 5 seconds before the starting sequence begins. If the required glow time is zero, the control will energize the starter after a 5 second delay. After a period of time, the starter solenoid (SS) is energized to crank the engine. The engine will crank for 10 seconds or until engine operation is sensed by the alternator signal. The glow relay is de-energized after the auxiliary input is sensed.
on. A 15 second null cycle will elapse before subsequent start attempts. The run relay will remain energized until the next starting sequence.

Before the next starting sequence, the oil pressure alternator auxiliary output is checked to insure that the engine is not running. For the second and third start attempts the glow time is increased by 5 seconds over the glow time of the first attempt listed below. The control allows three consecutive start attempts before the starting is locked out and the start failure alarm is activated.

**Variable Glow Time**

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

<table>
<thead>
<tr>
<th>Temperature</th>
<th>TV</th>
<th>DI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0°C (32°F)</td>
<td>15</td>
<td>55</td>
</tr>
<tr>
<td>1°C to 10°C (33°F to 50°F)</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>11°C to 25°C (51°F to 77°F)</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Greater than 26°C (78°F)</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

The second and third start attempts have a glow time that is 5 seconds greater than the table amount. The glow time can be manually overridden through the function parameters. If the coolant temperature sensor is defective the control assume a temperature of less than 0°C (32°F) for the glow timing.

**Minimum On Time**

Unit must run for the minimum run-time before it can consider shutting off. This time is necessary to prevent short cycling and ensure adequate air flow through the load to allow the micro to accurately sense load temperature and bring the battery up to minimum voltage level.

Minimum on time value is selected via keypad.

**Minimum Off-Time**

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

Minimum off time value is selected via keypad.

**Time start / Temp start**

Selection between time start or temp start is provided via the keypad.

Temp start: the unit will remain off until box temperature deviates from setpoint.

Time start: unit will restart automatically 30min after it has stopped regardless of the box temperature.
i. Battery voltage

Provisions are made to sense when the battery is good. A good battery is defined as having 13.4v at 24°C (75°F). This condition is used to allow shut-off of the diesel engine.

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

### Table 2-10 Battery Voltages

<table>
<thead>
<tr>
<th>Message-Display</th>
<th>Voltage-Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW BATT AL4</td>
<td>10 or Less</td>
<td>Unit will shut down except during cranking.</td>
</tr>
<tr>
<td></td>
<td>11 to 14.5</td>
<td>Considered as normal voltage</td>
</tr>
<tr>
<td>HI BATT AL5</td>
<td>17 or more</td>
<td>Unit will shut down.</td>
</tr>
</tbody>
</table>

j. Oil pressure signal

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

k. Maximum off-time

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

l. Start/Stop conditions

Unit will not cycle off if:

- engine coolant temperature is less than 50°C (122°F)
- battery is less than 13.4 Volts

Unit will restart (overriding minimum off time) if

- battery drops below 11 Volts
- coolant temperature drops below 1°C (34°F)

If the unit can not cycle off, it will operate normally in continuous mode. If all temperature probes fail and the setpoint is less or equal to -12°C (10°F) the unit will not shut down.

2.8.13 Remote Monitoring - Microlink (Optional)

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

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

2.9 REFRIGERATION COMPONENT OPERATION

2.9.1 Compressor pressure regulating valve (CPR) (see Figure 2-1 & Figure 2-2)

This adjustable regulating valve is installed on the suction line of the compressor to regulate the amount of suction pressure entering the compressor. The CPR valve setting is the maximum suction pressure for the compressor.

The suction pressure is controlled to avoid overloading the electric motor or engine during high box temperature operation.

2.9.2 Main Heat Valve MHV1 (NO) / MHV2 (NC)

![Figure 2-9 Main Heat Valves - NO and NC](image)

**Description**

The 2 valves govern cool or heat mode by allowing the hot gas refrigerant to circulate from the compressor to the condenser (cool) or to the evaporator (heat mode).
The valve MHV1 is a valve normally opened meaning that the gas goes through when solenoid is de-energized. In contrary with MHV2 which is a valve normally closed.

MHV1 and MHV2 are energized then hot gas goes through MHV2 to the serpentine, coil or evaporator.

**2.9.3 Hot Gas Valves HGV 1, 2 & 3 (NC)
Liquid Suction Valves LSV 1, 2 & 3 (NC)**

![Hot Gas & Liquid Suction Valves - NC](image)

**Description**

Each evaporator has one Hot Gas Valve and one Liquid Suction Valve.

During heating, the HGV opens and the LSV closes to allow hot gas to circulate in the evaporator coil.

During cooling, the LSV opens and the HGV closes to allow liquid into the Expansion valve.

**2.9.4 Accumulator**

![Accumulator](image)

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

**2.9.5 By-pass valve (NC) (Supra 850Mt² only)**

![By-pass valves - NC](image)

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

**2.9.6 Liquid sightglass**

![Sightglass, Liquid Indicator](image)

This component is placed on the receiver and indicates:

- Quickly the amount of refrigerant in the circuit. Permanent formation of refrigerant bubbles through the sightglass in cooling mode indicates a lack of refrigerant charge.
- water content in the liquid refrigerant by color change of the indicator disc.

GREEN means DRY CIRCUIT

YELLOW means WET CIRCUIT (in that case, the filter drier must be change).

2.9.7 Filter drier (see Figure 2-1 & Figure 2-2)

Function:
- retain contaminants in the circuit
- absorb humidity in the circuit
Insure correct expansion valve operation.

2.9.8 Service valve

Compressors and receiver are equipped with service valve for refrigeration circuit maintenance.

Each valve has 3 positions:

Compressor or receiver is isolated from the circuit

FRONT SIDE POSITION

Refrigerant is in contact with the manifold connection port.

Normal operation

BACK SIDE POSITION

2.9.9 Hot gas bypass unloader

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

b. Unloaded Operation

Pressure from the discharge manifold (Figure 2-13, 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.

Figure 2-13 Compressor cylinder heat unloader

Hot gas bypass
c. Loaded Operation

Discharge pressure bleeds from the discharge manifold (Figure 2-14, 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.

2.9.10 Battery charging alternator

**CAUTION**

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

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

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 2-14 Compressor cylinder head loader**

Hot gas bypass

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
2.10 GENERATOR (SINGLE PHASE ALTERNATOR)

2.10.1 Use of diagnosis connection of control box (see Figure 2-16)

a. To be connected on stud 3&4 of DC connector (Diagnosis connection) (situated in the control box) as well as wires AC4/EFB (red) and AC6/EFB (blue) (situated in control box).

b. Measure voltage value, intensity, power, frequency and $\cos \varphi$ according 3 working conditions (low & high speed engine and standby).

c. Compare with the table of value (see b. Generator chapter 2.5)

2.10.2 Intervention on generator for analysis

CAUTION

An intervention on the generator applies only after the warranty period.
Any intervention done during the warranty period will cancel this warranty.
a. Registered fault

<table>
<thead>
<tr>
<th>Registered fault</th>
<th>Initial cause of fault</th>
<th>Action to be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fault finding parts to be checked - Without load</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No voltage with no load when starting.</td>
<td>Loss of residual magnetism.</td>
<td>Apply a battery 4.5V to capacitor terminals. Load the alternator and run engine above nominal speed for a few seconds.</td>
</tr>
<tr>
<td></td>
<td>Defective capacitor.</td>
<td>Change the capacitor.</td>
</tr>
<tr>
<td></td>
<td>Rotor diode out of order or short circuit.</td>
<td>Change the 2 diodes on the rotor or change the generator.</td>
</tr>
<tr>
<td></td>
<td>Winding short circuit or loose connections.</td>
<td>Check the resistance of coils. (see b. Generator chapter 2.5)</td>
</tr>
<tr>
<td>Voltage with no load less than 80% of nominal voltage.</td>
<td>Speed of engine too low.</td>
<td>Check the speed range of the engine and the motor AC.</td>
</tr>
<tr>
<td></td>
<td>1 rotor diode out of order or short circuit. Partiel short circuit in winding.</td>
<td>Change the 2 diodes on the rotor short circuit. Check the resistance of the coils.</td>
</tr>
<tr>
<td>Too high voltage without load.</td>
<td>Speed of engine too high.</td>
<td>Check the speed range of the engine and the motor AC.</td>
</tr>
<tr>
<td><strong>Fault finding parts to be checked - With load</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No voltage</td>
<td>1 rotor diode short circuit or out of order.</td>
<td>Change the 2 diodes on the rotor.</td>
</tr>
<tr>
<td>Correct voltage without load, low voltage with load.</td>
<td>The speeds engine falls off.</td>
<td>Either, check value of load, or contact the engine specialist.</td>
</tr>
<tr>
<td>Excessive heat (over heating)</td>
<td>Ventilator holes partially blocked.</td>
<td>Dismantle and clean the stator.</td>
</tr>
</tbody>
</table>

b. Disassembly phase

- Unscrew the fixing bolts of the stator frame to the flange.
- Unscrew the 3 screws of the rear cover and dismantle it.
- Take out with handling precaution the rotor assembly of the housing.

c. Control of the capacitors (in the control box)

- Measure the value with a capacitance meter.
- Capacitors values for the tests:
  2 capacitors 8µF (± 5%) for 950Mt° versions
  2 capacitors 6µF (± 5%) for 750/850Mt° versions

<table>
<thead>
<tr>
<th>Versions</th>
<th>750Mt°/850Mt°</th>
<th>950Mt°</th>
</tr>
</thead>
<tbody>
<tr>
<td>220V / 50HZ</td>
<td>0.41A</td>
<td>0.55A</td>
</tr>
<tr>
<td>240V / 60HZ</td>
<td>0.54A</td>
<td>0.72A</td>
</tr>
</tbody>
</table>

d. Verification of diodes (Qty: 2)

- If you do not use capacitance meter, use multimeter and see as opposite:
- Cut out one side of the diodes.
- Check those diodes with an ohmeter.
- The diode is conforme if it has an infinite resistance in one direction and a resistance of 0 in the other. If the resistance is infinite in both directions or if it is at 0 in both directions, the diode is broken.

e. Check of the winding resistor (see generator resistance values section 2.5)

With an ohmeter:
- Stator: by the output wires (Check the connection).
- Rotor: requires to remove the rotor and to cut out the diodes.

f. Checking of the connectors

If the generator would not provide electricity, check that the connectors are well crimped

g. Assembly phase

- Mount the stator/rotor to the flange fasten the 4 bolts.
- For the reassembly of the tested generator, the tightening torques (N.m) for the fixation of the front cover, stator and rear cover onto the casing are:

<table>
<thead>
<tr>
<th>Versions</th>
<th>Torque values</th>
</tr>
</thead>
<tbody>
<tr>
<td>54-60029-00</td>
<td>4N.m ± 1N.m (screw M4)</td>
</tr>
<tr>
<td>54-60029-01</td>
<td></td>
</tr>
<tr>
<td>54-60032-00</td>
<td></td>
</tr>
<tr>
<td>54-00603-00</td>
<td>5N.m ± 1N.m (screw M6)</td>
</tr>
<tr>
<td>54-00603-01</td>
<td></td>
</tr>
</tbody>
</table>

2.11 REFRIGERANT CIRCUIT

2.11.1 Cooling mode

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

The compressor raises the temperature and pressure of the refrigerant and it passes through a normally open Main Heat Valve (MHV), through a check valve into the condenser. The condenser fan circulates surrounding air over the outside of the condenser tubes. Heat transfer is then established from the refrigerant gas (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat. This removal of heat causes the refrigerant to liquefy. Liquid refrigerant flows from the condenser and through a check valve to the receiver.

The receiver stores the additional charge necessary for low ambient operation and for heating and defrost modes. The refrigerant leaves the receiver and flows through a manual receiver shutoff valve (king valve).

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

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

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

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

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

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

In heat mode, two technologies can be used: Hot gas heating through the hot gas solenoid valves (HGV1, HGV2 & HGV3) or heating by electric heaters in the evaporator. Heating by hot gas is allowed only if no evaporator is in cooling mode.

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

Both hot gas and electric heat are used for defrost.

a. Hot Gas Heating

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

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

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

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

b. Principle Of Induction Heating (Electric Heat)

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

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

The system includes a control box, connected with electrical cables to the refrigeration unit and to the heaters inside the evaporator.
1. Compressor
2. High pressure switch (HP)
3. Discharge service valve
4. Main heat valve (MHV)
5. Check valve
6. Condenser
7. Receiver
8. Receiver service valve
9. Subcooler
10. Accumulator/Heat exchanger
11. Filter-drier
12. Sight glass
13. Liquid solenoid valve (LSV)
14. Expansion valve
15. Hot gas valve (HGV)
16. Evaporator
17. Electric heater
18. Compressor pressure regulating valve (CPR)
19. Suction service valve
20. Receiver pressure valve (RPV)
21. Bypass valve (850Mt° only)

Figure 2-17  Cooling Cycle
1. Compressor
2. High pressure switch (HP)
3. Discharge service valve
4. Main heat valve (MHV)
5. Check valve
6. Condenser
7. Receiver
8. Receiver service valve
9. Subcooler
10. Accumulator/Heat exchanger
11. Filter-drier
12. Sight glass
13. Liquid solenoid valve (LSV)
14. Expansion valve
15. Hot gas valve (HGV)
16. Evaporator
17. Electric heater
18. Compressor pressure regulating valve (CPR)
19. Suction service valve
20. Receiver pressure valve (RPV)
21. Bypass valve (850Mt° only)

Figure 2-18  Heat and Defrost Cycle
SECTION 3
OPERATION

3.1 PRE-TRIP INSPECTION

a. Before Starting Engine

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

2. Check radiator coolant level. (Add pre-mixed 50/50 permanent antifreeze-water as required.) USE MONOPROPYLENE GLYCOL ONLY.

3. Check evaporator and condenser coil for cleanliness.

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

5. Check compressor and receiver service valve position (backseat position).

6. Check unit compartment and remove any foreign material.

7. Check engine oil level.

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

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

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

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

12. Check defrost air switch tubes and connections for breaks or air leaks.

b. After starting Refrigeration Unit

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

2. Check engine speed.

3. Listen for abnormal noises. (Refer to section 5.3.7) If present, control compressor pressures with a manometer.

4. Check compressor oil level (Refer to section 4.10).

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

6. Check radiator hoses for leaks.

7. Check refrigerant level (Refer to Table 2-1).


9. Start microprocessor Pre-trip Inspection.

3.2 STARTING AND STOPPING INSTRUCTIONS - ENGINE DRIVE

![Warning]

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

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

3.2.1 Starting Instructions

1. Place the Run-Stop Switch in the RUN position on the Control Box.

2. Place the On-Off Switch (Cab Command) to ON position and press the Road Key. The microprocessor will perform a self-test (all display messages will appear in display window). Then setpoint and box temperature will be displayed.
3. The microprocessor will energize glow cycle (length of time depends on engine temperature) and start the engine.

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

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

c. **Stopping instructions**

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

### 3.3 STARTING AND STOPPING INSTRUCTIONS - STANDBY MOTOR DRIVE

**WARNING**

Check for correct power connection (220V or 380V) with connectors located in Main Control Relay Box.

1. Plug in the power plug.

2. Place the *On-Off Switch* (Cab Command) and *Run-Stop switch* to 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 switch to standby and power plug not plugged in.

3. Check for proper motor rotation. Condenser air must be drawn into unit (see indicating flag on front grille). To reverse rotation, stop unit, disconnect power cord and change polarity of plug.

### 3.4 COMPARTMENT OPERATION

#### 3.4.1 Operation with cab command

a. **Starting the unit**

Complete the pre-trip inspection described in the previous section.

- **Road operation**

1. Place the RUN/STOP switch (O/I) to the RUN position (I)

2. Press the ROAD operation key (only if the unit has been previously used in standby mode).

3. Place either one, two or three compartments OFF/ON switches to ON (I)

4. Then, the unit will:
   - perform a complete diagnostic check on the microprocessor controller
   - pre-heat for the required amount of time based on the engine temperature
   - starts automatically

- **On Standby**

1. Place the RUN/STOP switch (O/I) to the RUN position (I)

2. Press the STANDBY operation key

3. Place either one, two or three compartments OFF/ON switches to ON (I)

4. Then, the unit will begin to run on electric power.
b. Changing the setpoint
The sequence is the same for each compartment.

1. Start the unit
2. When the setpoint box temperature is displayed, press the UP or DOWN ARROW key to change the temperature setpoint.

c. Stop the unit

1. Place C1, C2 and C3 switches to the OFF position (O). “OFF” is displayed.
2. Place the RUN/STOP switch (O/I) to the OFF (O) position.

CAUTION
To shut down the unit, ALWAYS use the cab command.

d. Manual defrost

1. Press the MANUAL DEFROST Key. If conditions are required, a defrost cycle will be initiated.

3.4.2 Operation with auxiliary control panel

1. Start the unit.

2. Press the SYSTEM ON/OFF key. Power light will go ON.
3. Press the ON/OFF key to energize selected compartment.

4. DISPLAY

- waiting for communication with unit
- compartment temperature display
- setpoint temperature display
- evaporator status (heat or cool or null)
- compartment shut-down via remote control
- defrost compartment
- temperature sensor malfunction

a. Changing setpoint

Setpoint change can be made from control panel or cab control.
1. Press the UP or DOWN ARROW key to increase or decrease setpoint. This is the same operation for each compartment.

**b. Set pre-set setpoint**

The control panel allows the user to pre-set 5 different temperatures on each compartment.

1. Switch main RUN/STOP switch and required remote compartment switches on the unit to RUN.

2. Press Carrier logo and the lock light will be displayed.

3. Press host compartment UP ARROW key for 10 seconds. P1 will be displayed in all compartments.

4. Set lowest setpoint temperature required.

5. Press Carrier logo and P2 will be displayed. Set next lowest temperature required up to five pre-set setpoints are available.

6. Pressing the second compartment up or down arrow will allow the lowest temperature required to be preset in the second compartment. Pressing Carrier logo will then move on to the nest lowest (up to five).

7. Press the Carrier logo for 10 seconds and this will remove the lock light and store the pre-set setpoints in memory.

**c. Remove pre-set setpoint**

1. Switch main RUN/STOP switch and required remote compartment switches on the unit to RUN.

2. Press Carrier logo and the lock light will be displayed.

3. Press host compartment up arrow for 10 seconds. P1 will be displayed in all compartments.

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

5. Press the UP ARROW key on remote compartments will display the presets, take the temperature to the lowest possible and OFF will be displayed.

6. Press the Carrier logo for 10 seconds and the new information will be stored in memory.

**d. Lock the control panel**

1. Press the CARRIER logo until it stops flashing. It's blocked when the light is on.

2. The indicator comes on.
**Unlock the control panel**

1. Press the CARRIER logo until the light is off.
2. The indicator goes off.

**REMARK**

IT IS NOT NECESSARY FOR THE COMPARTMENT TO BE RUNNING IN ORDER TO MODIFY OR SEE THE SET-POINT VALUE AND THE TEMPERATURE OF THE COMPARTMENT.

THE UNIT CAN BE SHUT DOWN BOTH WITH THE CAB COMMAND AND THE GENERAL SWITCH.

### 3.5 CONTROL CIRCUIT OPERATION

#### 3.5.1 Introduction

**NOTE**

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

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

Connections to these boards are made through 3 multiple-pin plug connectors HC, HC2, & MP. The address system (example HCD2-MPW2) indicates a wire between plug HC, pin D2 and microprocessor MP & pin W2.

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

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

#### 3.5.2 Temperature Control Logic

There are basically 3 modes of operation: Cool, Heat or Defrost. Controller will automatically selects the necessary mode to maintain box temperature at setpoint.

There are two control ranges:

- Frozen: setpoint < -12°C (54°F)
- Perishable: setpoint > -12°C (54°F)

In the frozen range there are two control logic depending if heat is allowed or not (refer to micro configuration section 4.19.2, CNF-4).

There are also two operating modes:

- Continuous
- Start / Stop

**a. Temperature Control / Continuous Mode**

Diesel mode: since engine has two operating speeds, there are four possible states:

- High speed cool
- Low speed cool
- Low speed heat
- High speed heat

Standby mode: there are two possible states:

- Cool
- Heat

See Figure 3-2 and Figure 3-4.

**b. Temperature control / Start Stop**

When start/stop mode is activated there is an additional “off” state which correspond to unit shut off when box temperature is closed to setpoint.

See Figure 3-1 and Figure 3-3.

**c. Operation**

**Cool mode**: default mode for the micro.

**Heat mode**: micro will energize MHR relay (which controls the Main Heat Valve) via X1 output.

Depending upon which compartment requires heat the HGR 1, 2 or 3 (or any combination of the 3 relays)
will be energised. These control the Hot Gas Valve in the evaporators.

- **Micro**
  - N1: HGR1
  - S2: HGR2
  - W3: HGR3

- **Valve**
  - HGV1
  - HGV2
  - HGV3

**Speed**: (engine mode only) when high speed is needed, micro will energize SR relay (which controls speed solenoid SCS) via N3 output.

---

**Table 3-11 Relay Operation - Microprocessor Controller**

<table>
<thead>
<tr>
<th>Mode</th>
<th>DER</th>
<th>GPR</th>
<th>RCR</th>
<th>SSR</th>
<th>SR</th>
<th>CAR</th>
<th>FLR</th>
<th>CR1,2,3</th>
<th>EHR1,2,3</th>
<th>EMR1,2,3</th>
<th>HGR1,2,3</th>
<th>LSV1,2,3</th>
<th>RR1,2,3</th>
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<th>UFR850/950</th>
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</tbody>
</table>

I = Output is ON  
O = Output is OFF

1. Sequence shown is thermostat control selection. This may be overridden by suction pressure.
3.5.3 Supra 950 Mt° specific logic

Supra 950 Mt° units are equipped with a 05G compressor with one unloader for capacity control. The capacity controlled cylinders are easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid is energized 2 cylinders are unloaded (operating with no pressure differential) and absorbed power decreases. A de-energized solenoid reloads the cylinders.

There are two modes of operation for the unloader: temperature control and suction pressure control.

a. Temperature control

Operation is similar to the standard micro units, except that additional states are present based on the number of loaded cylinders.

See Figure 3-1 to Figure 3-4.

Unloader : micro will unload two cylinders by energizing unloader relay UFR (which controls the unloader solenoid) via X2 output.

Defrost specific logic (CNF6 ON and CNF8 OFF) : defrost damper (if provided) is closed at defrost start and is kept closed for 90s with heat on 60s after defrost has terminated.

b. Suction pressure operation

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. These specific varipower equations apply to low and middle ambient temperature.

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 in 6 cylinders if not it will run in 4 cylinders.

Unloader is energized during engine or standby motor start.

3.5.4 Supra 850 Mt° specific logic

Supra 850 Mt° units are equipped with a 05K4 compressor with one unloader for capacity control. The capacity controlled cylinders are easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid is energized 2 cylinders are unloaded (operating with no pressure differential) and absorbed power decreases. A de-energized solenoid reloads the cylinders.

There are two modes of operation for the unloader: temperature control and suction pressure control.

a. Temperature control

Operation is similar to the standard micro units, except that additional states are present based on the number of loaded cylinders.

See Figure 3-1 to Figure 3-4.

Unloader : micro will unload two cylinders by energizing unloader relay UFR (which controls the unloader solenoid) via X2 output.

b. Suction pressure operation

The microprocessor will monitor suction pressure of the refrigeration system via ambient temperature which 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. These specific varipower equations apply to low and middle ambient temperature.

On Supra 850 Mt°, if the suction pressure is below the equation value the compressor will run in 4 cylinders if not it will run in 2 cylinders. Unloader is energized during engine or standby motor start.

For high ambient temperatures, the high pressure cutout HP2 switch energizes the unloader if the discharge pressure is above 27.5 bars and does not de-energize the unloader until 23 bars is reached.
### a. CPL Bypass Valve

The valve is controlled by the micro (P2). The valve opens and closes at the values chosen by FN6.

See Table 1-4 "Bypass Valve Setup".

The valve is energised during pull-down if the suction pressure is below the value chosen by FN6 (default = 1.17 bars). If the pressure rises above the value chosen by FN6 (default = 1.72 bars) the valve is de-energised. The valve is de-energised during regulation (in low speed heat and cool and null - See figures 2-14 to 2-17).

### 3.5.5 Relay operation

- **Engine mode**
  - Automatic start:
    - Run relay is energized via W1 output.
    - Diesel/Electric relay is energized via N2 output:
      - Run/stop solenoid is activated in RUN position. Fuel pump is energized.
  - Voltage supply to standby motor contactor and subsequent motor start is prevented.
  - Glow plugs are energized via GPR relay (T3 output).
  - Then starter solenoid is energized via SSR relay and T2 output. Engine will crank for 10 seconds or until engine operation is sensed by the alternator signal (L3).
  - GPR is de-energized after the auxiliary input is sensed on. If engine does not start a 15 seconds null period will elapse before next start attempt. Run relay (RR) is kept energized.
  - Standby mode
    - Automatic start:
      - DER relay is energized via N2输出.
      - Prevents activation of engine run solenoid and fuel pump.
      - Standby motor contactor is energized.
      - RR is energized. Electrical power is supplied to the standby motor for starting.
On start/stop, the diesel engine stops when all compartments are in null. It restarts when any one of the compartment reaches autorestart preset conditions.

Perishable set point > -12°C

**Figure 3-1** Temperature Controller Operating Sequence (Perishable Range) Controller Set Point Above -12°C (+10°F)

Hot gas heating for lead compartment

**Figure 3-2** Temperature Controller Operating Sequence “Lead” Evaporator (Perishable Range) Controller Set Point Above -12°C (+10°F)
On start/stop, the diesel engine stops when all compartments are in null. It restarts when any one of the compartment reaches autorestart preset conditions.

Frozen set point < -12°C

Electrical heating for non lead compartment

Figure 3-3 Temperature Controller Operating Sequence (Frozen Range) Controller Set Point Below -12°C (+10°F)

Figure 3-4 Temperature Controller Operating Sequence “Lead” Evaporator (Frozen Range) Controller Set Point Below -12°C (+10°F)
SECTION 4
SERVICE

WARNING
Beware of unannounced starting of engine or standby motor caused by the unit thermostat or the start/stop cycle.

Personal Protective Equipment: before doing anything on this product, as explained in this manual. Always use safety precautions before doing any maintenance on the unit:
safety glasses ☑️, gloves ☑️,
safety shoes ☑️, safety clothes ☑️

WARNING
Before servicing unit, make sure the Run-Stop switch is in the STOP position. Also disconnect the negative battery cable.

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

4.1 MAINTENANCE SCHEDULE

<table>
<thead>
<tr>
<th>Supra 750Mt° / 850Mt°</th>
<th>REQUIRED SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without bypass oil filter</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>250</td>
<td>1000</td>
</tr>
<tr>
<td>With bypass oil filter (option)</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>250</td>
<td>1250</td>
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<table>
<thead>
<tr>
<th>Supra 950Mt°</th>
<th>REQUIRED SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>With standard oil filter</td>
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</tr>
<tr>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>250</td>
<td>1250</td>
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### 4.2 DESCRIPTION OF SERVICE REQUIREMENTS

<table>
<thead>
<tr>
<th>SERVICE</th>
<th></th>
</tr>
</thead>
</table>
| Service A | ● Drain the engine oil, replace oil filter and by-pass filter (if so equipped).  
 |          | ● Check engine cooling system.  
 |          | ● Clean the cartridge of the dry air filter.  
 |          | ● Check air cleaner and change air cleaner oil.  
 |          | ● Check all bolts, screws and unit mouting bolts for tightness. Thighten as required (1st service only).  
 |          | ● Check all belts.  |
| Service B | ● Replace fuel filter.  
 |          | ● Check fuel pump filter.  
 |          | ● Replace the cartridge of the dry air filter.  
 |          | ● Check the battery terminals and fluid level.  
 |          | ● Check compressor oil level.  
 |          | ● Check alternator brushes. Check it for diesel hours PLUS standby hours.  
 |          | ● Check engine thermostat for proper operation.  
 |          | ● Check defrost:  
 |          |   - Check timer setting and function.  
 |          |   - Check refrigerant control valves for proper operation.  
 |          |   - Fans stop.  
 |          |   - Defrost ends automatically.  
 |          |   - Water drains from evaporator.  
 |          | ● Check and adjust rocker arms.  
 |          | ● Replace belts as necessary.  |
| Service C | ● Clean radiator and condenser.  
 |          | ● Check refrigerant level.  
 |          | ● Check engine speed under load  
 |          |   - Supra 750Mt⁺ : 2200 rpm / 1800 rpm  
 |          |   - Supra 850Mt⁺ : 2400 rpm / 1800 rpm  
 |          |   - Supra 950Mt⁺ : 2250 rpm / 1800 rpm  
 |          | ● Change the fan motor brushes.  
 |          | ● Check and rebuild the alternator.  
 |          | ● Clean and adjust fuel injectors (140 kg/cm²)  |
| Service D | ● Check all belt tension pulleys.  
 |          | ● Change anti-freeze in diesel engine.  
 |          | ● Check bearings in clutch(es) and electric motors.  |
4.3 SERVICING ENGINE RELATED COMPONENTS

4.3.1 Cooling system

The condenser and radiator assembly is designed with the radiator located after the condenser coil. The condenser fans draw the air through the condenser and radiator coil.

1. Cleaning the 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.

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.

WARNING

Do not use high pressure water spray to avoid damaging condenser fins.

2. Replace coolant

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

b. Install hose and fill system with clean, untreated water to which any proprietary radiator cleaner should be added (six ounces - dry 151 grams to one gallon = 3.78 liters) of water.

c. Run engine for the time recommended by the cleaner product used and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

d. 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.

3. Checking radiator operation

a. Check visually the cooling system (specially hose between radiator and coolant bottle).

b. Verify coolant level inside the radiator and top up if necessary.

c. Power up the unit.

d. Run engine to operating temperature until coolant level in coolant bottle increases (flow from the radiator to the coolant bottle).

e. Stop the unit and verify that coolant decreases inside the coolant bottle (flow from the coolant bottle to the radiator).

![Figure 4-1 Cooling circuit](image-url)
4.3.2 Changing Lube Oil and Lube Oil filters

**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.

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

4.3.3 Fuel filter and fuel circuit

![Fuel filter and fuel circuit diagram](image)

**Figure 4-2 Fuel filter and fuel circuit**

**CAUTION**

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

Replace filter(s), lightly oil gasket on filter before installing and add lube oil. (Refer to section 2.2) Warm up engine and check for leaks.
a. Checking fuel circuit

1. The engine must run with bleed port slightly unscrewed. This indicates that injection pump pressure is greater than 0.1 bars. (If not check for air leakages and clean fuel lines).

2. The electrical pump is designed to deliver 0.7 bar. The fuel circuit flow rate in the return line is about 5 liters per hour.

b. Changing fuel filter

After changing fuel filter operate the electrical pump to bleed properly the fuel circuit before engine start.

CAUTION

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

4.3.4 Replacing solenoids (Figure 4-3)

1. Remove spring from the run/stop (or speed) lever (item 4.).

2. Disconnect solenoid. Remove clip (item 3.) from linkage rod (item 5.).

3. Remove solenoid and install the new one (clip + spring).

4. Energize the solenoid and verify that:
   - for STOP SOLENOID: run/stop lever is at full position. Lever should not touch surface.
   - for RUN SOLENOID: speed lever touches high speed adjusting screw (at rated operation speed).

5. De-energize the solenoid and verify that:
   - for STOP SOLENOID: engine shutdowns immediatly. Otherwise, adjust solenoid position.
   - for SPEED SOLENOID: speed lever touches low speed adjusting screw (at rated operation speed).

6. Verify that solenoid moves smoothly when energized or de-energized.

---

Figure 4-3 Speed and run control solenoids
4.3.5 Engine air cleaner

a. Inspection

The oil type air cleaner, hose and connections should be inspected for leaks or fractures in the inlet and outlet hoses. 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.

b. Service Procedure (dry type)

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

4.3.6 Servicing fuel pump

a. To check or to replace

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

![WARNING]

Protect carefully your eyes from solvent.

4. To install reverse above steps.

b. Verify fuel pump capability

1. Remove fuel pump from the system. Connect the manometer to pump outlet. Energize fuel pump with a small quantity of fuel.
2. At zero flow, the fuel pump should provide about 0.7 bars of pressure at the pump outlet.
3. When running correctly the fuel pump generates noise according to pulsation of the inner piston.
- 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.

4.3.7 Servicing Glow plugs

- CT2.29TV / CT3.44TV & CT3.69TV engine have slow glow plugs:
  - 25 seconds to reach 800°C under 12.5 V

In case of fast brun of glow plugs, verify that micro configuration is correct:
- TV for all engine types

When servicing, the glow plug is to be fitted carefully into the cylinder head to prevent damage to glow plug. Torque value for the glow plug is 0.8 to 1.5 mkg (6 to 11 ft-lb).

Checking for a Defective Glow Plug

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.

A good plug draws 8 to 10 A.

4.3.8 Clutch control

a. Engagement speed

Clutch is designed to engage around 1200 rpm (engine speed) for Supra 750Mt° / 850Mt° and 900 rpm for Supra 950Mt°. This engagement speed will increase with shoes wear. It is crucial to replace shoes before engagement speed reaches around 1600 rpm to avoid clutch burnout.

Control procedure

Remove clip and connecting rod from stop/run solenoid. Manually move run lever in full position. Start the unit in Engine mode and let it reach high speed.

Then decrease speed until clutch disengage. From this position slowly increase engine speed until clutch engages (compressor is driven by engine) and record the speed.

b. Shoes wear

1. Observe clutch housing to check for any discoloration of the metal surface, sigh that clutch has overhead. In that case, check shoes condition.

2. Remove clutch cover plate and using a mirror observe shoe condition and lining material thickness. If thickness is less than 1 mm, replace shoes.

4.3.9 Servicing alternator

Inspection

- verify heightness of connections especially for the excitation wire. If disconnected unit shall display ALT AUX and battery will not reloaded during unit operation.

Brushes (every 5 000 hours)

- make sure battery terminals and alternator exciting cable are disconnected.
- remove the two screws holding the regulator.
- replace the brushes.
- reassembly the regulator.

Voltage control

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

4.4 SERVICING AND ADJUSTING V-BELTS

WARNING

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

It is recommended using an electronic belt tension gauge (tester) P/N 07-60098-00, shown in Figure 4-5 whenever V-belts are adjusted or replaced.
- Make sure the belt drive is static (not in motion).
- Hold the tension meter close to static belt section to avoid misreadings due to hand movement.
- Place the probe a few millimeters above or below the belt.
- Tap the belt with a finger to bring the belt into vibration. At the same time press the ON/OFF button and hold.
- The red dot in the display lights up in response to the belt frequency. When a measurement is obtained, the device will beep and display the frequency of vibration in Hertz (the red dots do not represent commas).

Table 4-1 Belt tension

<table>
<thead>
<tr>
<th>Belts</th>
<th>Tension (Hz) ±5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>750 Mt*</td>
</tr>
<tr>
<td>CT3-44TV engine (D722) Water pump</td>
<td>Automatic belt tensioner</td>
</tr>
<tr>
<td>CT2-29TV engine (Z482) Water pump</td>
<td></td>
</tr>
<tr>
<td>Engine to compressor</td>
<td>82</td>
</tr>
<tr>
<td>Alternator</td>
<td>114</td>
</tr>
<tr>
<td>Standby motor to compressor</td>
<td>88</td>
</tr>
<tr>
<td>Standby motor to Generator</td>
<td>149</td>
</tr>
</tbody>
</table>

4.4.2 Trapezoidal V-belt

Figure 4-6 V-belt arrangement

Supra 750 Mt⁺
1. Engine to compressor v-belt
2. Standby motor to alternator v-belt
3. Standby motor to compressor v-belt
4. Standby motor to generator v-belt
X Frequency checking point with electronic belt tensioner

Supra 850 Mt⁺
1. Engine to compressor v-belt
2. Standby motor to alternator v-belt
3. Standby motor to compressor v-belt
4. Standby motor to generator v-belt
X Frequency checking point with electronic belt tensioner

Supra 950 Mt⁺
1. Engine to compressor v-belt
2. Standby motor to alternator and generator v-belt
3. Standby motor to compressor v-belt
X Frequency checking point with electronic belt tensioner
4.4.3 Alternator V-belt

a. Make sure negative battery terminal is disconnected.

b. Tension is done by rotation of alternator around its pivot.

4.4.4 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 its correct tension.

4.4.5 Standby motor - Compressor V-belt

Diesel engine - Compressor V-belt

a. Tension is realized by moving idler pulley:
   UPWARDS (Engine / Compressor)
   DOWNWARDS (Standby / Compressor)

Depending on unit an adjusting screw easiest the displacement of the pulley along the idler.

4.5 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, quench 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/cm² (1 psig).

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

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

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

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

8. Leak check connections with a leak detector.

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

10. Check the refrigerant charge. (Refer to section 4.8.2)

| NOTE |
| Store the refrigerant charge in an evacuated container if the system must be opened between the compressor discharge valve and receiver. Whenever the system is opened, it must be evacuated and dehydrated. (Refer to section 4.7). |

b. Removing the Refrigerant charge

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

4.6 REFRIGERANT LEAK CHECKING

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

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

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

| NOTE |
| It must be emphasized that only the correct refrigerant cylinder be connected to pressurize the system. Any other gas or vapor will contaminate the system which will require additional purging and evacuation of the high side (discharge) of the system. |
c. Remove refrigerant using a refrigerant recovery system and repair any leaks. Evacuate and dehydrate the unit. (Refer to section 4.7) Charge unit with refrigerant. (Refer to section 4.8)

4.7 EVACUATION AND DEHYDRATION

4.7.1 General

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

4.7.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.6)
b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5 cfm = 8m³H volume displacement, P/N 07-00176-01) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator).

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

4.7.3 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 4-7 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 4.8)
4.8 CHARGING THE REFRIGERANT SYSTEM

4.8.1 Installing a complete charge

a. Dehydrate unit and leave in deep vacuum. (Refer to section 4.7)

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 Table 2-1.

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.

4.8.2 Checking the refrigerant charge

Start unit in cooling mode. Run approximately ten minutes. Partially block off air flow to condenser coil so discharge pressure rises to 14.8 kg/cm² (210 psig).

The unit is correctly charged when the lower receiver sight glass is full and no refrigerant is in the upper receiver sight glass.
4.9 REPLACING THE COMPRESSOR

Figure 4-8 Compressors

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 4.5.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), the wiring to the high pressure switch (HP) and low pressure (BP) as necessary.
4. Release idler pulleys and remove belts. Then remove the compressor from chassis.
5. Remove the pulley from the compressor.
6. Drain oil from defective compressor before shipping.

b. Installing

1. To install the compressor, reverse the procedure outlined when removing the compressor.
2. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns \( (29.90^\circ \text{ Hg vacuum} = 75.9 \text{ cm Hg vacuum}) \). Turn off valves on both lines to pump.
3. Fully backseat (open) both suction and discharge service valves.
4. Remove vacuum pump lines and install manifold gauges.
5. Check refrigerant level (Refer to section 4.8.2).

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is important to check the compressor oil level of the new compressor and fill if necessary.</td>
</tr>
</tbody>
</table>

6. Check compressor oil level. (Refer to section 4.10) Add oil if necessary.
7. Check refrigerant cycles.

4.10 CHECKING 05K / 05G COMPRESSOR OIL LEVEL

a. To check oil level in 05K compressor

1. Operate the unit in high speed cooling for at least 20 minutes.
2. Check the oil sight glass on the compressor to ensure that no foaming of the oil is present after 20 minutes of operation. If the oil is foaming excessively after 20 minutes of operation, check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before performing step 3.
3. Check the level of the oil in the front 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 d. If the level is below sight glass, add oil to the compressor following step b.

b. Adding oil with compressor in system

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

1. Oil Pump Method

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

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

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

2. Closed System Method

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

CAUTION

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

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

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

c. Adding oil to service replacement compressor

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

If compressor is without oil:

Add correct oil charge (Refer to section 2.3) by removing the oil fill plug (See Figure 4-8)

d. To remove oil from the compressor

1. Close suction service valve (frontseat) and pump unit down to 0.1 to 0.3 kg/cm² (2 to 4 psig). Frontseat discharge service valve and slowly bleed remaining refrigerant.

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

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

4.11 COMPRESSOR UNLOADER VALVE - FOR SUPRA 850MT* & 950MT* 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 setpoint temperature at least 5°F (2.8°C) above set point and the compressor will be fully loaded (unless suction pressure is higher than varipower equation and forced compressor to be in 4 cylinders). Note suction pressure.

2. Increase setpoint slowly to until unloader valve is energized (followed by continuity light or ohmmeter). Verify that suction pressure rise of approximately 3 psig (0.2 bars).

NOTE

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

b. Solenoid coil replacement

The coil may be removed without pumping the unit down.

1. Disconnect leads. Lift off coil. (see Figure 4-9)
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 (see Figure 4-9)

1. Pump down the unit. Frontseat both service valves to isolate the compressor.
2. Remove coil.
3. Remove enclosing tube collar (item 4, Figure 4-9) 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).
7. Evacuate and dehydrate the compressor. (Refer to section 4.7)
8. Start unit and check unloader operation (Refer to section 4.11.a.).

Figure 4-9 Unloader solenoid valve

4.12 CHECKING AND REPLACING FILTER-DRIER

2 methods

To Check Filter-Drier

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

To Replace Filter-Drier

a. Pump down the unit per section 4.5. Remove bracket, then replace drier.
b. Check refrigerant level. (Refer to section 4.8.2)

4.13 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCH

4.13.1 Replacing high pressure switch

a. Pump down the unit (Refer to section 4.5). Frontseat both suction and discharge service valves to isolate compressor (HP) or discharge and receiver valve (BP).
b. Slowly release compressor pressure through the service valve gauge ports.
c. Disconnect wiring from defective switch. The high pressure switch is located near the top of the compressor. Low pressure switch on compressor or suction line.
d. Install new cutout switch after verifying switch settings. (Refer to section 4.13.2)
e. Evacuate and dehydrate the compressor. (Refer to section 4.7)

4.13.2 Checking high pressure switch

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 165 kg/cm² (2350 psi). Do not use oxygen in or near a refrigerant system as an explosion may occur (see Figure 4-10).
1. Cylindervalve and gauge
2. Pressure regulator
3. Nitrogen cylinder
4. Pressure gauge
5. Bleed-Off valve
6. 1/4 inch connection

Figure 4-10 Typical setup for testing high pressure switch

4.14 CHECKING AND REPLACING LOW PRESSURE CUTOUT SWITCH

4.14.1 Replacing low pressure switch

a. Unplug
b. Unscrew
c. Calibrate new sensor (refer to section 3.18.4)
d. Screw into place
e. Connect

4.14.2 Checking low pressure switch

a. Start the unit after having installed a manometer on compressor.
b. Close receiver valve to pump down suction line.
c. Using an ohmmeter or continuity light, verify that switch opens or closes according to specification.
d. Repeat checkout procedure until switch actuates at correct gauge reading.
e. After switch is adjusted, place a small amount of paint or glycerol on the adjusting screw so that vibration will not change switch setting.

4.15 REPLACING RECEIVER SIGHT GLASS ASSEMBLY

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are two types of receiver sight glasses; the floating ball type, and the prism type; both are interchangeable.</td>
</tr>
</tbody>
</table>

a. Store the refrigerant in an evacuated container. (Refer to Section 3.5b)
b. Unscrew the sight glass assembly. Spread some sealing compound on pipe threads of new sight glass assembly and install.
c. Leak check receiver sight glass per Section 3.6.
d. After leak checking unit, evacuate and dehydrate as outlined in section 3.7.
e. Add refrigerant charge. (Refer to section 3.8).
f. Check for noncondensibles.

4.16 COILS CLEANING

4.16.1 Evaporator coil

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.

4.16.2 Condenser coil

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

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.

4.17 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.

4.18 THERMOSTATIC EXPANSION VALVE

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

a. Replacing expansion valve

1. Pump down the unit by closing the King valve. (Refer to section 4.5.a.)
2. Remove insulation from expansion valve bulb and then remove bulb from suction line.
3. Loosen inlet and outlet and equalizer nuts and remove expansion valve.
4. Check for foreign material in valve body and / or calibrated orifice.
5. Install the new expansion valve and equalization line via ORFS connection. Make sure that o-ring are correctly in place to avoid leaks.

6. The thermal bulb must be installed as shown on Figure 4-13. Interface area must be clean to ensure positive bulb contact. Strap thermal bulb with clamps to suction line and insulate.

7. Protect capillary loop from vibrate using heat shrink tube.

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

9. Open King valve and then check refrigerant level. (Refer to section 4.8.2)

10. Check superheat.

b. To measure superheat

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

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

3. Place thermocouple above (parallel) expansion valve bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line.

4. Connect an accurate gauge to the 1/4” port on the evaporator suction line.

5. Run unit until stabilized. Set controller 5.5°C (10°F) below box temperature.

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

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

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

4.19.1 Service guidelines

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

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Table 4-2 Connection Point Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection point</td>
</tr>
<tr>
<td>CDT, RAS, SAS, WTS</td>
</tr>
<tr>
<td>MPF1</td>
</tr>
</tbody>
</table>
4.19.2  Microprocessor configuration

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

To reach the configuration fields:

1. Turn the Run/Stop switch to the Stop position.
2. With the unit off, locate the serial port plug located below the control panel. Remove the protective plug to gain access to the wire terminals. Place an insulated jumper wire between wires SPA and SPB at the serial port plug.

![CAUTION]

Do not allow jumper wire to touch any ground.

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

4. To change the configuration selection:

a. Bring the configuration to be changed onto the display. Press the ENTER key to allow change access to the displayed configuration.

b. Press either the UP or DOWN keys to display available selections for that configuration. Leave the correct selection on the screen. The selection display will flash warning the operator that the displayed value has not been entered. Press the ENTER key to enter the new selection into memory. (The display will revert to the original selection if no further action is taken for the next 5 seconds.)

c. Continue to scroll through the configuration list by pressing the FUNCTION key. Change any other configurations as required.

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

### Hour Meter

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

The microprocessor has 2 programmable registers which are set via the serial port. These registers are compared to one of the hour meters (diesel, standby, or switch on). If the hour meter is greater than the register then the proper alarm is set.

<table>
<thead>
<tr>
<th>Table 4-3 Microprocessor Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration</strong></td>
</tr>
<tr>
<td>CNF1 TV</td>
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<td>OFF</td>
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</table>
CNF1: Glow time
Indicates to the micro which engine is in the system and which glow time should be used.

CNF2: Discharge sensor
Indicates to the micro if the Discharge sensor is installed.

CNF3: high setpoint limit
Indicates maximum setpoint allowed and controls functional parameter lockout in conjunction with CNF11. Default is: high speed not active and function lock not active.

CNF4: Heat lockout override
Indicates to the micro if the heat lockout is overridden.

CNF5: MOP enable / disable option
Configuration used to enable / disable the MOP control of the unloaders. If enable MOP is chosen, then the MOP will control the unloaders. If disable MOP is chosen, then the unloaders will operate independent of the suction pressure.

CNF6: Truck unit
Indicates to the micro if the system has been selected for truck operation.

CNF7: Lock in high speed override
Indicates to the micro if lock in high speed is overridden.

CNF8: Electric fan
Indicates to the micro if electric fans are being used.

CNF9: Out of range shut down
Indicates if main compartment out of range alarm shuts unit down after 45 minutes.

CNF11: Functional parameters (keypad) lockdown
In conjunction with CNF3, controls the functional parameter keypad lockout options.

CNF13: Heat only unit operation option
Converts unit to a “heat only” unit.

CNF14: Invertable multitemp
Not used.

CNF15: Ultra Fresh II
Not used.

CNF16: Shut down with alternator aux alarm
If CNF16 is on, shut down in diesel when alternator auxiliary signal is not present.

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

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

At least one lead from the sensor (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 0 °C (32 °F) or a calibrated temperature tester.

<p>| Table 4-4 Sensor Resistance (ATS, DTS, CDT, RAS, SAS &amp; WTS) |
|-----------------|-----------------|-----------------|
| <strong>Temperature</strong> | <strong>ATS, DTS, RAS, SAS &amp; WTS Resistance In Ohms</strong> | <strong>CDT Resistance In Ohms</strong> |</p>
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<td>46,300</td>
<td>463,000</td>
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4.19.4 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 cannot be calibrated. Once the micro is calibrated, the display will read out 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 3 seconds, the display should read "0". If display reads "0" install suction pressure transducer into unit.

Table 4-5 R-404A Temperature-Pressure chart

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<tr>
<th>Temperature °C</th>
<th>Temperature °F</th>
<th>Pressure Psig</th>
<th>Pressure Kg/cm²</th>
<th>Pressure Bar</th>
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### SECTION 5

**TROUBLESHOOTING**

---

**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.

---

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<th>INDICATION / TROUBLE</th>
<th>POSSIBLE CAUSES</th>
<th>REFERENCE SECTION</th>
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<tbody>
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<td>5.1 DIESEL ENGINE</td>
<td></td>
<td></td>
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<tr>
<td>5.1.1 Engine will not start</td>
<td>Battery insufficiently charged</td>
<td>Check</td>
</tr>
<tr>
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<td>Battery terminal post dirty or defective</td>
<td>Check</td>
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<tr>
<td></td>
<td>Bad electrical connections on starter</td>
<td>Check</td>
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<tr>
<td></td>
<td>Starter motor malfunctions</td>
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</tr>
<tr>
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<td>Starter motor solenoid defective</td>
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<td>Open starting circuit</td>
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<tr>
<td></td>
<td>Incorrect grade of lubricating oil</td>
<td>2.2</td>
</tr>
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</table>

| Starter motor cranks but engine fails to start | No fuel in tank | Check |
|                                                | Air in fuel system | Check |
|                                                | Water in fuel system | Drain Sump |
|                                                | Plugged fuel filters | Replace |
|                                                | Plugged fuel lines to injector (s) | Check |
|                                                | Fuel control operation erratic | Engine |
|                                                | Glow plug(s) defective | 4.3.7 |
|                                                | Run solenoid defective | 4.3.4 |
|                                                | Fuel pump (FP) malfunction | 4.3.6 |

<p>| Starter cranks, engages but dies after a few seconds | Engine lube oil too heavy | 2.2 |
|                                                     | Voltage drop in starter cable(s) | Check |</p>
<table>
<thead>
<tr>
<th>INDICATION / TROUBLE</th>
<th>POSSIBLE CAUSES</th>
<th>REFERENCE SECTION</th>
</tr>
</thead>
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<td><strong>5.1.2 Engine starts then stops</strong></td>
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<tr>
<td>Engine stops after several rotations</td>
<td>Fuel supply restricted</td>
<td>Check</td>
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<tr>
<td></td>
<td>No fuel in tank</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Leak in fuel system</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Faulty fuel control operation</td>
<td>Engine</td>
</tr>
<tr>
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<td>Fuel filter restricted</td>
<td>Replace</td>
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<td>Injection pump defective</td>
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<td>Air cleaner or hose restricted</td>
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<td>Safety device open</td>
<td>2.7</td>
</tr>
<tr>
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<td>Open wiring circuit to run solenoid</td>
<td>Check</td>
</tr>
<tr>
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<td>Fuel pump (FP) malfunction</td>
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<td><strong>5.1.3 Starter motor malfunction</strong></td>
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<td>Starter motor will not crank or turns slowly</td>
<td>Battery insufficiently charged</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Battery cable connections loose or oxidized</td>
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</tr>
<tr>
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<td>Battery cables defective</td>
<td>Replace</td>
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<td>Starter brushes shorted out</td>
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<td>Starter brushes hang up or have no contact</td>
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<td>Starter solenoid damaged</td>
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<td>Run-Stop or Start-Run-Stop switch defective</td>
<td>Replace</td>
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<tr>
<td></td>
<td>Engine lube oil too heavy</td>
<td>2.2</td>
</tr>
<tr>
<td>Starter motor turns but pinion does not engage</td>
<td>Pinion or ring gear obstructed or worn</td>
<td>Clean both, remove burrs, or replace; apply grease</td>
</tr>
<tr>
<td>Starter motor does not disengage after switch was depressed</td>
<td>Run-Stop or Start-Run-Stop switch defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Starter motor solenoid defective</td>
<td>Engine Manual</td>
</tr>
<tr>
<td>Pinion does not disengage after engine is running</td>
<td>Defective starter</td>
<td>Engine Manual</td>
</tr>
<tr>
<td><strong>5.1.4 Malfunction in the engine starting circuit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No power to starter motor solenoid (SS)</td>
<td>Battery defective</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Loose electrical connections</td>
<td>Tighten</td>
</tr>
<tr>
<td>Run solenoid does not energize or does not remain energized</td>
<td>Battery defective</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Loose electrical connections</td>
<td>Tighten</td>
</tr>
<tr>
<td></td>
<td>Oil pressure safety switch (OP) defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Run relay (RR) defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Water temperature safety switch open</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>Water temperature sensor (WTS) defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Run solenoid defective</td>
<td>4.3.4</td>
</tr>
<tr>
<td></td>
<td>Run-Stop or Start-Run-Stop switch defective</td>
<td>Replace</td>
</tr>
</tbody>
</table>
### 5.2 ALTERNATOR (AUTOMOTIVE TYPE)

<table>
<thead>
<tr>
<th>INDICATION / TROUBLE</th>
<th>POSSIBLE CAUSES</th>
<th>REFERENCE SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternator fails to charge</td>
<td>Limited charging system operating time</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Battery condition</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Alternator belt loose/broken</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Loose, dirty, corroded terminals, or broken leads</td>
<td>Check/Repair</td>
</tr>
<tr>
<td></td>
<td>Excessively worn, open or defective brushes</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Open blocking diode</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Regulator faulty</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Open isolation diode</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Open rotor (field coil)</td>
<td>Check</td>
</tr>
<tr>
<td>Low or unsteady charging rate</td>
<td>Alternator belt loose</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Loose, dirty, corroded terminals, or broken leads</td>
<td>Check/Repair</td>
</tr>
<tr>
<td></td>
<td>Excessively worn, sticky or intermittent brushes</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Faulty regulator</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Grounded or shorted turns in rotor</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>Open, grounded or shorted turns in stator</td>
<td>Replace</td>
</tr>
<tr>
<td>Excessive charging rate (as</td>
<td>Regulator leads loose, dirty, corroded terminals, or wires broke</td>
<td>Clean/Repair</td>
</tr>
<tr>
<td>evidenced by battery requiring too</td>
<td>Defective regulator</td>
<td>Check</td>
</tr>
<tr>
<td>frequent refilling) or charge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>indicator shows constant “charge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with engine idling”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noisy alternator</td>
<td>Defective or badly worn V-belt</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Worn bearing(s)</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Misaligned belt or pulley</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Loose pulley</td>
<td>Tighten</td>
</tr>
</tbody>
</table>

### 5.3 REFRIGERATION

#### 5.3.1 Unit will not cool

<table>
<thead>
<tr>
<th>Component</th>
<th>Malfunction(s)</th>
<th>Reference Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel engine</td>
<td></td>
<td>5.1</td>
</tr>
<tr>
<td>Compressor malfunction</td>
<td>Compressor drive defective</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Compressor defective</td>
<td>4.9</td>
</tr>
<tr>
<td>Refrigeration system</td>
<td>Defrost cycle did not terminate</td>
<td>5.3.5</td>
</tr>
<tr>
<td></td>
<td>Abnormal pressure</td>
<td>5.3.6</td>
</tr>
<tr>
<td></td>
<td>Hot gas valve malfunction</td>
<td>5.3.11</td>
</tr>
</tbody>
</table>

#### 5.3.2 Unit runs but has insufficient cooling

<table>
<thead>
<tr>
<th>Component</th>
<th>Malfunction(s)</th>
<th>Reference Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor</td>
<td>Compressor valves defective</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Unloader malfunction</td>
<td>4.11</td>
</tr>
<tr>
<td>Refrigeration system</td>
<td>Abnormal pressure</td>
<td>5.3.6</td>
</tr>
<tr>
<td></td>
<td>Expansion valve malfunction</td>
<td>5.3.10</td>
</tr>
<tr>
<td></td>
<td>No or restricted evaporator airflow</td>
<td>5.3.9</td>
</tr>
<tr>
<td></td>
<td>Unloader malfunction</td>
<td>4.11</td>
</tr>
<tr>
<td>Engine does not develop full rpm</td>
<td>Speed control linkage</td>
<td>4.3.4</td>
</tr>
<tr>
<td></td>
<td>Engine malfunction</td>
<td>5.1</td>
</tr>
<tr>
<td>INDICATION / TROUBLE</td>
<td>POSSIBLE CAUSES</td>
<td>REFERENCE SECTION</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>5.3.3 Unit operates long or continuously in cooling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container</td>
<td>Hot Load</td>
<td>Allow time to pull down</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct</td>
</tr>
<tr>
<td>Refrigeration system</td>
<td>Abnormal pressure</td>
<td>5.3.6</td>
</tr>
<tr>
<td></td>
<td>Temperature controller malfunction</td>
<td>5.3.8</td>
</tr>
<tr>
<td>Compressor</td>
<td>Defective</td>
<td>4.9</td>
</tr>
<tr>
<td><strong>5.3.4 Unit will not heat or has insufficient heating</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigeration</td>
<td>Abnormal pressure</td>
<td>5.3.6</td>
</tr>
<tr>
<td></td>
<td>Temperature controller malfunction</td>
<td>5.3.8</td>
</tr>
<tr>
<td></td>
<td>Hot gas valve malfunction</td>
<td>5.3.11</td>
</tr>
<tr>
<td>Compressor</td>
<td>Compressor drive defective</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Compressor defective</td>
<td>4.9</td>
</tr>
<tr>
<td>Engine does not develop full rpm</td>
<td>Speed control linkage</td>
<td>4.3.4</td>
</tr>
<tr>
<td></td>
<td>Engine malfunction</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>5.3.5 Defrost cycle malfunction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will not initiate defrost automatically</td>
<td>Defrost thermostats (DTT) open or defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Loose terminal connections</td>
<td>Tighten</td>
</tr>
<tr>
<td></td>
<td>Air sensing tubes defective or disconnected</td>
<td>Check</td>
</tr>
<tr>
<td>Will not initiate defrost manually</td>
<td>Microprocessor defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Loose terminal connections</td>
<td>Tighten</td>
</tr>
<tr>
<td></td>
<td>Defrost thermostats (DTT) open or defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Glow/Defrost switch defective</td>
<td>Replace</td>
</tr>
<tr>
<td>Initiates but does not defrost</td>
<td>Hot gas valve malfunction</td>
<td>5.3.11</td>
</tr>
<tr>
<td></td>
<td>Defrost relay (DR) defective</td>
<td>Replace</td>
</tr>
<tr>
<td>Frequent defrost</td>
<td>Defrost timer to be adjusted</td>
<td>2.8.6</td>
</tr>
<tr>
<td></td>
<td>Wet load</td>
<td>Normal</td>
</tr>
<tr>
<td>Does not terminate or cycles on defrost</td>
<td>Defrost thermostats (DTT) shorted closed</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Glow/Defrost switch defective</td>
<td>Replace</td>
</tr>
<tr>
<td><strong>5.3.6 Abnormal pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5.3.6.1 Cooling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High discharge pressure</td>
<td>Condenser coil dirty</td>
<td>4.16.2</td>
</tr>
<tr>
<td></td>
<td>Condenser fan defective</td>
<td>Check</td>
</tr>
<tr>
<td></td>
<td>V-belt broken or loose</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Discharge check valve restricted</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Noncondensibles or refrigerant overcharge</td>
<td>Replace</td>
</tr>
<tr>
<td>Low discharge pressure</td>
<td>Compressor valves(s) worn or broken</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Hot gas valve malfunction</td>
<td>5.3.11</td>
</tr>
<tr>
<td>High suction pressure</td>
<td>Compressor valves(s) worn or broken</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Compressor gasket(s) defective</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Hot gas valve malfunction</td>
<td>2.9.2</td>
</tr>
<tr>
<td>INDICATION / TROUBLE</td>
<td>POSSIBLE CAUSES</td>
<td>REFERENCE SECTION</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Low suction pressure</td>
<td>Suction service valve partially closed</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td>King valve partially closed</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td>Filter-drier partially plugged</td>
<td>4.12</td>
</tr>
<tr>
<td></td>
<td>Low refrigerant charge</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>Expansion valve malfunction</td>
<td>5.3.10</td>
</tr>
<tr>
<td></td>
<td>No evaporator air flow or restricted air flow</td>
<td>5.3.9</td>
</tr>
<tr>
<td></td>
<td>Excessive frost on coil</td>
<td>Check</td>
</tr>
<tr>
<td>Suction and discharge pressures tend to equalize when unit is operating</td>
<td>Compressor valves defective</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Hot gas valve malfunction</td>
<td>2.9.2</td>
</tr>
</tbody>
</table>

### 5.3.6.2 Heating

| High discharge pressure                                  | Overcharged system                                                             | 4.8.2             |
|                                                          | Condenser fan defective                                                        | Check             |
|                                                          | V-belts broken or loose                                                        | 4.4               |
|                                                          | Noncondensibles in system                                                       | Check             |
| Low discharge pressure                                    | Compressor valve(s) worn or broken                                             | 4.9               |
|                                                          | Hot gas valve malfunction                                                      | 2.9.2             |
|                                                          | Low refrigerant charge                                                         | 4.8               |
| Low suction pressure                                      | Refrigerant shortage                                                           | 4.8               |
|                                                          | Compressor pressure regulating valve malfunction                              | 4.17              |
|                                                          | Suction service valve partially closed                                         | Open              |

### 5.3.7 Abnormal noise

| Compressor                                               | Loose mounting bolts                                                          | Tighten           |
|                                                          | Worn bearings                                                                  | 4.9               |
|                                                          | Worn or broken valves                                                          | 4.9               |
|                                                          | Liquid slugging                                                                | 5.3.10            |
|                                                          | Insufficient oil                                                               | 4.10              |
| Condenser or evaporator fan                              | Loose or striking shroud                                                       | Check             |
|                                                          | Bearings defective                                                             | Check             |
|                                                          | Bent shaft                                                                     | Check             |
| V-belts                                                  | Cracked or worn                                                                | 4.4               |

### 5.3.8 Control system malfunction

<p>| Will not control                                        | Sensor defective                                                               | 4.19.3            |
|                                                          | Relay(s) defective                                                             | Check             |
|                                                          | Microprocessor controller malfunction                                          | 4.19              |</p>
<table>
<thead>
<tr>
<th>INDICATION / TROUBLE</th>
<th>POSSIBLE CAUSES</th>
<th>REFERENCE SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.3.9 No evaporator air flow restricted air flow</strong></td>
<td>Evaporator coil blocked</td>
<td>Frost on coil</td>
</tr>
<tr>
<td></td>
<td>Dirty coil</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fan motor(s) malfunction</td>
<td></td>
</tr>
<tr>
<td>No or partial evaporator air flow</td>
<td>V-belt broken or loose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clutch defective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaporator fan loose or defective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaporator fan rotating backwards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaporator air flow blocked in trailer (box)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fan motor(s) malfunction</td>
<td></td>
</tr>
<tr>
<td><strong>5.3.10 Expansion valve malfunction</strong></td>
<td>Low suction pressure with high superheat</td>
<td>Low refrigerant charge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>External equalizer line plugged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ice formation at valve seat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wax, oil or dirt plugging valve or orifice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Broken capillary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power assembly failure or partial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loss of element/bulb charge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Superheat setting too high</td>
</tr>
<tr>
<td></td>
<td>Low superheat and liquid slugging in compressor</td>
<td>Superheat setting too low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>External equalizer line plugged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ice holding valve open</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foreign material in valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pin and seat of expansion valve eroded or held open by foreign material</td>
</tr>
<tr>
<td>Fluctuating suction pressure</td>
<td>Improper bulb location or installation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low superheat setting</td>
<td></td>
</tr>
<tr>
<td><strong>5.3.11 Hot gas valve malfunction</strong></td>
<td>High superheat</td>
<td>Broken capillary</td>
</tr>
<tr>
<td>Valve does not function properly</td>
<td>No power to valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improper wiring or loose connections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coil defective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Valve improperly assembled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coil or coil sleeve improperly assembled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temperature controller malfunction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Movement of plunger restricted due to: a. Corroded or worn parts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Foreign material lodged in valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Bent or dented enclosing tube</td>
<td></td>
</tr>
<tr>
<td>Valve shifts but refrigerant continues to flow</td>
<td>Foreign material lodged under seat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defective seat</td>
<td></td>
</tr>
<tr>
<td>INDICATION / TROUBLE</td>
<td>POSSIBLE CAUSES</td>
<td>REFERENCE SECTION</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>5.4 STANDBY MOTOR MALFUNCTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standby motor fails to start</td>
<td>Motor contactor (MC) defective</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Motor Overload (OL) open</td>
<td>Replace motor</td>
</tr>
<tr>
<td></td>
<td>Improper power supply</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Oil pressure switch (OPS) open</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Selector switch (SSW) defective</td>
<td></td>
</tr>
<tr>
<td>Standby motor starts, then stops</td>
<td>Motor Overload (OL) open</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>High amperage draw</td>
<td>Check</td>
</tr>
</tbody>
</table>

6.1 POE OIL

1. PRODUCT AND COMPANY IDENTIFICATION
CARRIER TRANSICOLD INDUSTRIES
810 route de Paris
76520 FRANQUEVILLE ST PIERRE
FRANCE

4. FIRST AID MEASURES

EYE CONTACT:
flush thoroughly with water. If irritation occurs, call a physician.

SKIN CONTACT:
wash contact areas with soap and water. High pressure accidental injection through the skin requires immediate medical attention for possible incision, irrigation and/or debridement.

INHALATION:
not expected to be a problem.

INGESTION:
not expected to be a problem. However, if greater than 1/2 liter (pint) ingested, seek medical attention.

5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA:
carbon dioxide, foam, dry chemical and water fog

SPECIAL FIRE FIGHTING PROCEDURES:
water or foam may cause frothing. Use water to keep fire exposed containers cool. Water spray may be used to flush spills away from exposure. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply.

SPECIAL PROTECTIVE EQUIPMENT:
for fires in enclosed areas, fire fighters must use self-contained breathing apparatus.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

NFPA HAZARD ID:
health : 0,
flammability : 1,
reactivity : 0

HAZARDOUS DECOMPOSITION PRODUCTS:
carbon monoxide
6. ACCIDENTAL RELEASE MEASURES

PROCEDURES IF MATERIAL IS RELEASED OR SPILLED:
small spills can be absorbed with fire retardant treated sawdust, diatomaceous earth, etc. Contain and remove larger spills for salvage or disposal according to applicable regulation.

ENVIRONMENTAL PRECAUTIONS:
prevent spills from entering storm sewers or drains and contact with soil.

PERSONAL PRECAUTIONS:
see section 8.

7. HANDLING AND STORAGE

STORAGE:
do not store in open or unlabelled containers. Store away from strong oxidizing agents or combustible material.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION:
no special requirements under ordinary conditions of use and with adequate ventilation.

RESPIRATORY PROTECTION:
no special requirements under ordinary conditions of use and with adequate ventilation.

EYE PROTECTION:
normal industrial eye protection practices should be employed.

SKIN PROTECTION:
no special equipment required. However, good personal hygiene practices should always be followed.

10. STABILITY AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS:
carbon monoxide (in case of fire)

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL:
EVEN THOUGH THIS PRODUCT IS READILY BIODEGRADABLE, IT MUST NOT BE INDISCRIMINATELY DISCARDED INTO THE ENVIRONMENT.
This product is suitable for burning in an enclosed, controlled burner for fuel value and for recycling at an approved facility. In addition, it can be disposed of at an approved waste disposal facility. Land farming and processing through sewage treatment facilities may be available disposal options but necessary approvals must first be obtained from appropriate regulatory authorities. Specific characteristics of the waste at the time of disposal may affect the availability of the above options.

The complete data sheets are available in English and French from Carrier Transicold Industries on request.
6.2 FORANE R404A

1. PRODUCT AND COMPANY IDENTIFICATION

CARRIER TRANSICOLD INDUSTRIES
810 route de Paris
76520 FRANQUEVILLE ST PIERRE
FRANCE

Product name: Forane (R) 404A
Product synonym(s)

Chemical family: hydrofluorocarbons
Chemical formula: CF3CH2F/CF3CH2F/CF3CH3
Chemical name: 1,1,1,2-tetrafluoroethane (HFC-134a)/Pentafluoroethane (HFC-125)/
1,1,1-trifluoroethane (HFC-143a).

2. COMPOSITION / INFORMATION ON INGREDIENTS

BLEND OF FORANE 125, 143a, 134a

This product is not hazardous to health as define by the European Union dangerous substances and preparations directives.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Colorless liquified gas with faint ether odor.

WARNING

LIQUID AND GAS UNDER PRESSURE, OVERHEATING AND OVERPRESSURIZING MAY CAUSE GAS RELEASE OF VIOLENT CYLINDER BURSTING. MAY DECOMPOSE ON CONTACT WITH FLAMES OR EXTREMELY HOT METAL SURFACES TO PRODUCE TOXIC AND CORROSIVE PRODUCTS. VAPOR REDUCES OXYGEN AVAILABLE FOR BREATHING AND IS HEAVIER THAN AIR. HARMFUL IF INHALED AND MAY CAUSE HEART IRREGULARITIES, UNCONSCIOUSNESS OR DEATH. LIQUID CONTACT WITH EYES OR SKIN MAY CAUSE FROSTBITE.

POTENTIAL HEALTH, EFFECTS

Skin contact and inhalation are expected to be the primary routes of occupational exposure to this material. As with most liquified gases, contact with the rapidly volatilizing liquid can cause frostbite to any tissue. High vapor concentrations are irritating to the eyes and respiratory tract and may result in central nervous system (CNS) effects such as headache, dizziness, drowsiness and, in severe exposure, loss of consciousness and death. The dense vapor of this material may reduce the available oxygen for breathing. Prolonged exposure to an oxygen-deficient atmosphere may be fatal. Inhalation may cause an increase in the sensitivity of the heart to adrenaline, which could result in irregular or rapid heartbeats. Medical conditions aggravated by exposure to this material include heart disease or compromised heart function.
4. FIRST AID MEASURES

EYE CONTACT
immediately flush with plenty of water. Get medical attention if irritation persists.

SKIN CONTACT
flush exposed skin with lukewarm water (not hot), or use other means to warm skin slowly. Get medical attention if frostbitten by liquid or if irritation occurs.

INGESTION
not applicable. Product is a gas at ambient temperatures.

INHALATION
remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention. DO NOT GIVE ADRENALINE, EPINEPHRIN OR SIMILAR DRUGS FOLLOWING EXPOSURE TO THIS PRODUCT.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA
use extinguishing media appropriate to surrounding fire conditions.

FIRE FIGHTING INSTRUCTIONS
stop the flow of gas if possible. Use water spray on person making shut-off and on containers and cylinders. Fire fighters and others who may be exposed to products of combustion should wear full fire fighting turn out gear (full Bunker Gear) and self-contained breathing apparatus. Fire fighting equipment should be thoroughly decontaminated after use.

FIRE AND EXPLOSION HAZARDS
some mixtures of HCFCs and / or HFCs, and air or oxygen may be combustible if pressurized and exposed to extreme heat or flame.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR LEAK
use Halogen leak detector or other suitable means to locate leaks or check atmosphere. Keep upwind. Evacuate enclosed spaces and disperse gas with floor-level forced-air ventilation. Exhaust vapors outdoors. Do not smoke or operate internal combustion engines. Remove flames and heating elements.

7. HANDLING AND STORAGE

HANDLING
avoid breathing gas. Avoid contact with eyes, skin and clothing. Keep container closed. Use only with adequate ventilation. Do not enter confined spaces unless adequately ventilated.
STORAGE

do not apply direct flame to cylinder. Do not store cylinder in direct sun or expose it to heat above 48°C (120°F). Do not drop or refill this cylinder. Keep away from heat, sparks and flames.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EYE / FACE PROTECTION

where there is potential for eye contact, wear chemical goggles and have eye flushing equipment available.

SKIN PROTECTION

wear appropriate chemical resistant protective clothing and chemical resistant gloves to prevent skin contact. Consult glove manufacturer to determine appropriate type glove material for given application. Rinse contaminated skin promptly. Wash contaminated clothing and clean protective equipment before reuse. Wash skin thoroughly after handling.

RESPIRATORY PROTECTION

avoid breathing gas. When airborne exposure limits are exceeded, use respiratory protection equipment appropriate to the material and / or its components (full facepiece recommended). For emergency and other conditions where exposure limit may be significantly exceeded, use an approved full face positive-pressure, self-contained breathing apparatus or positive-pressure airline with auxiliary self-contained air supply.

10. STABILITY AND REACTIVITY

INCOMPATIBILITY

avoid contact with strong alkali or alkaline earth metals, finely powdered metals such as aluminium, magnesium or zinc and strong oxidizers, since they may react or accelerate decomposition.

HAZARDOUS DECOMPOSITION PRODUCTS

thermal decomposition products include hydrogen fluoride, hydrogen chloride, carbon monoxide, carbon dioxide and chlorine.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

recover, reclaim or recycle when practical. Dispose of in accordance with federal, state and local regulations.

Note : chemical additions to, processing of, or otherwise altering this material may take this waste management information incomplete, inaccurate, or otherwise inappropriate. Furthermore, state and local waste disposal requirements may be more restrictive or otherwise different from federal laws and regulations.

The complete data sheets are available in English and French from Carrier Transicold Industries on request.
This section contains Electrical Schematic Wiring Diagram covering the Models listed in Table 2-1. 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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Drawing #</th>
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<tr>
<td>Supra Mt²</td>
<td>62-60972</td>
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</table>

**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.
Figure 7-1 - Electrical schematic diagram - MICROPROCESSOR CONTROLLER 1/2