Onan Auxiliary Power Unit

Service Manual

DKX

AUX™ Series

Printed in U.S.A.

981-0513
8/95
Specs A & B

Table of Contents

Safety Precautions

Before operating the Auxiliary Power Unit (APU), read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the unit is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator or service personnel, and to potential equipment damage.

⚠DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

Read and observe each of the following safety precautions.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Make sure that exhaust components are in good condition and that all connections are secure. Do not use exhaust gases to heat a compartment.
- Inspect the exhaust system daily for leaks per the maintenance schedule. Do not use engine cooling air to heat a compartment.

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the radiator pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

SERVICING AIR CONDITIONING SYSTEMS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Refrigerant R-12 released into the air creates the hazard of frostbite and severe eye damage. Freon also creates a hazard of respiratory problems that can lead to death. Have all air conditioning service work performed by a qualified service person.
- Refrigerant R-12 produces a poisonous gas called phosgene when it comes in contact with an open flame. Do not allow an open flame, pilot light, cigarettes or other ignition source in the shop or areas sharing ventilation when working on the air conditioning system. Make sure that the shop area has adequate fresh air ventilation.
- Breathing refrigerant R-134a can cause severe personal injury, including:
  giddiness, weakness, dizziness,
  nausea, unconsciousness and
  fatal cardiac arrhythmia (irregular heartbeat).
  Do not release refrigerant R-134a into the air. Use a recovery system to remove refrigerant from the system. Make sure the shop area has adequate fresh air ventilation.
- The AC system is under high pressure. Be extremely careful not to open any part of the system (hoses, valves, etc.) or severe personal injury could result.

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury can result from improper practices.

- DO NOT fill fuel tanks while the engine is running. Fuel contact with hot engine or exhaust is a potential fire hazard.
- Do not smoke or allow an open flame, pilot light, or spark producing equipment or switch near the fuel system.
- Fuel lines must be adequately secured and free of leaks. Inspect the fuel lines and connections daily for leaks per the maintenance schedule.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Before starting work on the APU, disconnect both the negative (–) and positive (+) battery cable(s) from the batteries to prevent accidental starting. Disconnect the negative (–) cable first to reduce the risk of arcing.
- Do not remove any belt guards or covers while the power unit is running.
- Make sure that fasteners are secure. Tighten supports and clamps, keep guards in position over fans, etc.
- Keep your hands away from moving parts.
- Do not wear loose clothing or jewelry while working on equipment, because they can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Before starting work on the APU, disconnect both the negative (–) and positive (+) battery cable(s) from the batteries before removing protective shields or touching electrical equipment. Disconnect the negative (–) cable first to reduce the risk of arcing.
- Tag remote or open switches to avoid accidental closure or starting.

GENERAL SAFETY PRECAUTIONS

- Wear safety glasses and protective clothing when servicing batteries. DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.
- Have a fire extinguisher rated ABC nearby. Maintain the fire extinguisher properly and become familiar with its use.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating, engine damage, and a potential fire hazard.
- Do not store anything in the power unit such as oil or gas cans, oily rags, chains, wooden blocks, portable propane cylinders, etc. A fire could result or the operation may be adversely affected. Keep the power unit floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

ADW-3

1. Introduction

ABOUT THIS MANUAL

This manual contains troubleshooting and repair information on the controls and power unit components. Refer to the Kubota[R] Workshop manual (981-0514) for engine troubleshooting and repair information. Refer to the Red Dot[R] Service Manual (981-0515) for trouble-shooting and repair information on the air conditioning system.

Kubota is a registered trademark of Kubota Corporation. Red Dot is a trademark of Red Dot Corporation.

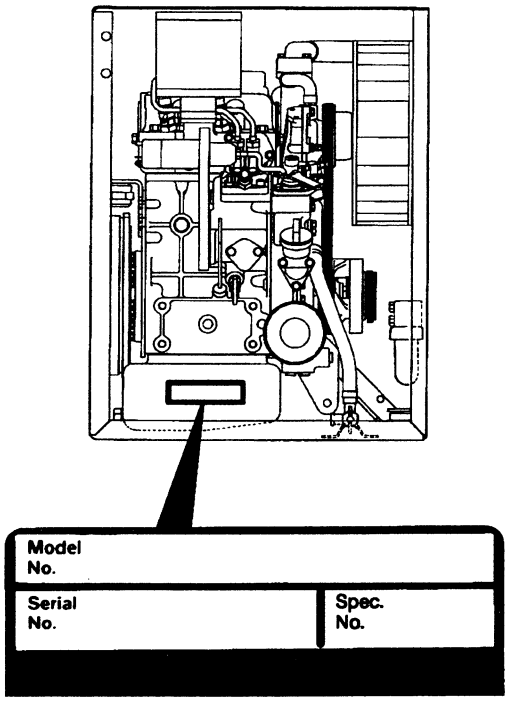
The Operator's manual (981-0135) contains the maintenance schedule and routine maintenance procedures. This manual is normally located in the vehicle glove box. Each of these manuals can be ordered through your Cummins service center.

MODEL IDENTIFICATION

When ordering replacement parts, identify the unit with the complete model number and serial number listed on the nameplate. See Figure 1-1.

⚠WARNING

INCORRECT SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL, MECHANICAL AND AIR CONDITIONING SERVICE.

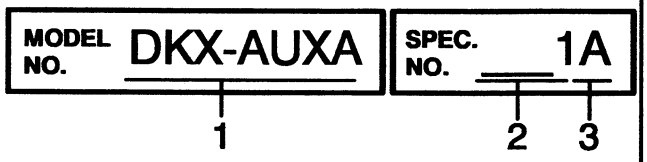


NAMEPLATE

FIGURE 1-1. MODEL IDENTIFICATION

Model Number Identification

Figure 1-2 shows a breakdown of the model number for a typical AUX (DKX).

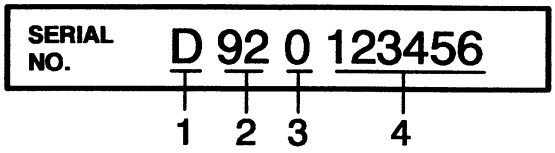


1. Spaces one thru nine are used for product description as follows:
   D = Diesel Engine
   K = Kutota Engine
   X = Engine power rating - unique to AUX
   – = Separates product description
   AUXA = Unit provides sleeper heating, sleeper air conditioning and 12-volt DC battery charging.
2. Specification number - (Code for options and special features)
3. Specification letter - (Used to identify major manufacturing changes)

FIGURE 1-2. MODEL NUMBER IDENTIFICATION

Serial Number Identification

Figure 1-3 shows a breakdown of the serial number for a typical AUX (DKX).



1. Month genset was built:
   A = January
   B = February
   etc.
2. Year unit was built:
   92 = 1992
   93 = 1993
   etc.
3. Location where unit was built:
   0 = Fridley, Minnesota
   3 = Huntsville, Alabama
4. Active serial number

FIGURE 1-3. SERIAL NUMBER IDENTIFICATION

2. Specifications

MODEL	AUX (DKX)
ENGINE	
Engine Model	Kubota Z482B
Engine Type	Two Cylinder, Vertical, 4-Cycle Diesel, Water Cooled
Engine Speed	2600 rpm
Fuel	Diesel Fuel No. 2 (No. 1 Below 32°F [0°C])
Fuel Pump Lift	3 ft (914 mm)
Average Fuel Consumption:	
Heating Mode	0.25 gph (0.95 L/h)
Air Conditioning Mode	0.35 gph (1.32 L/h)
Engine Oil Capacity (with Oil Filter)	5 qt (4.73 L)
Coolant Capacity (Engine and Radiator)*	3 qt (2.8 L)
Starting System	12-Volt Electric Start
ALTERNATOR OUTPUT (12 VDC)	35 Amp
HEATING CAPACITY	12,500 btu/hr
Heating Hose Size	3/4 in.
COOLING CAPACITY	9,000 btu/hr
Refrigerant Type	R12
High Pressure Hose/Fitting Size	#6
Low Pressure Hose/Fitting Size	#10
POWER UNIT DIMENSIONS	
Length	25.5 in. (647.7 mm)
Width	18 in. (457.2 mm)
Height	23 in. (584.2 mm)
Weight	245 lb (111 kg)

*Coolant capacity does not include hose and sleeper heater capacity.

**For Evaporator unit and control dimensions refer to section 3.

MODEL	DKX–AUXA 2A
ENGINE	
Engine Model	Kubota® Z482B
Engine Type	Two Cylinder, Vertical, 4-Cycle Diesel, Water Cooled
Engine Speed	2600 rpm
Fuel	Diesel Fuel No. 2 (No. 1 Below 32°F [0°C])
Fuel Pump Lift	3 ft (914 mm)
Average Fuel Consumption:	
Air Conditioning Mode	0.32 - 0.38 gph (1.21 - 1.44 L/h)
Heating Mode	0.25 gph (0.95 L/h)
Engine Oil Capacity (with Oil Filter)	5 qt (4.73 L)
Coolant Capacity (Engine and Radiator)*	3 qt (2.8 L)
Starting System	12-Volt Electric Start
ALTERNATOR OUTPUT (12 VDC)	35 Amp
HEATING CAPACITY	12,500 btu/hr
Heater Hose Size	3/4 in.
COOLING CAPACITY	9,000 btu/hr
Refrigerant Type	R-134a
High Pressure Hose/Fitting Size	#6
Low Pressure Hose/Fitting Size	#10
POWER UNIT DIMENSIONS**	
Length	25.5 in. (647.7 mm)
Width	18 in. (457.2 mm)
Height	23 in. (584.2 mm)
Weight	260 lb (118 kg)

*Coolant capacity does not include hose and heater coil capacity.

**For Evaporator unit and control dimensions refer to section 3.

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3. Preparing for Service

TROUBLESHOOTING

Before starting to service the AUX, follow the troubleshooting procedures in section 4. For servicing purposes, troubleshooting has been divided into the following sections:

- Controls
- Battery Charge
- Sleeper – Heating System
- Sleeper – Air Conditioning System

The troubleshooting sections list typical problems along with possible causes and corrective actions. Note that some problems might have several possible causes. It may be necessary to investigate each possible cause in order to isolate the actual source of the problem.

SPECIAL TOOLS

A complete set of standard and metric shop tools are required to service the power unit. A multimeter and a thermometer are needed to diagnose problems. If the power unit needs to be lowered for service, a forklift truck or floor jack will be needed (refer to section 6). For engine service or air conditioning service tool requirements, refer to the appropriate Kubota or Red Dot service manual.

SAFETY CONSIDERATIONS

Always consider the safety aspects of any service procedure. Servicing presents several hazards that the service technician must be aware of to safely complete the job. Study the safety precautions on pages iii and iv of this manual and familiarize yourself with the hazards listed in Table 3-1. Approach the job in a safety-conscious manner. Being safety conscious is the most effective way to avoid injury to yourself and to others. Reduce the risk of an accident by adopting the following safeguards.

Safeguards to Avoid Hazards

Use personal protection: Protect your body by wearing the appropriate safety equipment such as:

- Safety shoes
- Gloves
- Safety glasses

Do not wear rings, jewelry or loose clothing: they might get caught on equipment, or conduct electricity.

Reduce the hazard: A safe, orderly work area and well-maintained equipment reduce the risk of hazard. Leave all guards and shields in place on machinery, and maintain equipment in top condition. Store flammable liquids in approved containers, away from flame, spark, pilot light, arc-producing equipment and other ignition sources. Keep the work area clean, well-lighted, and well-ventilated. Keep fire extinguishers and safety equipment nearby, and be prepared for any emergency.

TABLE 3-1. HAZARDS AND THEIR SOURCES

- **Fire and explosions**
  - Leaking or spilled fuel
  - Hydrogen gas from charging battery
  - Oily rags improperly stored
  - Flammable liquids improperly stored
  - Any fire, flame, spark, pilot light, arc-producing equipment or other ignition sources
- **Poisonous gases**
  - Carbon monoxide from faulty exhaust
  - Operating power unit where exhaust gases can accumulate
  - Phosgene gas from freon in contact with an open flame
- **Burns**
  - Hot exhaust pipes
  - Hot engine surfaces
  - Hot engine oil
  - Electrical short in DC wiring system
- **Rotating Machinery**
  - Jewelry or loose clothing catching in moving parts
- **Heavy Objects**
  - Removing power unit from vehicle
  - Removing heavy components
- **Slippery Surfaces**
  - Leaking or spilled oil

Develop safe work habits: Unsafe practices are the cause of most accidents involving tools or machinery. Be familiar with your tools and machines and learn how to use them safely. Use the right tool for the job, and check its condition before starting.

Follow all warnings and cautions in this manual, and take extra precautions when working around electrical equipment. Avoid working alone, and do not take risks. Do not work when tired or after consuming any alcohol or drug that makes the operation of equipment unsafe.

Be prepared for a potential accident: The Red Cross and public safety departments offer courses in first aid, CPR, and fire control. Use this information to be ready for an accident.

Be safety-conscious, and make safety procedures part of the work routine.

4. Troubleshooting

INTRODUCTION

Figures 4-1 and 4-2 show the AUX system component locations. The AUX control panel (normally located inside the sleeper) is described in the following section.

Use the troubleshooting guides to help diagnose problems. The Troubleshooting section is divided into four parts:

- Operating the Power Unit
- Battery Charge
- Sleeper Heating
- Sleeper Air Conditioning

Common problems are listed with their possible causes. Refer to the Corrective Action column for the appropriate test or adjustment procedure. The section and page number in the right column lists the location of the test or adjustment procedure in this manual.

Conditional schematics are used to highlight the circuitry that is energized during the sequence of operation. Always refer to the wiring schematic and diagram in section 8 that corresponds to the model and spec number of the power unit when troubleshooting.

Make a thorough inspection of the wiring to make sure that good wire harness and ground connections are made. Correct wiring problems before performing tests or replacing any components.

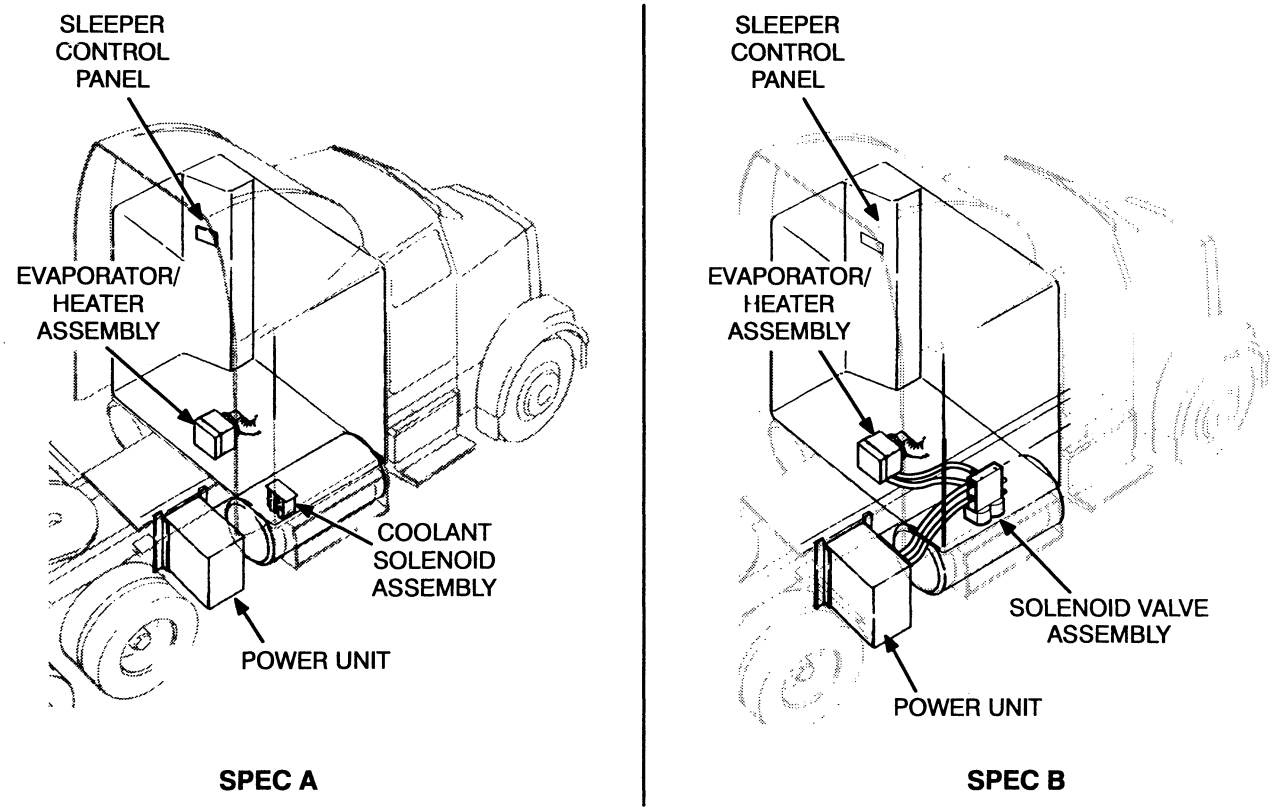


FIGURE 4-1. AUX SYSTEM COMPONENT LOCATIONS

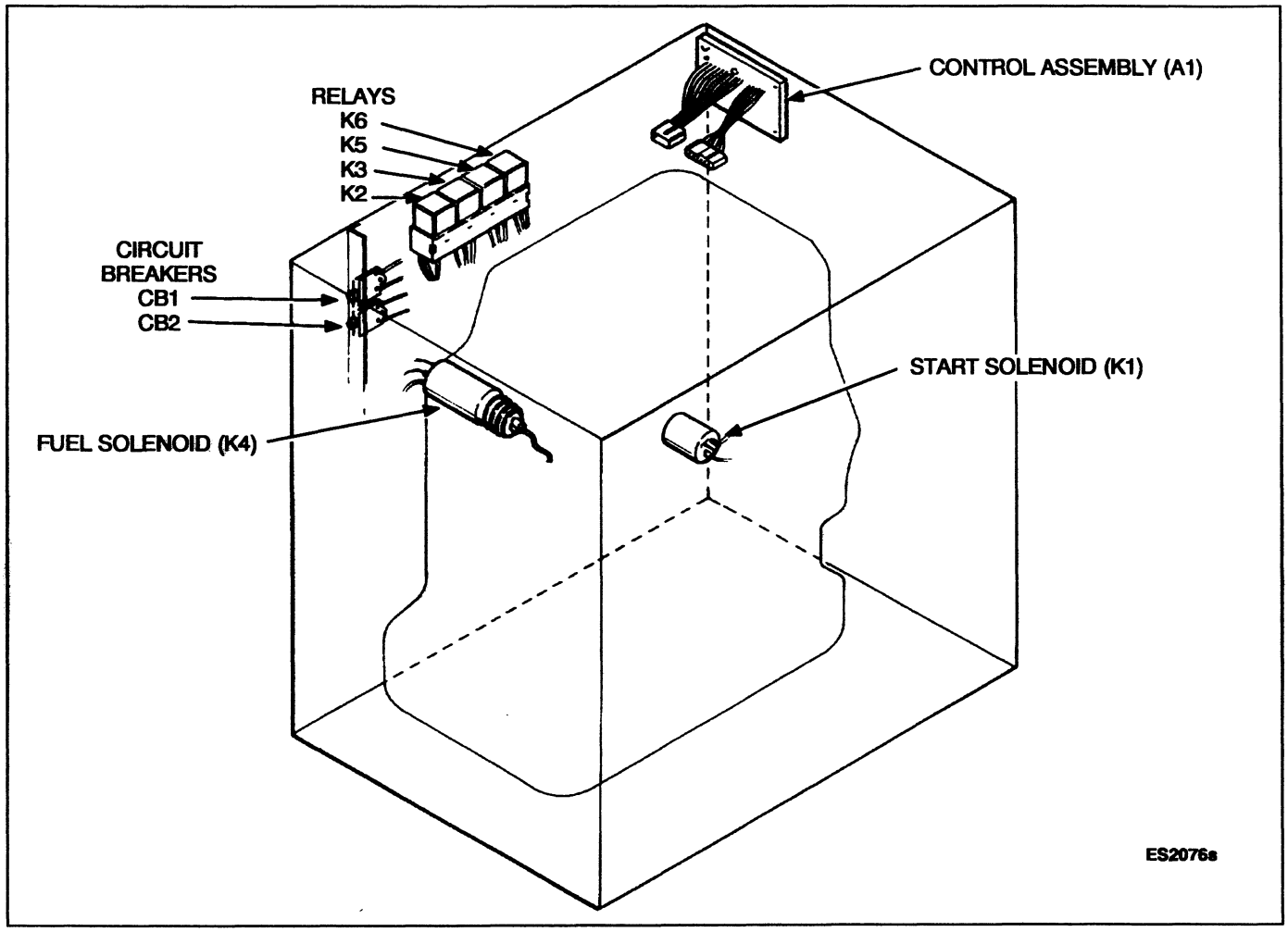


FIGURE 4-2. POWER UNIT COMPONENT LOCATIONS

SLEEPER CONTROL PANEL

The control panel is used to start the power unit and to operate the auxiliary heating and air conditioning. The control panel also monitors fault conditions for high coolant temperature and low oil pressure. The panel is described in the following section. Figure 4-3 shows the control panel.

Control Panel Features

Preheat Switch: Placing the preheat switch in the Preheat position will heat the glow plugs to aid cold weather starting. The preheat feature should be used when outside temperatures are below 50°F (10°C).

Start / Stop-Reset Switch: The engine is started by holding the switch in the Start position. The engine is stopped by pressing the switch to the Stop/Reset position. Engine operation is indicated by the light on the switch.

If a high engine temperature or low oil pressure fault occur, the engine will automatically shut down. The switch must be pushed to the Stop/Reset position before the engine can be restarted.

Heat / AC Switch: Select either the Heat or AC position to heat or cool the sleeper compartment when using the AUX. The Heat position is signified by the flame and the AC position is signified by the snowflake on the control panel. Select the center (Off) position when the AUX is not being used or when it is being used to heat the main truck engine.

Temp control: The TEMP control thermostat is used to adjust the temperature of the air entering the sleeper compartment.

Fan Speed Switch: The fan has three speed settings and an off position. When using the heating or cooling features select the low, medium or high fan speed setting. Use the fan speed in conjunction with the TEMP control to achieve the desired sleeper temperature.

Hour Meter: The hour meter records the cumulative number of hours that the engine has been running. Use this meter to record the number of hours between periodic maintenance intervals and for fuel savings records.

High Temp - Low Oil Fault Lights: The appropriate fault light will illuminate and the engine will shut down when high engine coolant temperature or low oil pressure are sensed. Let the power unit cool down before inspecting the cooling system or oil level. The Stop/Reset must be pushed before restarting.

System On Light: This light will illuminate when one of the fan speed settings is selected and the Heat/AC switch is in either the heat or AC position. This light acts as reminder to turn the fan off when the AUX is not in use, to prevent battery discharge.

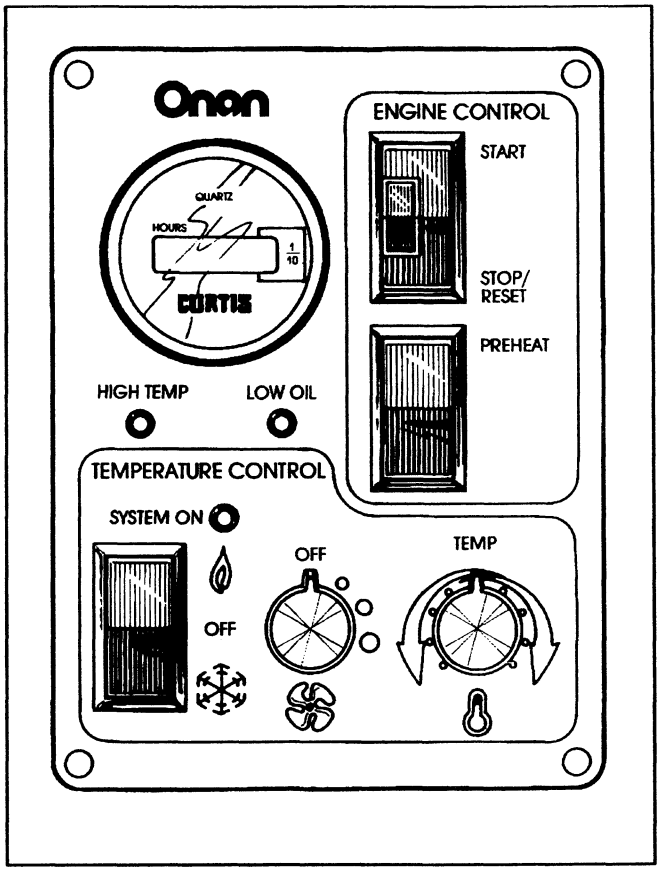


FIGURE 4-3. CONTROL PANEL

PREHEAT - MODE

The preheat heat mode uses glow plugs to aid cold weather starting.
Holding the preheat switch in the Preheat position provides battery positive (B+) to the preheat relay (K2) through circuit breaker CB1. While the preheat switch is held the following occurs:

⚠ CAUTION ***Do not hold the Preheat switch in for longer than 20 seconds, or damage to the glow plugs can occur.***

- Battery positive (B+) is supplied to the preheat relay coil (K2). This energizes the preheat relay and closes the preheat relay contacts. Battery positive (B+) is then supplied to the glow plugs through the preheat relay contacts.

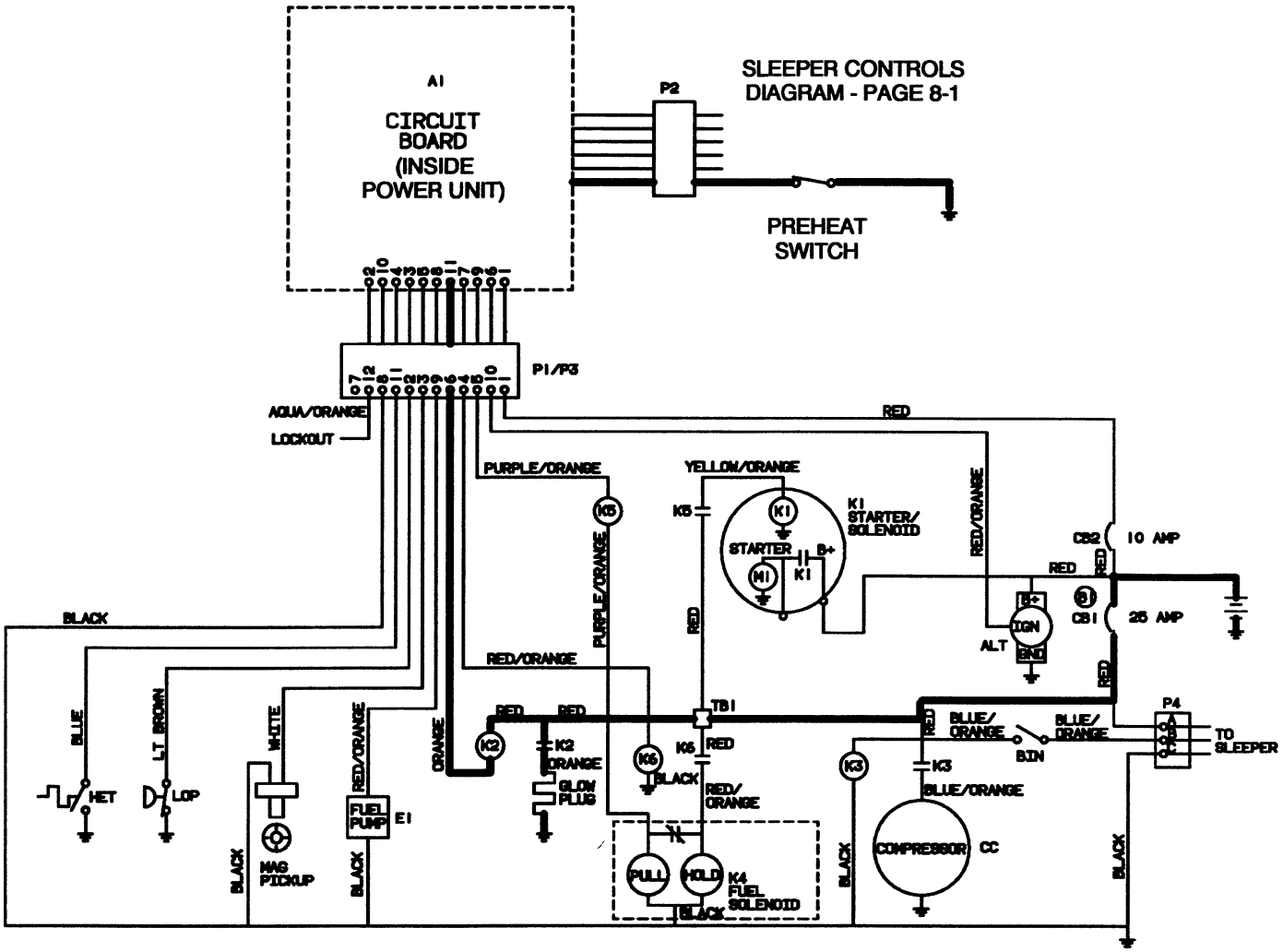


FIGURE 4-4. PREHEAT MODE

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-1. CONTROL TROUBLESHOOTING – PREHEAT MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
Glow Plugs Do Not Heat	1. Open circuit breaker CB1.	1. Check circuit breaker. If open, locate and correct cause of overload.	
	2. Insufficient battery voltage due to: a. Batteries not charged. b. Battery connections loose or dirty.	2a. Check condition of batteries and recharge or replace bad batteries. 2b. Clean and tighten all battery connections and the power unit B+ connection.	
	3. Preheat relay (K2) not energized due to: a. Open circuit to preheat relay coil. b. Defective preheat switch. c. Defective preheat relay.	3a. Check wiring continuity to the preheat relay (K2) circuit, refer to Figure 4-4. 3b. Test preheat switch. 3c. Test preheat relay (K2).	 5-3 5-9
	4. Defective glow plug(s)	4. Check wiring continuity between Preheat relay contacts and glow plug(s). Also check continuity of glow plug(s). Replace glow plug(s) with infinite resistance.	

START - CRANKING MODE

The start condition is divided into a cranking mode and an ignition mode to simplify troubleshooting. Battery positive (B+) is supplied to the control assembly (A1) through circuit breaker (CB2). Holding the start/stop switch in the Start position activates control assembly (A1) by closing the start signal input circuit. While the start/stop switch is held, the control assembly turns on the following components:

- Start relay (K5) is energized through the low impedance fuel solenoid (K4) pull coil. K5 contacts close to energize the starter solenoid (K1), K1 contacts close to begin cranking.

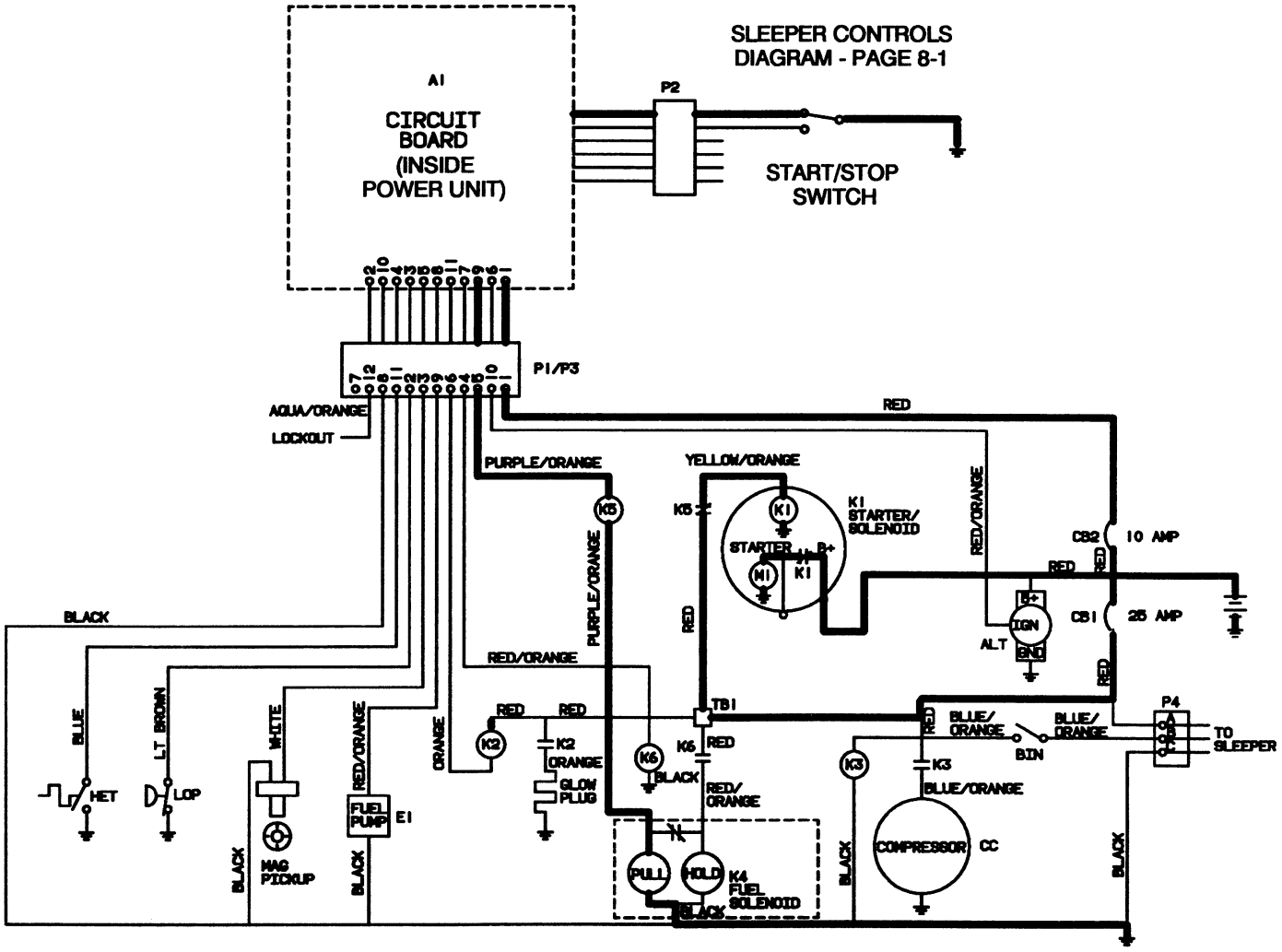


FIGURE 4-5. START – CRANKING MODE

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-2. CONTROL TROUBLESHOOTING – CRANKING MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
Engine Does Not Crank	1. Open circuit breaker CB1 or CB2.	1. Check breakers. If open, locate and correct cause of overload.	
	2. Insufficient battery voltage due to: a. Batteries not charged. b. Battery connections loose or dirty.	2a. Check condition of batteries and recharge or replace bad batteries. 2b. Clean and tighten all battery connections and the power unit battery connections.	
	3. Start solenoid (K1) not energized due to: a. Open in start - cranking circuit. b. Defective start/stop switch. c. Defective start relay (K5). d. Defective start solenoid (K1). e. Defective control assembly (A1).	3a. Check wiring continuity of the start - cranking circuit, refer to Figure 4-5. 3b. Test start/stop switch (S1). 3c. Test start relay (K5). 3d. Test start solenoid, see engine manual. 3e. Measure voltage to start relay coil with switch (S1) held in the Start position. If voltage is not present and continuity and battery check OK, cont. assembly (A1) is defective.	5-3 5-9
	4. Starter (M1) not energized due to: a. Open circuit between battery (B+) and the start solenoid contact (BAT). b. Defective starter (M1).	4a. Check wiring continuity between battery (B+) and the start solenoid (BAT). Refer to Figure 4-5. 4b. Test starter, see engine manual.	

START - IGNITION MODE

Holding the start/stop switch in the Start position activates control assembly (A1) by closing the start signal input circuit. While the start/stop switch is held, the control assembly turns on the components described in the cranking mode along with the following:

- Fuel shutdown relay (K6), K6 contacts close to power the fuel solenoid (K4) hold coil
- Fuel solenoid (K4) pulls in and opens the fuel solenoid contacts
- Fuel pump (E1)
- Alternator Enable

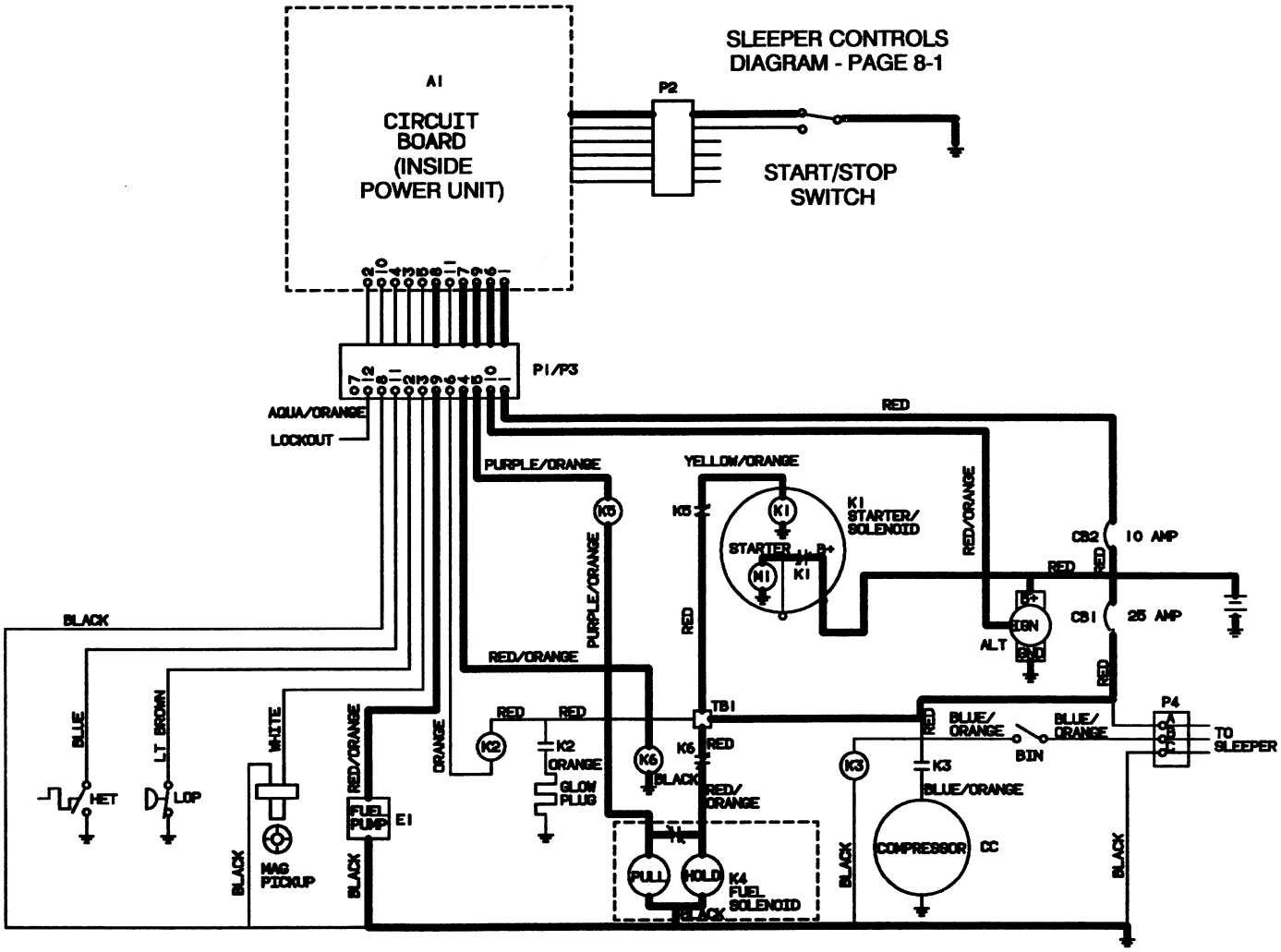


FIGURE 4-6. START – IGNITION MODE

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-3. CONTROL TROUBLESHOOTING – IGNITION MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
Engine Cranks But Does Not Start	1. Restricted fuel supply due to: a. Fuel level below pickup tube in tank. b. Fuel filter clogged. c. Fuel injectors clogged.	1a. Add fuel if low. Prime the fuel system. 1b. Replace clogged fuel filter and check fuel supply for contamination. 1c. Refer to engine service manual.	7-5
	2. Fuel solenoid (K4) open due to: a. Open in fuel solenoid circuit. b.Defective fuel solenoid.	2a. Check wiring continuity of fuel solenoid circuit, refer to Figure 4-6. 2b. Test fuel solenoid.	5-9
	3. Fuel pump (E1) not working due to: a. Open in fuel pump circuit. b. Defective fuel pump. c. Defective control assembly (A1)	3a. Check wiring continuity of fuel pump circuit, refer to Figure 4-6. 3b. Test fuel pump. 3c. Measure voltage to fuel pump with Start switch held in the Start position. If voltage is not present and fuel pump circuit checks ok, control assembly (A1) is defective.	5-8
	4. Engine fuel injection or other engine problem.	4. Refer to the engine service manual.	

RUN MODE

When the engine starts, release the start/stop switch and it will return to the center Run position. The control assembly (A1) begins the run mode when the switch is released or the engine speed exceeds 1500 rpm. The following events occur:

- Start relay (K5) is de-energized. K5 contacts open and the starter solenoid disengages and the starter stops cranking (above 1500 rpm).
- Fuel shutdown relay (K6) continues to be energized, K6 contacts remain closed to power the fuel solenoid (K4) hold coil.
- Fuel pump (E1) remains energized
- Alternator enable remains energized.
- AUX control Run Lamp and hour meter are energized.

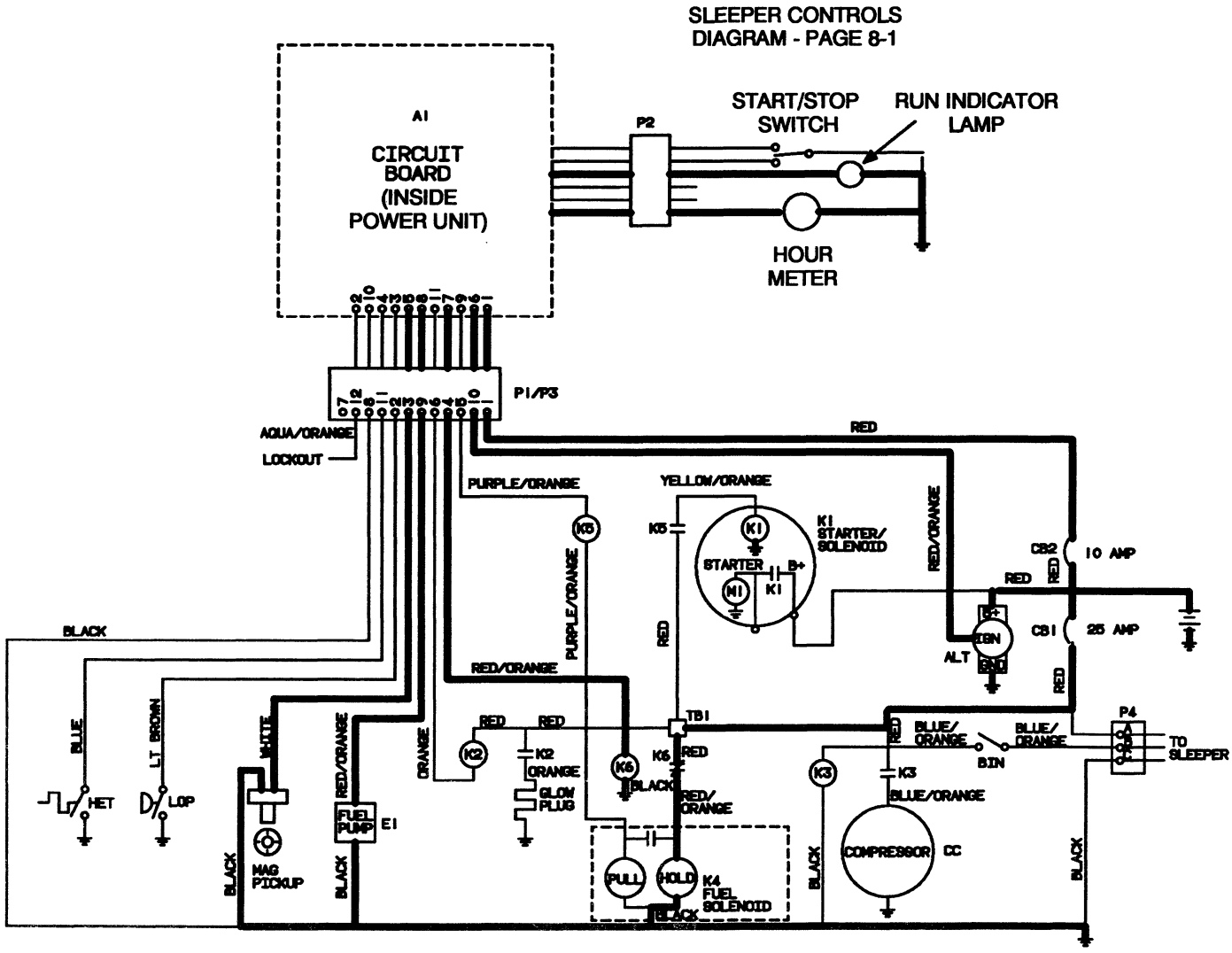


FIGURE 4-7. RUN MODE

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-4. CONTROL TROUBLESHOOTING – RUN MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
Engine Starts and Runs, Then Stops	1. Fuel level is below fuel pickup tube or AUX engine oil level is low. 2. Contaminated or incorrect fuel. 3. Dirty air filter. 4. Defective low oil pressure switch. 5. Engine high engine temp shutdown due to: a. Air inlet blocked or low coolant level. b. Defective water pump. c. Defective high engine temp sensor. 6. Weak battery(ies). 7. Dirty mag pickup.	1. Check fuel and oil level and refill if low. 2. Refill tank with fresh fuel. Clean fuel filter if water or sediment are in filter. 3. Check air filter and clean if dirty. 4. Refer to engine service manual. 5a. Check air inlet to make sure it is open and free of debris. Also check coolant level and hoses for blockage. 5b. Refer to engine service manual. 5c. Refer to engine service manual. 6. Check batter(ies) and connections. 7. Clean mag pickup.	7-4 7-3 6-5
AUX Control Run Lamp or Time Meter Inoperative	1. Open circuit in control wiring. 2. If hour meter works and run lamp does not. 3. If run lamp works but hour meter does not. 4. If remote switch functions properly for starting and stopping power unit but meter and run lamp do not operate, and step 1 checks OK, control assembly (A1) defective.	1. Check continuity between sleeper control and control assembly (A1). 2. Replace start/stop switch. 3. Replace hour meter. 4. Check output voltage at sleeper control (approximately 12 VDC) during run condition from control harness P2-C to ground. If voltage is not present, replace control assembly (A1).	

TABLE 4-5. CONTROL TROUBLESHOOTING – BATTERY CHARGE MODE (REFER TO RUN MODE SCHEMATIC FIGURE 4-7)

Trouble	Possible Cause	Corrective Action	Section/ Page
Low Battery Voltage	1. Weak or discharged batteries due to: a. Low electrolyte level in batteries. b. Long periods of non-use. c. Load connected to battery while unit is turned off. 2. Power unit alternator not functioning due to: a. Poor battery or alt. connections. b. Loose or defective belt. c. Defective alternator.	1a. Replenish electrolyte and recharge battery. 1b. Use AUX to charge batteries. 1c. Disconnect load and recharge batteries. 2a. Check connections between alternator, start solenoid and Batteries. 2b. Check belt condition and tension. 2c. Refer to alternator check.	7-6 6-8

STOP MODE

Momentarily pushing the start/stop switch to the Stop position begins the stop mode with the following results:

- Fuel shutdown solenoid K6 is de-energized.
- Fuel pump (E1) is de-energized.
- Alternator enable is de-energized.

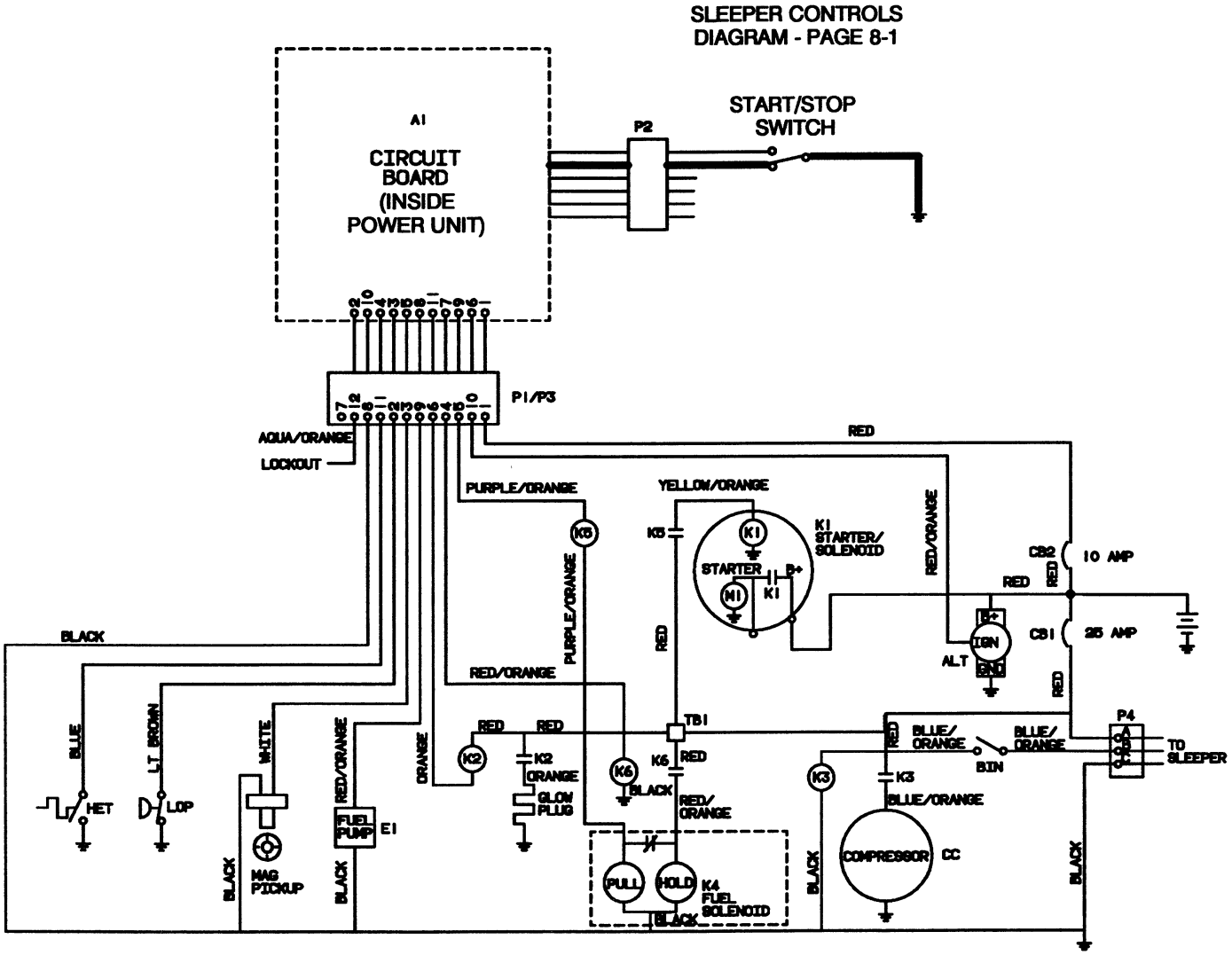


FIGURE 4-8. STOP MODE

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-6. CONTROL TROUBLESHOOTING – STOP MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
Power Unit Does Not Stop When Switch Is Pushed To Stop	1. Open circuit between control assembly (A1) and the sleeper control. 2. Defective start/stop switch. 3. Defective control assembly (A1).	1. Check wiring continuity between control assembly (A1) and sleeper control start/stop switch. 2. Check the start/stop switch. 3. If steps 1 and 2 check OK, replace control assembly (A1)	5-3

SLEEPER HEAT MODE

In this mode the sleeper is heated by the AUX power unit or the main truck engine. The sleeper heat is thermostatically controlled by the AUX control in the sleeper.

Operate the AUX power unit or the main truck engine to heat the coolant. Set the sleeper control heat/AC switch to Heat. Adjust the TEMP dial to the hottest setting. Set the fan speed switch to the highest setting. The following Heat Mode actions occur:

- The sleeper fan operates at the fan speed setting (the sleeper fan does not cycle on and off).
- The thermistor in the air outlet duct senses the temperature from the heater core. The sleeper control circuit compares this temperature to the TEMP control setting and energizes the two solenoid valves with a 12-volt DC signal. The solenoid valves remain energized until the TEMP control setting is reached, then the solenoid valves are cycled off and on to maintain the set temperature.
- Energizing the solenoid valves causes the coolant to pass through the sleeper heater core. The sleeper fan draws air across the heater core and circulates the heated air through the sleeper.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-7. SLEEPER HEATING SYSTEM TROUBLESHOOTING – SLEEPER HEAT MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
No Sleeper Heat	1. Low coolant level. 2. Air inlet to sleeper heater is blocked. 3. Blocked or restricted coolant hose. 4. Sleeper fan does not operate due to: a. Open circuit to sleeper fan. b. Defective fan speed switch. c. Defective or binding fan motor. d. Defective high speed relay 5. Check valve defective or backwards. 6. Solenoid valve(s) not operating due to: a.Open circuit to solenoid valve(s). b. Defective solenoid valve(s). 7. Temp control pot on sleeper control panel defective. 8. Thermistor circuit open or thermistor defective. 9. Constant temperature control defective.	1. Check coolant level. 2. Check for blockage of air inlet. 3. Examine hoses for restrictions. 4a. Check wiring continuity between the fan and the sleeper control. 4b. Test fan speed switch. 4c. Check fan wheel for binding and test fan motor. 4d. Test high speed relay. 5. Examine and test check valve. 6a. Check wiring continuity between the solenoid valves and the sleeper control. 6b. Test the solenoid valve(s). 7. Test the temp control pot. 8. Check continuity between the thermistor and the sleeper control. Also test the thermistor. 9. Replace the constant temp. control.	5-4 5-9 5-7 5-4 5-7
Hot All The Time (Too Hot)	1. Solenoid valve(s) defective (sticking). 2. Temp control pot on sleeper control panel defective. 3. Constant temp. control defective.	1. Test the solenoid valve(s). 2. Test the temp control pot. 3. Replace the constant temp. control.	5-7 5-4

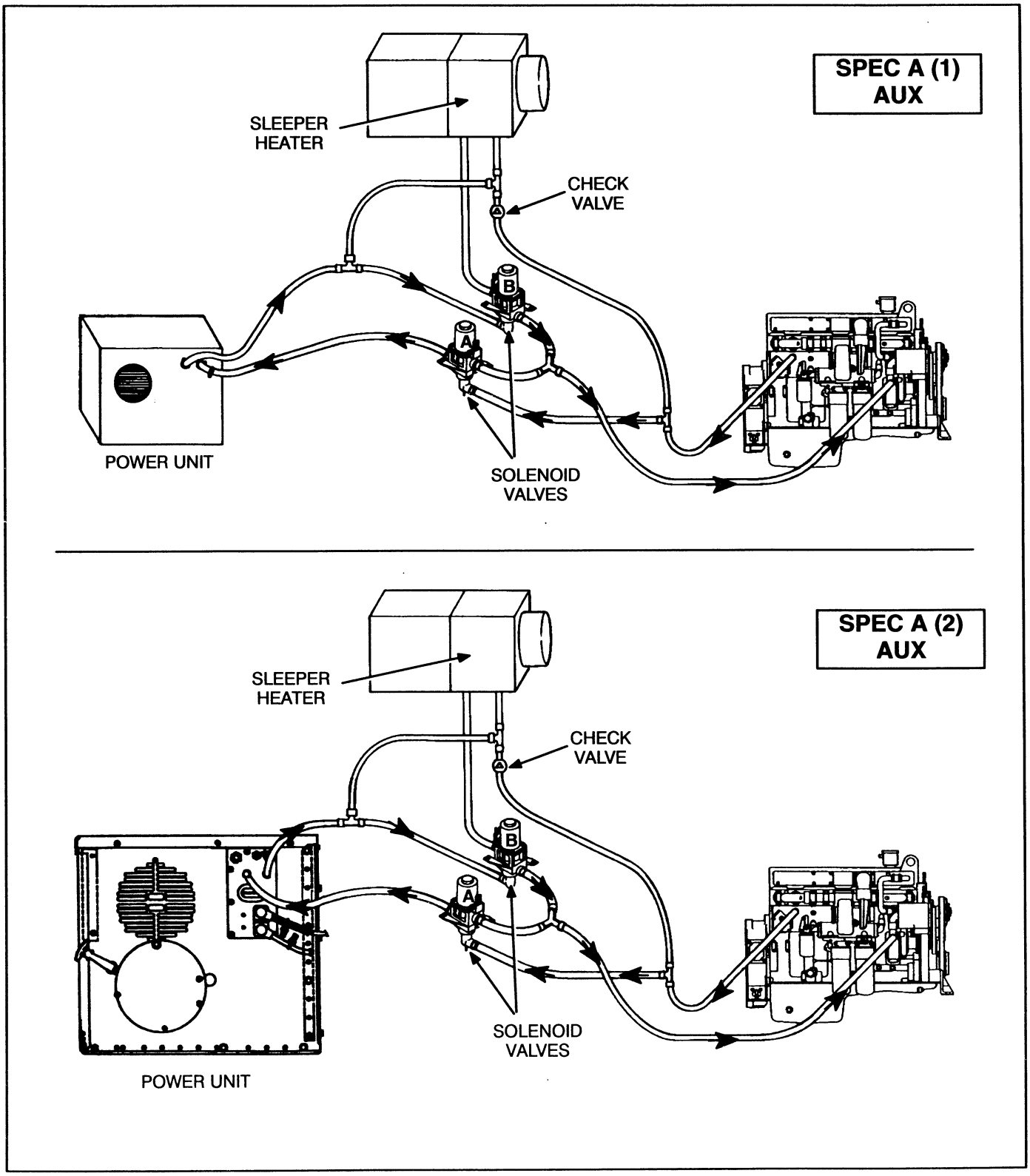


FIGURE 4-9a. COOLANT FLOW DIAGRAM - SLEEPER HEATER OFF, POWER UNIT OR TRUCK ENGINE ON (SOLENOIDS ARE NOT ENERGIZED)

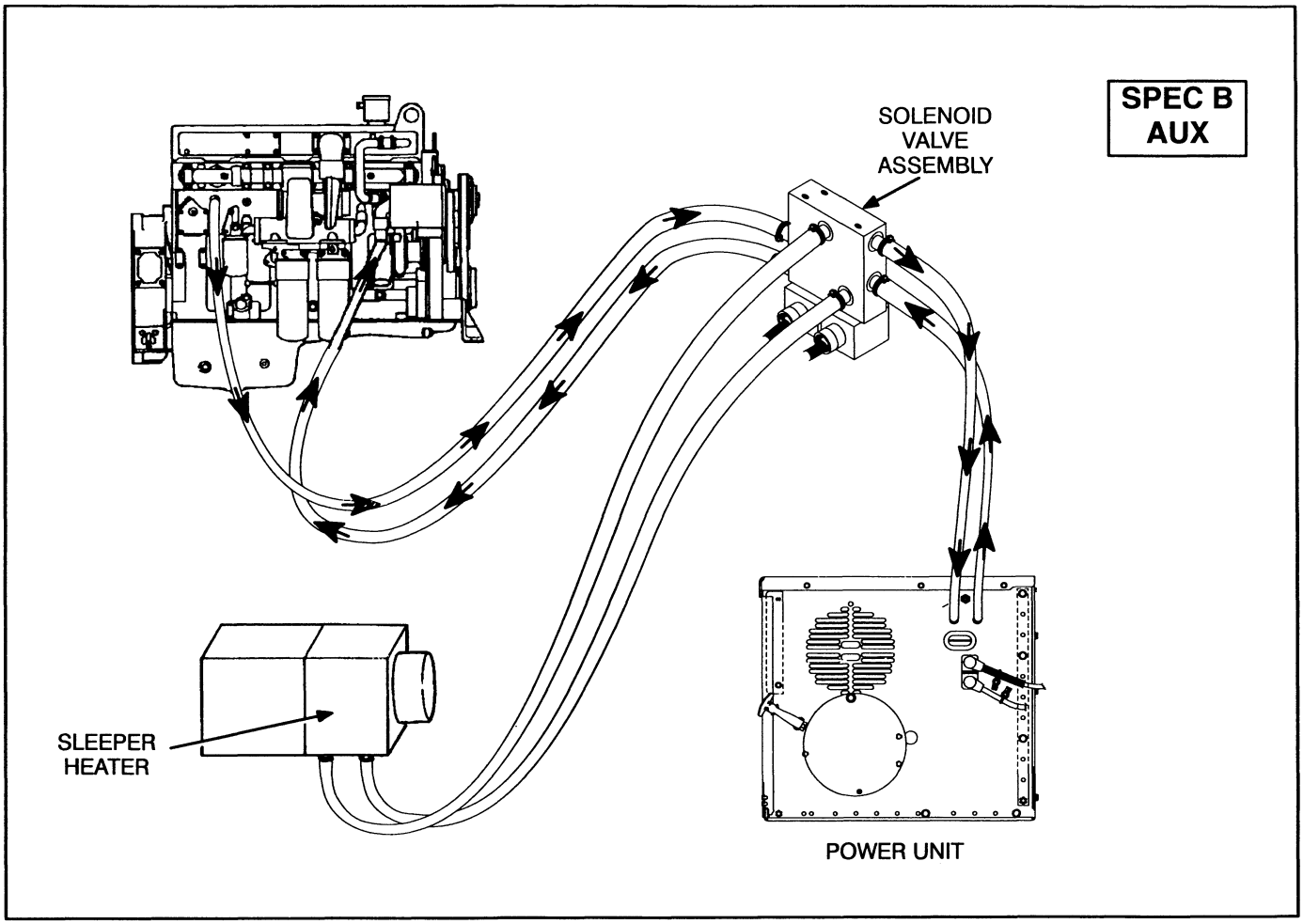


FIGURE 4-9b. SPEC B AUX COOLANT FLOW DIAGRAM - SLEEPER HEATER OFF, POWER UNIT OR TRUCK ENGINE ON (SOLENOIDS ARE NOT ENERGIZED)

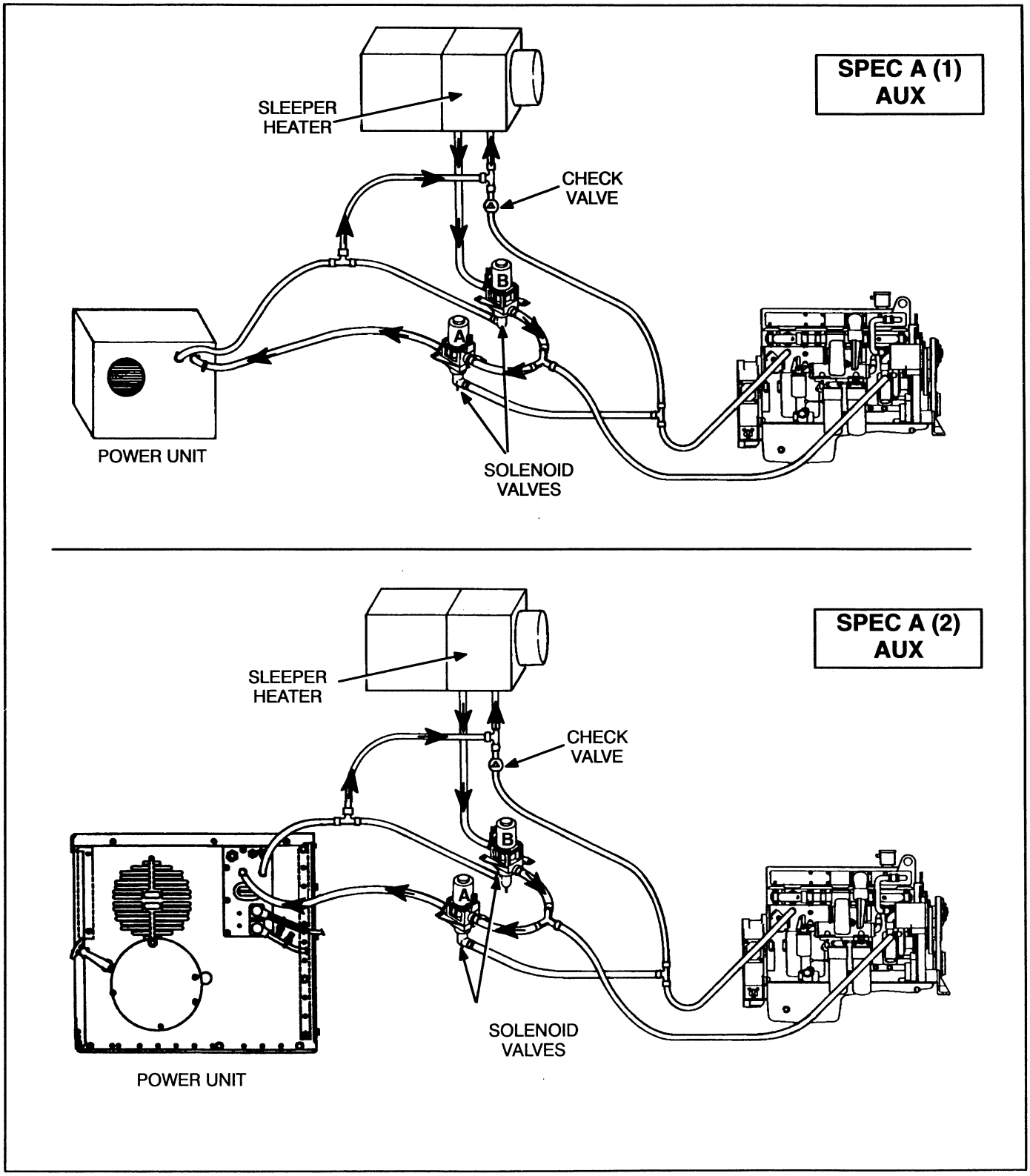


FIGURE 4-10a. COOLANT FLOW DIAGRAM - HEATING SLEEPER WITH THE POWER UNIT (SOLENOIDS ARE ENERGIZED)

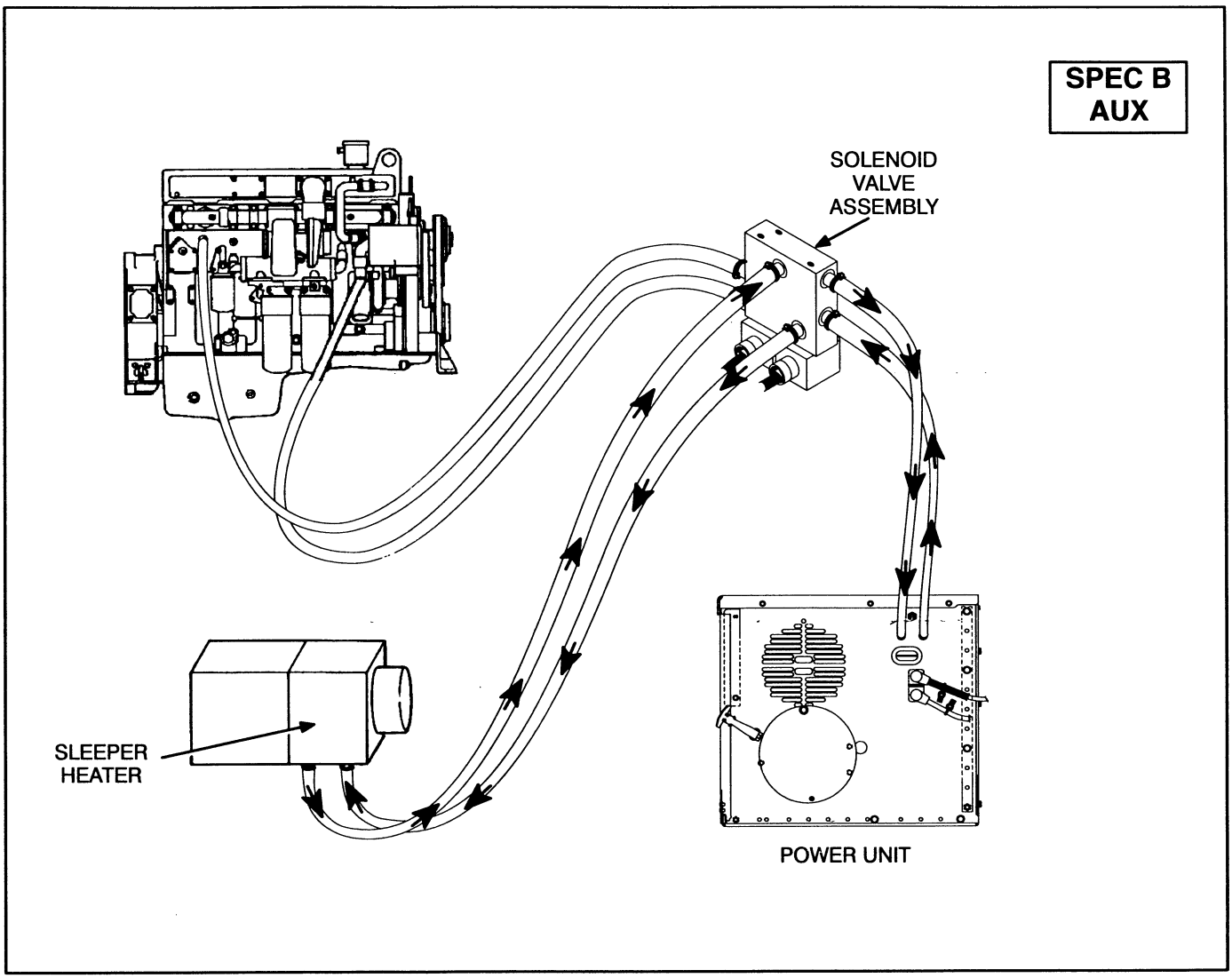


FIGURE 4-10b. COOLANT FLOW DIAGRAM - HEATING SLEEPER WITH THE POWER UNIT (SOLENOIDS ARE ENERGIZED)

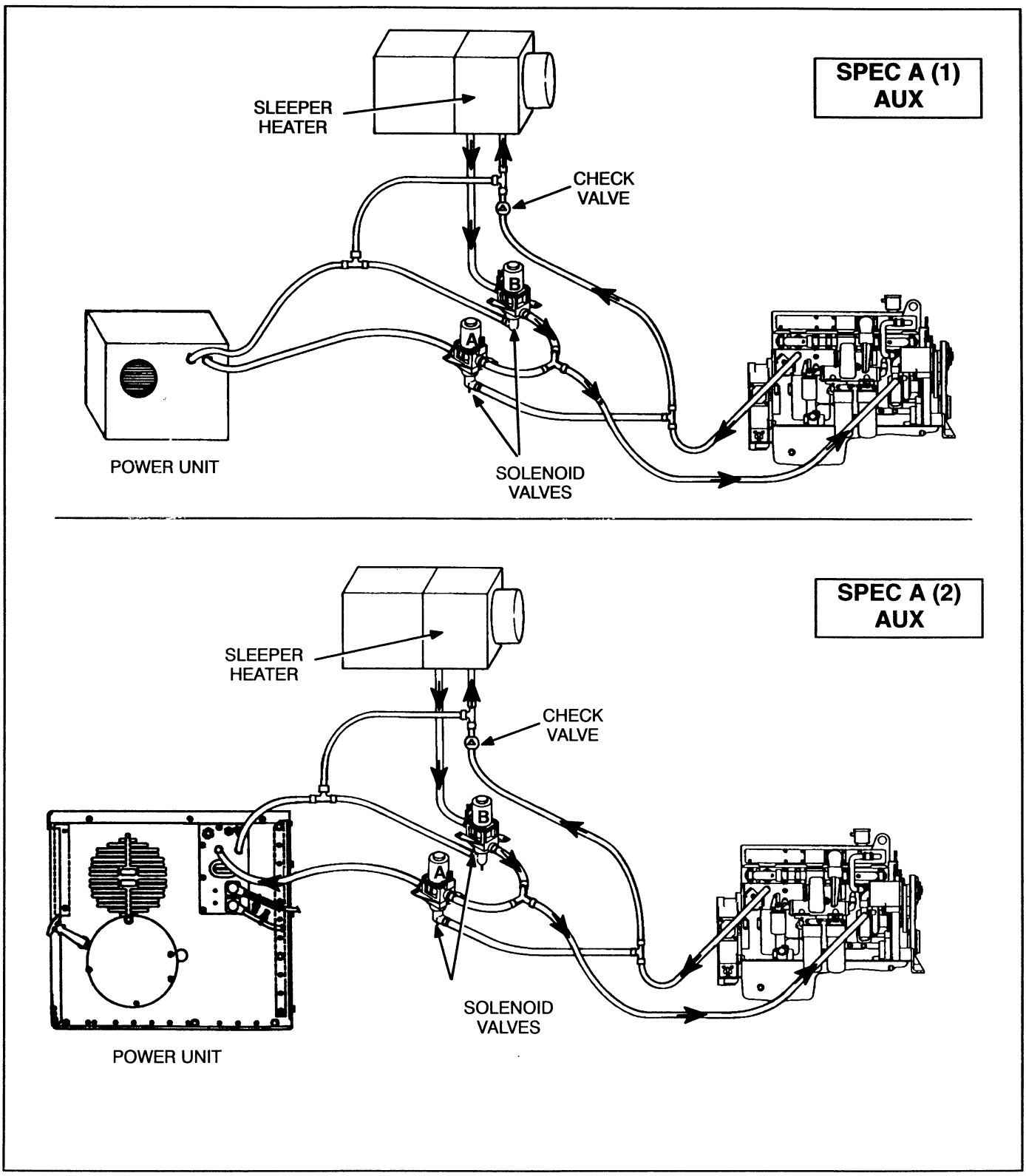


FIGURE 4-11a. COOLANT FLOW DIAGRAM - HEATING THE SLEEPER WITH THE TRUCK ENGINE (SOLENOIDS ARE ENERGIZED)

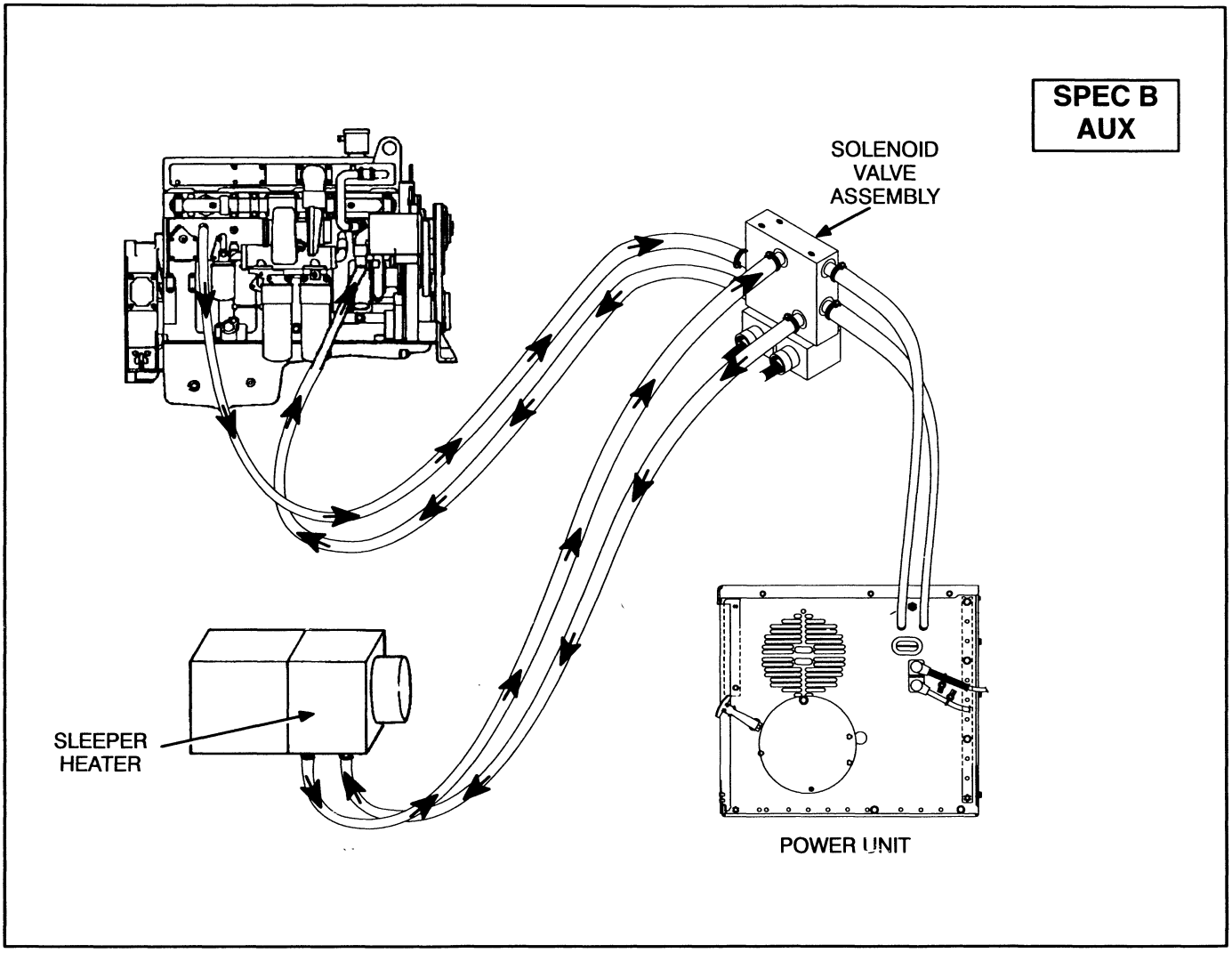


FIGURE 4-11b. COOLANT FLOW DIAGRAM - HEATING THE SLEEPER WITH THE TRUCK ENGINE (SOLENOIDS ARE ENERGIZED)

SLEEPER AIR CONDITION - MODE

In this mode the sleeper is cooled by the AUX air conditioning system. The sleeper temperature is thermostatically controlled by the AUX control in the sleeper.
Start the AUX power unit and set the sleeper control heat/AC switch to AC. Adjust the TEMP dial to the coldest setting. Set the fan speed switch to the highest setting. The following AC mode actions occur:

- The sleeper fan operates at the fan speed setting (the sleeper fan does not cycle on and off).
- The thermistor in the air outlet duct senses the temperature from the evaporator. The sleeper control circuit compares this temperature to the TEMP control setting and cycles the compressor clutch on and off to maintain the set temperature.
- The compressor circulates freon through the evaporator in the sleeper. The sleeper fan draws air across the evaporator core and circulates the cool air through the sleeper.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

TABLE 4-8. SLEEPER AIR CONDITIONING SYSTEM TROUBLESHOOTING – SLEEPER AC MODE

Trouble	Possible Cause	Corrective Action	Section/ Page
No Sleeper Air Conditioning	1. Power unit air inlet covered. 2. Air inlet to evaporator is blocked. 3. Low freon (R-12) charge. 4. Blocked or restricted freon hose. 5. Sleeper fan does not operate due to: a. Open circuit to sleeper fan. b. Defective fan speed switch c. Defective or binding fan motor. 6. Defective compressor belt. 7. Defective component in the air conditioning system. 8. Temp control pot on sleeper control panel defective. 9. Thermistor circuit open or thermistor defective. 10. Defective compressor relay (K3). 11. Constant temperature control defective.	1. Move inlet cover to open position. 2. Check sleeper for blockage of air inlet. 3. Check freon charge. (See AC Manual.) 4. Examine hoses for restrictions. 5a. Check wiring continuity between the fan and the sleeper control. 5b. Test fan speed switch. 5c. Check fan wheel for binding and test fan motor. 6. Check compressor belt. 7. Refer to the AC service manual for additional troubleshooting and service information. 8. Test the temp control pot. 9. Check continuity between the thermistor and the sleeper control. Also test the thermistor. 10. Test compressor relay (K3). 11. Replace constant temperature control.	5-3 6-4 5-4 5-7 5-9
AC On All The Time (Too Cold)	1. Temp control pot on sleeper control panel defective. 2. Thermistor circuit open or thermistor defective. 3. Constant temperature control defective.	1. Test the temp control pot. 2. Check continuity between the thermistor and the sleeper control. Also test the thermistor. 3. Replace the constant temp. control.	5-4 5-7

5. Control Components

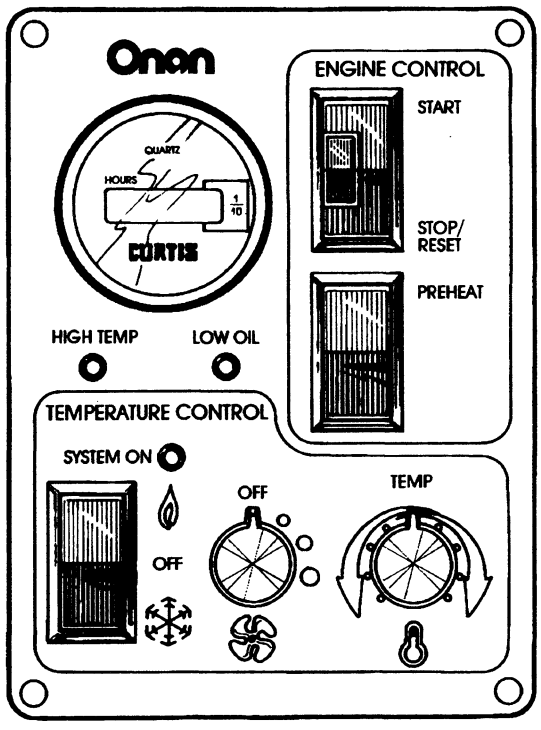
INTRODUCTION

This section covers component locations, and test procedures. The system consists of a sleeper control panel, a power unit control assembly (A1) and individual components located inside and outside the power unit.

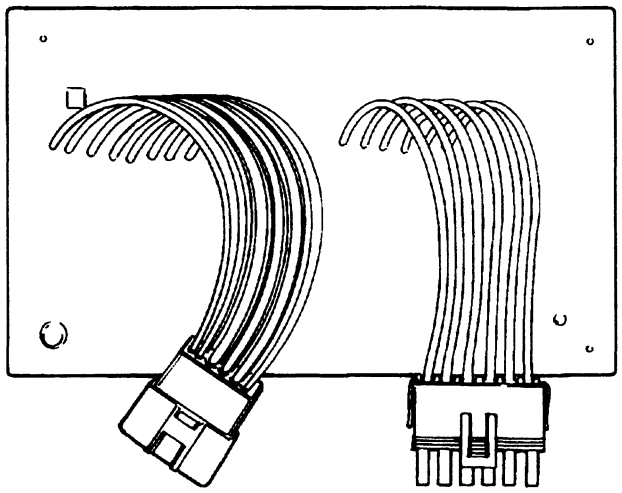
Refer to the engine service manual for engine mounted components and to the air conditioning service manual for air conditioning and heating system components.

The controls covered in this section consist of the following components:

- Sleeper Control Panel Components
- Control Assembly (A1)
- Thermistor
- Coolant Solenoid
- Fuel Pump (E1)
- Relays (K2, K3, K5, and K6)
- Fuel Solenoid (K4)



SLEEPER CONTROL PANEL



CONTROL ASSEMBLY A1
(LOCATED ON BACK WALL
OF POWER UNIT)

ES2077s

FIGURE 5-1. CONTROL ASSEMBLIES

Sleeper Control Panel

The control panel is used to start the power unit and to operate the auxiliary heating and air conditioning. The control panel also monitors fault conditions for high coolant temperature and low oil pressure. The components on the panel are described in section 4. Figure 4-3 shows the control panel.

Control Assembly (A1)

The control assembly consists of a printed circuit board with components and relays that are potted (encapsulated in a non-conductive material) to protect them from moisture. The control assembly is mounted on the back wall of the power unit. See Figure 4-2.

The control assembly controls and monitors the start, stop and fault shutdown operations of the power unit.

Circuit Breakers (CB1 and CB2)

The 25-amp circuit breaker (CB1) protects the AC compressor and evaporator/heater assembly in the sleeper from a short circuit or overload. The circuit breaker is located on the inside of the power unit (Figure 4-2).

The 10-amp circuit breaker (CB2) protects the control assembly (A1) from a short circuit. The circuit breaker is also located on the inside of the power unit (Figure 4-2).

If an overload occurs, the breaker can be reset after the circuits are checked for a short or overload.

Relays (K2, K3, K5, and K6)

Four relays are used to energize components inside the power unit. The relays are mounted inside the power unit (Figure 4-2). The relays are named as follows:

- Preheat Relay (K2)
- AC Compressor Relay (K3)
- Start Relay (K5)
- Fuel Shutdown Relay (K6)

Fuel Pump (E1)

An electric fuel pump delivers fuel to the power unit engine. The pump is located inside the power unit on the lower right side.

Coolant Solenoids

The coolant solenoids are used to control coolant flow to the sleeper heater. The coolant solenoids are generally located under the sleeper, between the sleeper heater and the power unit.

High Engine Temp Switch

The high engine temp switch is located below the engine thermostat. The switch closes if the coolant temperature rises to approximately 222°F (105.5°C), activating an engine shutdown. The switch is normally open below the shutdown temperature and normally closed above the shutdown temperature.

Component Tests

The following component checks can be made to verify if components are defective. Disconnect the starting battery positive (+) and negative (–) cables, negative (–) cable first, before performing these tests.

⚠WARNING ***Accidental starting or electrical shock can cause severe personal injury or death. Disconnect both generator set starting battery cables before performing maintenance. Remove the negative (–) battery cable first and connect it last to reduce the risk of arcing.***

SLEEPER CONTROL PANEL

Start/Stop, Preheat and Heat/AC Switches

Check the suspect switch by noting and removing the harness wires from the switch terminals (Figure 5-2).

Start/Stop switch: Continuity should be measured between the center contact and the bottom contacts only when the switch is held in the Start position. Continuity should be measured between the center contact and the top contact directly above the center contact only when the switch is held in the Stop position. Approximately 17 ohms should be measured between the center contact and the top contact marked 4 (light circuit).

Preheat switch: Continuity should be measured between the switch contacts only when the switch is held in the Preheat position.

Heat/AC switch: Continuity should be measured between the center contacts and the bottom contacts only when the switch is held in the Heat position. Continuity should be measured between the center contacts and the top contacts only when the switch is held in the AC position.

If an abnormal reading is measured, replace the switch and retest. If the suspect switch tests good, perform a continuity check on the each of the harness wires from the switch through the connectors and to the component being controlled by the switch. Also visually inspect the pin connections for corroded, loose or bent pins. Clean or correct any pin connection problems.

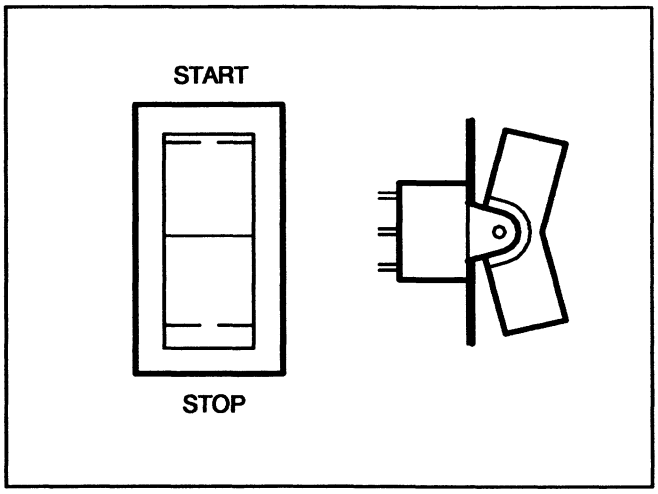


FIGURE 5-2. SWITCH (START/STOP SWITCH SHOWN FOR REFERENCE)

Temp Control Pot

A check can be made by measuring the resistance of the Temp Control Pot. Disconnect the Sleeper Control Panel eight-pin connector. Connect an ohmmeter across the orange and green leads from the Temp Control Pot. The resistance should vary between zero and 10,000 ohms as the pot is rotated. (The resistance increase is non-linear.) If the resistance measured is outside the range given, make sure the pot does not have weak or cold solder connections (solder connections that are not smooth and shiny). If connections are good replace the pot.

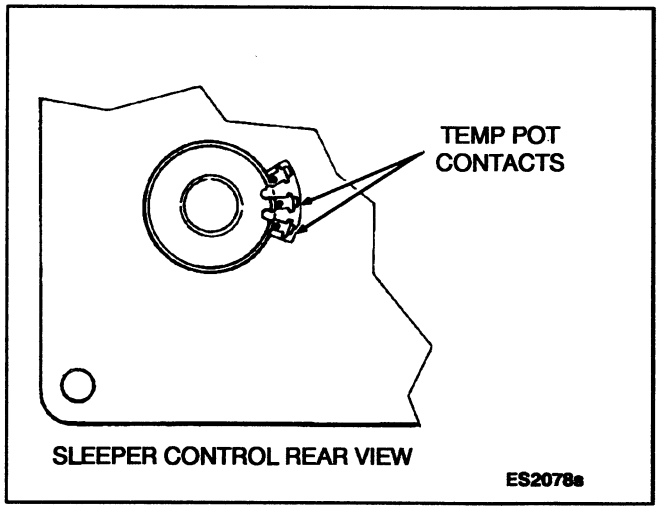


FIGURE 5-3. TEMP CONTROL POT

Fan Speed Switch

Check the switch by noting and removing the harness wires from the switch terminals (Figure 5-4).

Use an ohmmeter to check the switch for continuity. Refer to Table 5-1 to see which contacts are made in each switch position. If the switch checks bad, replace it.

If the switch tests good, perform a continuity check on the each of the harness wires from the switch through the connectors and to the fan or high speed relay. Also visually inspect the pin connections for corroded, loose or bent pins. Clean or correct any pin connection problems.

TABLE 5-1. FAN SPEED SWITCH

● Indicates Contacts Made	Fan Speed Switch			
Contacts	B			
Function	C	L	M	H
Off				
Low	●	●		
Medium	●		●	
High	●			●

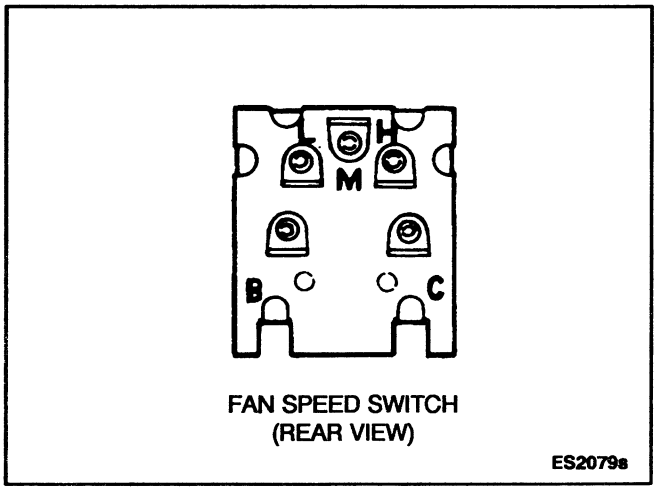


FIGURE 5-4. FAN SPEED SWITCH

Isolation Diode

The diode is used to isolate the fan high speed relay located on the evaporator/heater assembly. The diode can be checked with a diode checker. Remove the lead from the back of the diode. Continuity should be indicated in the forward bias direction and an open circuit should be indicated in the reverse bias direction (refer to your meter instruction manual). If the diode checks bad, replace it. Figure 5-5 illustrates the forward bias check.

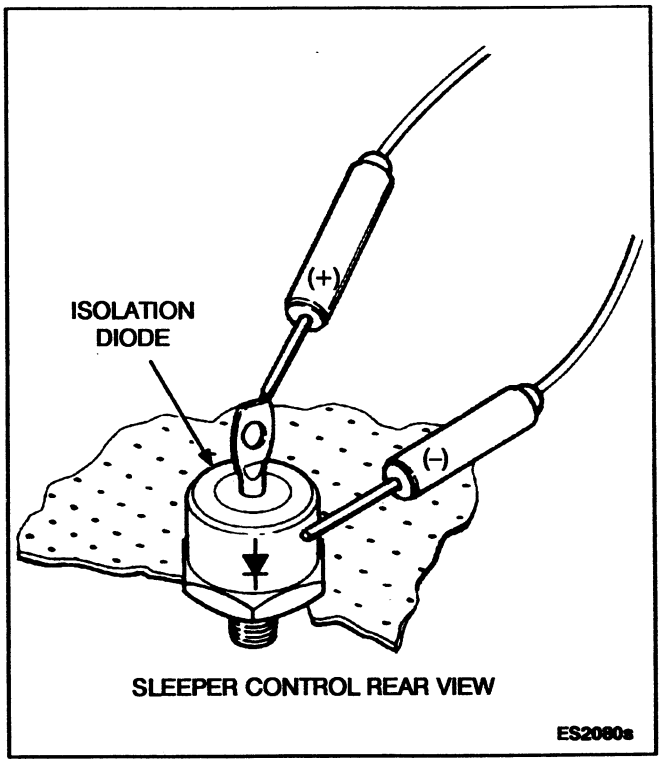


FIGURE 5-5. DIODE BRIDGE CR1 CHECK

CONTROL ASSEMBLY (A1)

The Control Assembly consists of a printed circuit board with components and relays that are potted (encapsulated in a non-conductive material) to protect them from moisture. It is difficult to isolate individual components on the control assembly for testing. Use section 4 (Troubleshooting) to identify possible problems in the control circuit. If a problem with the Control Assembly is suspected, check the control outputs with a voltmeter. Figure 5-6 shows the Control Assembly (A1) and the P1/P3 and P2 connectors. Voltages can be checked using a voltmeter with long test probes.

⚠WARNING ***Electrical shock can cause severe personal injury or death. Do not touch the voltmeter or any wiring when the power unit is operating. Attach and remove meter leads only when the power unit is stopped.***

Table 5-2 lists the control outputs at the P1/P3 and P2 connector plugs for each control mode. Measure control output voltages between connector pins shown and ground. Battery B + voltage must be present at the Control Assembly P1-1/P3-1 at all times. If battery voltage is present at the P1-1/P3-1 connector and the control outputs are not present, check the P1/P3 connections and the Start/Stop switch. If the connector and switch check good, replace the Control Assembly with a new Control Assembly and recheck operation.

TABLE 5-2. CONTROL OUTPUTS

CONTROL OUTPUT (CONNECTOR PIN)	CONTROL MODE		
	CRANK	RUN	STOP
STARTER RELAY (K5) (P1-5/P3-5)	≥9 VDC	0 VDC	0 VDC
FUEL PUMP (P1-9/P3-9)	≥9 VDC	≥9 VDC	0 VDC
ALTERNATOR ENABLE (P1-10/P3-10)	≥9 VDC	9 VDC	0 VDC
FUEL SOL. RELAY (K6) (P1-4, P3-4)	9 VDC	≥9 VDC	0 VDC
REMOTE RUN (P2-C)	0 VDC	≥9 VDC	0 VDC

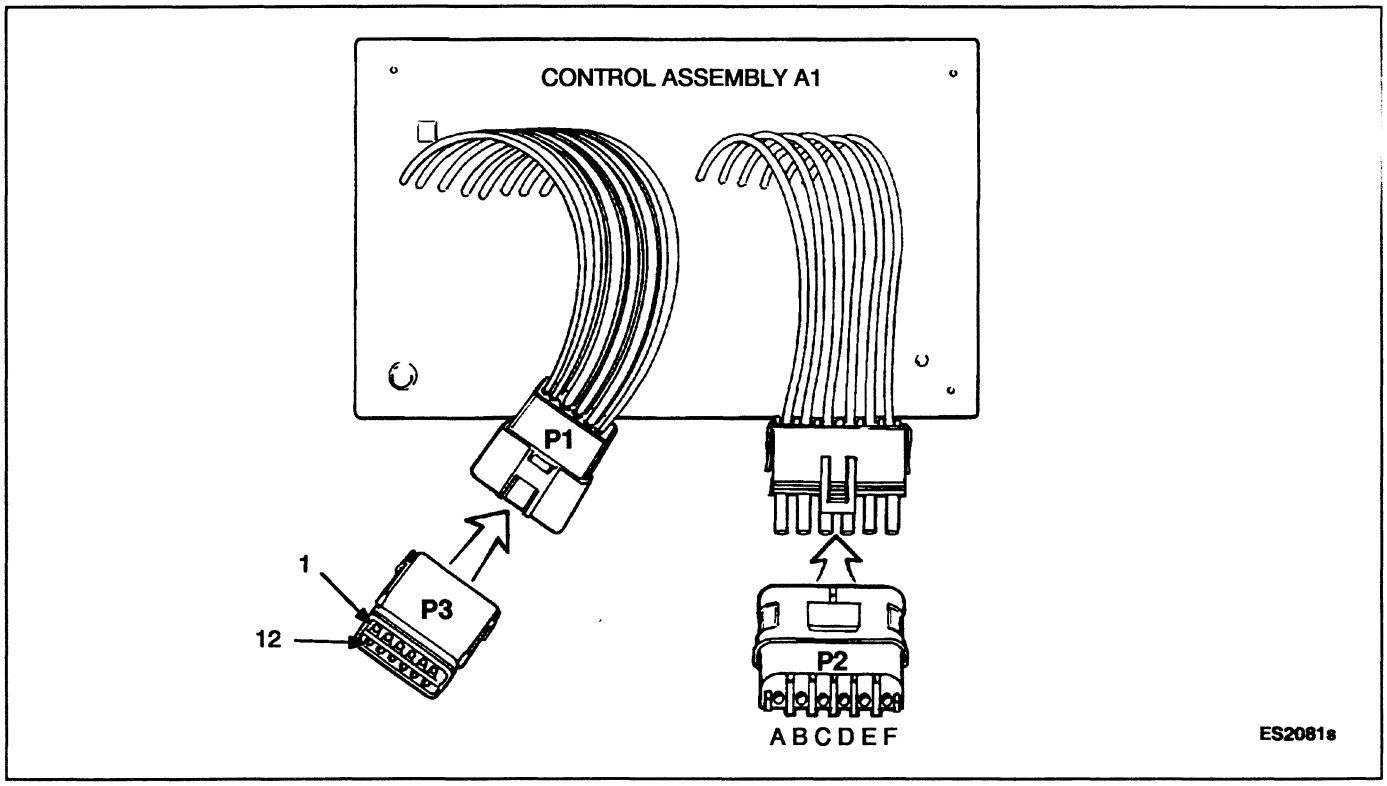


FIGURE 5-6. CONTROL ASSEMBLY CHECK

THERMISTOR

The thermistor can be checked with an ohmmeter. Disconnect the thermistor harness connector and measure the resistance across the leads. The reading should be approximately 3,000 ohms at 77°F (25°C). If an abnormal reading is measured, replace the thermistor.

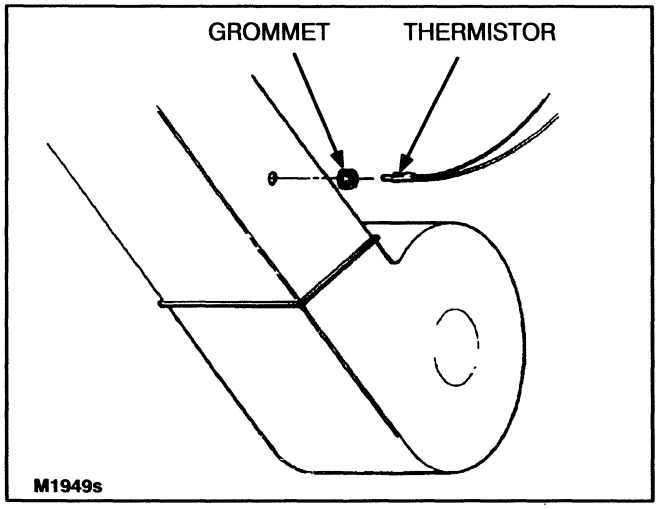


FIGURE 5-7. THERMISTOR

COOLANT SOLENOID

The coolant solenoids can be checked with an ohmmeter. Disconnect the harness connector and measure the resistance across the suspect solenoid coil.

The reading should be approximately 12.5 ohms. If an abnormal reading is measured, replace the solenoid. If the solenoid coil checks good the solenoid could be stuck or binding. Apply 12 VDC across the solenoid coil, the solenoid should pull in with a noticeable click. If the solenoid does not function properly or if it leaks, replace it.

Spec A AUX: The solenoid housings are made of plastic. Care should be taken when installing or removing hoses to prevent damage to the solenoid housing.

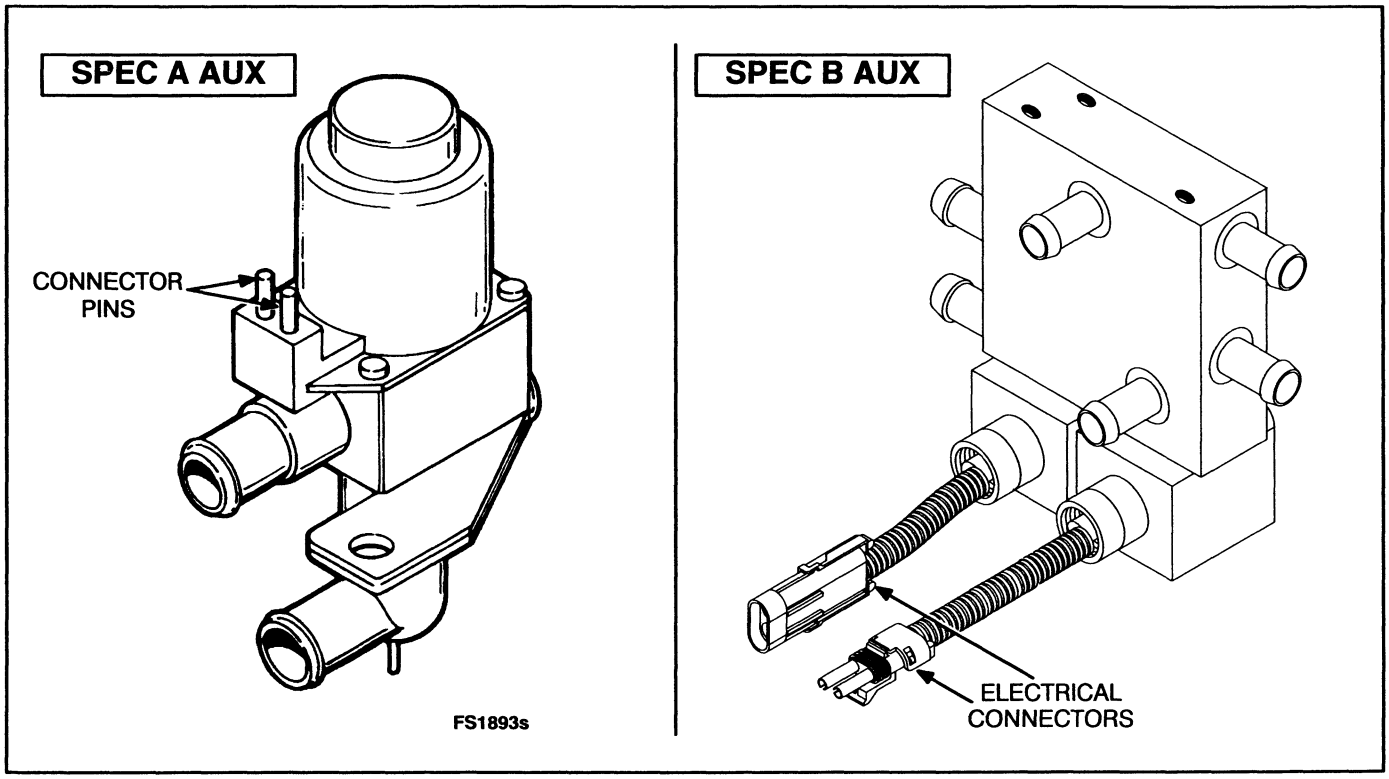


FIGURE 5-8. COOLANT SOLENOID

FUEL PUMP

An electric fuel pump is used to supply fuel. If the pump malfunctions or if insufficient fuel delivery is suspected, use the following procedures to test the fuel pump.

⚠WARNING ***Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system. Keep a type ABC fire extinguisher nearby.***

Fuel Pump Test: Test the fuel pump by checking the fuel pump outlet pressure as follows:

1. Make sure the fuel tank has sufficient fuel to supply the power unit. The fuel pick-up tube ends above the bottom of the fuel tank. The power unit can be out of fuel even when the tank is partly full.
2. Check the the starting battery voltage when cranking and running the power unit. Measure battery voltage between the brown lead and ground (Figure 5-9). The pump will not work properly if the cranking or running voltage is less than 6 VDC.
   If the battery voltage is low, charge the battery(ies) and retest.
3. Remove the fuel line from the injector housing inlet and install a pressure gauge.
4. Press the Start switch and hold it for several seconds, until the pressure reading stabilizes.
5. The pressure reading should be 3.5 psi (24.1 kPa) to 5 psi (34.5 kPa). The pressure should hold constant or drop off very slowly.

If the pressure reading is below 3.5 psi (17.2 kPa), tap the pump body with a screw driver handle to free the piston from fuel deposits. If the pump still does not work and the battery voltage is adequate, replace fuel pump.

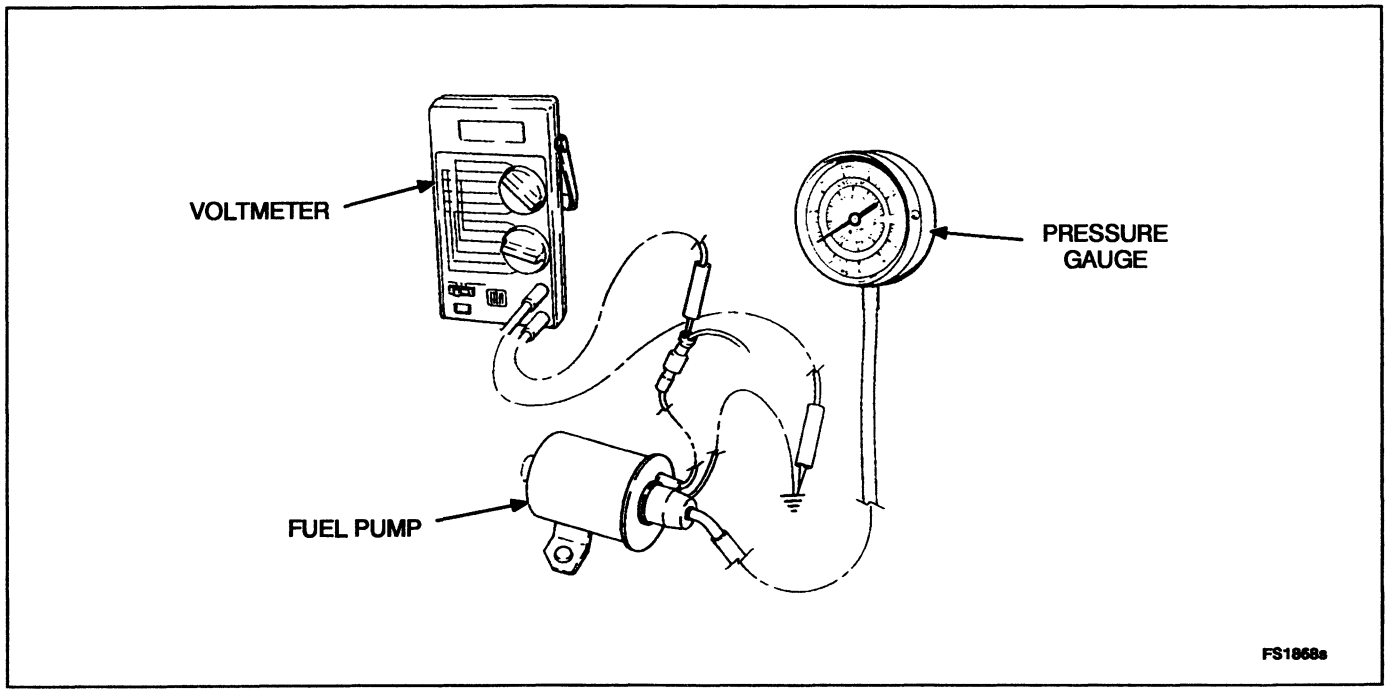


FIGURE 5-9. FUEL PUMP TEST

RELAYS (K2, K3, K5 AND K6)

Relays K2, K3, K5 and K6 are identical parts and each can be tested the same way. A quick check of the relay coils can be made with an ohmmeter. Disconnect the harness connectors and measure the resistance across the coil (terminals 85 and 86). The coil should measure approximately 85 ohms (±5 ohms). If an abnormal reading is measured, replace the relay.

Check the relay operation by applying 12 VDC to the coil (contacts 85 and 86). Measure continuity between terminals 30 and 87a, and between 30 and 87 with the relay energized and de-energized. Continuity should be as indicated in table 5-3.

If relay checks good, visually inspect the connectors for corroded, loose or bent terminals. Clean or correct any connector problem. If the relay checks bad, replace it.

TABLE 5-3. RELAY CHECK

● Indicates Contacts Made	RELAY K2, K3, K5 & K6	
Contacts / Function	30 to 87a	30 to 87
Relay Energized		●
Relay De-energized	●	

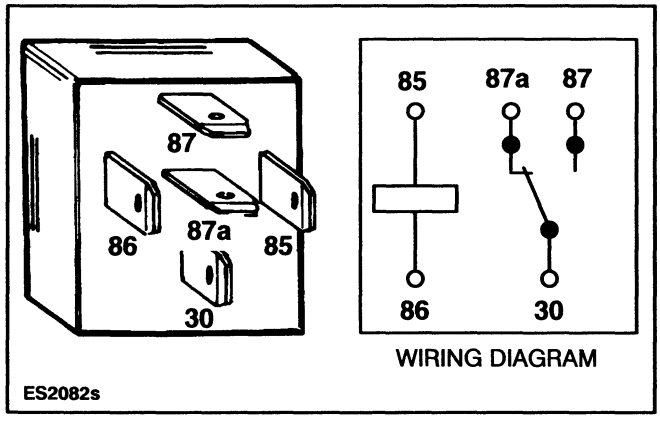


FIGURE 5-10. RELAY

FUEL SOLENOID

If the power unit engine is getting fuel to the injection pump, but not to the injection nozzles, the fuel solenoid may be defective. Watch for solenoid actuation when B+ is applied to the pull and hold coils (start switch in Start position). If the fuel solenoid does not actuate, check for 12 VDC at the pull and hold coils during startup. If 12 VDC is present and the solenoid does not actuate, replace the fuel solenoid. If 12 VDC is not present during startup, check the wiring connections to the fuel solenoid.

NOTE: Adjustment of this solenoid is critical. A set of contacts inside the solenoid must break when the solenoid energizes. If these contacts do not break, the pull windings remain energized and will cause failure of the solenoid. The plunger must fully bottom in the solenoid before the linkage arrests its travel.

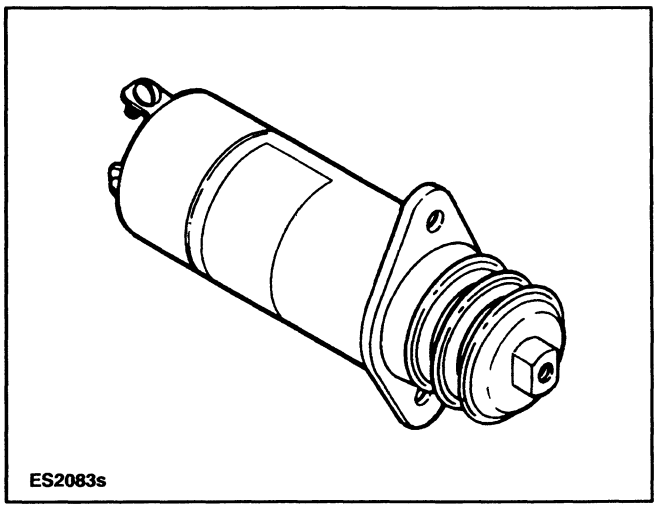


FIGURE 5-11. FUEL SOLENOID

6. Power Unit Components

INTRODUCTION

This section covers service procedures for some of the components located inside the power unit.

This section covers the following:

- Power Unit Service
- Compressor Belt Tension System
- Mag Pickup
- Fuel Injector Timing
- Bypass Thermostat
- Radiator/Condenser
- Alternator

Refer to the engine service manual for other engine mounted components. Refer to the air conditioning service manual for air conditioning and heating system components. Carefully observe all safety precautions contained in the service manuals. See the Maintenance section (7) for alternator belt service.

⚠WARNING ***The AC system is under high pressure. Be extremely careful not to open any part of the system (hoses, valves, etc.) or severe personal injury can result.***

⚠CAUTION ***Contamination and damage to the air conditioning system components can result if the system is opened. Always replace the receiver drier when the AC system is opened for service.***

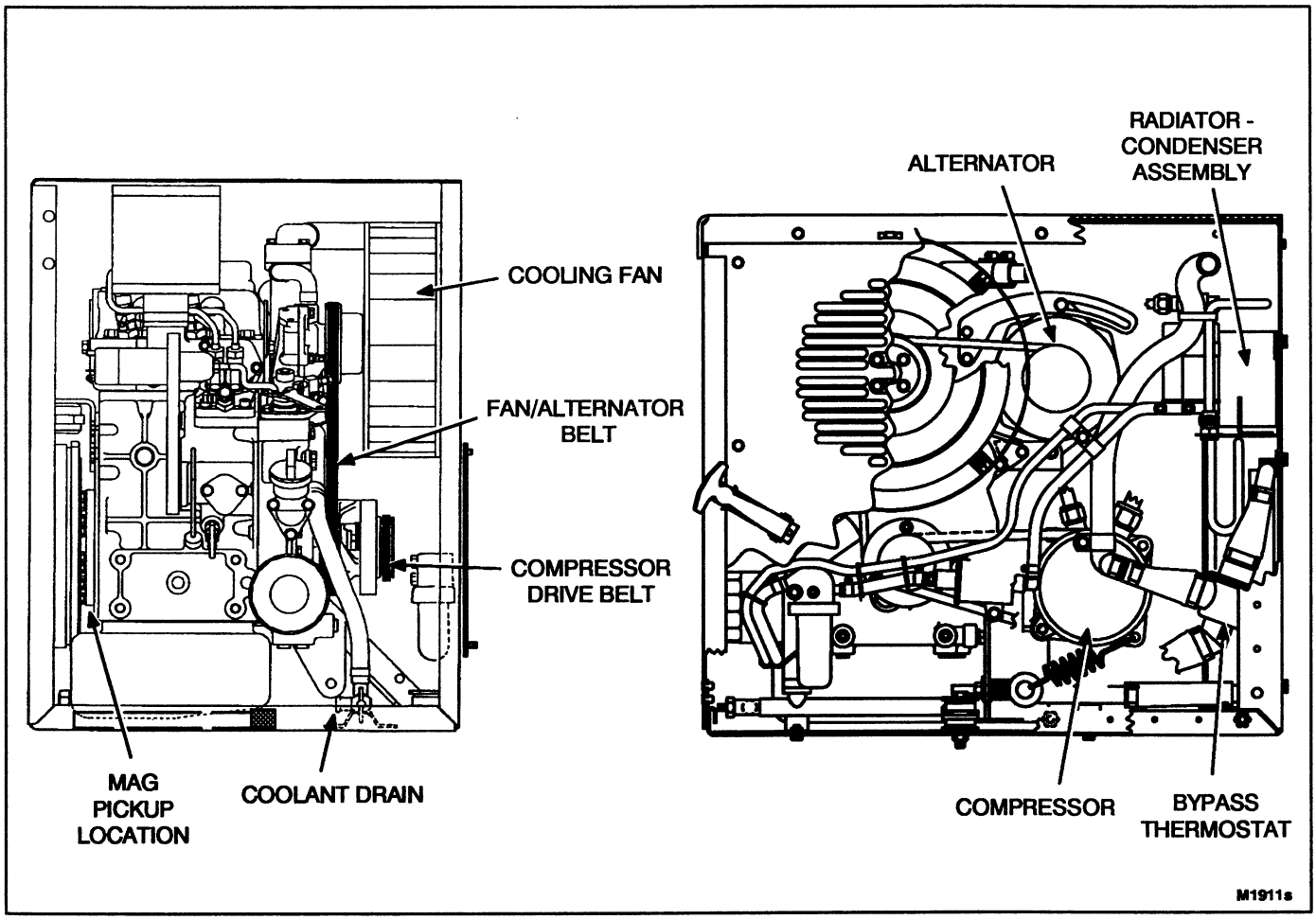


FIGURE 6-1. POWER UNIT COMPONENT LOCATIONS

POWER UNIT SERVICE

The power unit components can be serviced through the front and top panels, depending on which parts are involved in the service procedure.

⚠WARNING ***Accidental starting of the AUX can cause severe personal injury or death. Stop the AUX and disable it by disconnecting the starting battery cables (negative [–] cables first) when maintaining or repairing the AUX.***

⚠WARNING ***Operating the AUX with the access covers removed can result in severe personal injury or equipment damage. Hot and rotating components are exposed when the access cover is removed and cooling air does not circulate properly. Do not operate the power unit with the access cover removed.***

Access Cover Removal

To remove the access cover: Grip the handles on the rubber mounting straps and pull them forward and away from the side mounting flanges. Slide the cover up, then pull the bottom of the cover away from the unit and down to remove.

To secure the access cover: Insert the top of the cover inside the top lip of the housing cover, then push the bottom of the cover in and lower the cover into position. Pull rubber straps out and secure them to the side mounting flanges.

Top Cover Removal

To gain access to the components located near the back of the power unit, remove the top cover. In some installations access to the power unit from the top is restricted by the sleeper.

Tilting Power Unit for Top Access

If the power unit is located under the sleeper or other obstruction, the power unit can be tilted down for better service access as follows:

⚠WARNING ***Dropping the power unit can cause severe personal injury or death. Be careful when lowering or raising the power unit. Keep feet and hands clear when lifting the power unit.***

1. Position a floor jack or forklift under the power unit. Raise the floor jack or lift until slight upward pressure is placed on the power unit.
2. Remove all but the bottom mounting bolts that secure the mounting brackets to the side of the power unit. Loosen the bottom bolts slightly. These bolt will be used as the pivot point for lowering the power unit (Figure 6-2).

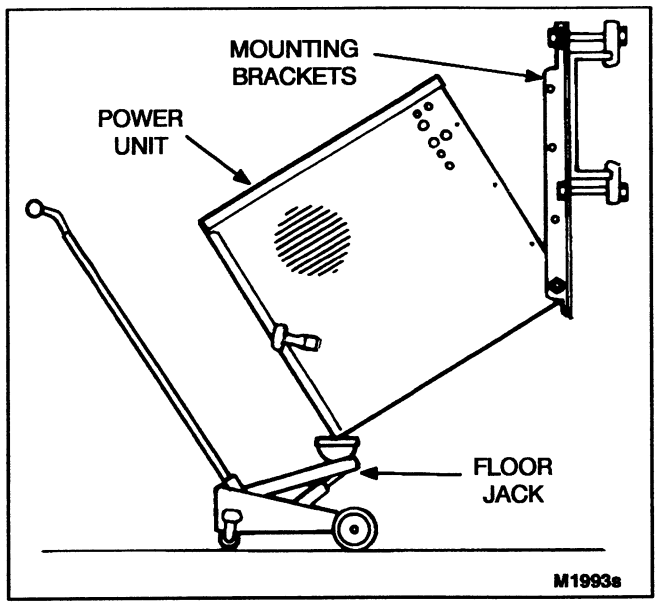


FIGURE 6-2. SERVICE ACCESS

3. Make sure that fuel lines, coolant lines, coolant lines and electrical leads have adequate play to prevent damage. Carefully lower the power unit until top access is adequate. Place wooden blocks under the power unit and lower the power unit onto the blocks for support.
4. When service is complete, carefully raise the power unit and secure the side angle bracket mounting bolts to 32 ft lbs (43 N•m).

Power Unit Removal

If it becomes necessary to remove the power unit from the truck rails, carefully follow these safety precautions and instructions. A trained air conditioning technician with refrigerant recycling equipment is required to perform this procedure. Read this entire section before starting the power unit removal.

Disconnecting the Power Unit from the Vehicle Systems

Disconnect each of the following items from the power unit.

⚠WARNING ***Accidental starting of the AUX can cause severe personal injury or death. Stop the AUX and disable it by disconnecting both the negative (–) and positive (+) battery cable from the batteries when maintaining or repairing the AUX. Disconnect the negative (–) cable first to reduce the risk of arcing.***

1. Disconnect both the negative (–) and positive (+) battery cable from the batteries (negative [–] cable first). Remove wire ties from the power unit battery cables and remove them from the battery area. Coil the cables and place them next to the power unit.
2. Remove the power unit front and top covers.
3. Disconnect the 3-pin and 6-pin harness connectors. Remove the pins from the connectors being careful not to damage the mounting tabs and cover them with tape to protect them. Pull the harness out of power unit through the side panel.

   ⚠WARNING ***Fuel is extremely flammable and can cause severe personal injury or death if ignited. Make certain all fuel line openings are plugged to prevent fuel leakage. Before opening the fuel line eliminate all possible sources of ignition including fire, flame, spark, pilot light, arc-producing equipment, cigarettes, or other ignition sources.***

4. Disconnect the fuel lines and plug them to prevent fuel spill. If the unit will be transported, also drain the fuel filter bowl inside the power unit.
5. Close the coolant supply and return valves (if equipped) or clamp the coolant hoses outside the power unit to prevent coolant loss. Disconnect the coolant hoses from the power unit.

   ⚠WARNING ***The AC system is under high pressure. Be extremely careful not to open any part of the system (hoses, valves, etc.) or severe personal injury can result.***

   ⚠CAUTION ***Contamination and damage to the air conditioning system components can result if the system is opened. Always replace the receiver drier when the AC system is opened for service.***

6. Have a qualified air conditioning technician remove the freon from the system. Disconnect the freon fittings from the side of the power unit and plug the fittings to prevent entrance of dirt. Always replace the receiver drier when the AC system is opened for service.

   ⚠WARNING ***Dropping the power unit can cause severe personal injury or death. Be careful when lowering or raising the power unit. Keep feet and hands clear when lifting the power unit.***

7. Before removing the power unit, place wooden blocks in the location that the power unit will be placed. Make sure the blocks are high enough to prevent the unit from resting on the muffler. Position a floor jack or forklift under the power unit. Raise the floor jack or lift until slight upward pressure is placed on the power unit.
8. Remove the bolts from the rail mounting clamps. Lower the power unit carefully.

Follow the instructions in the installation manual (981-0603) for installing a new power unit or for reinstalling the power unit.

COMPRESSOR BELT TENSION

The air conditioning compressor is mounted below the alternator in the back of the power unit (Figure 6-3). A spring tension system is used to maintain the drive belt tension.

To check belt tension: The belt tension can be checked with a tension gauge. Measure the tension between the compressor and the engine pulley. The belt should read in the green range of the scale (65 to 70 lbs. of tension). The total width of the spacer washers on the eye bolt must be 7/8-inch (22.7 mm).

To replace the belt:

1. Carefully loosen the AC compressor eye bolt spring tensioning nut as far as possible without removing the nut (Figure 6-3). Accidental removal of the nut from the end of the eye bolt will cause the adjustment spacers to drop into the unit. If this happens all of the spacers will have to be recovered and installed on the eye bolt for proper belt tension.
2. Loosen the AC compressor belt tension by loosening the adjustment bolt through the access hole in the front panel (Figure 7-5).
3. Remove the AC compressor drive belt first, then remove the alternator drive belt.

⚠WARNING ***The AC system is under high pressure. Be extremely careful not to open any part of the system (hoses, valves, etc.) or severe personal injury can result.***

⚠ CAUTION ***Contamination and damage to the air conditioning system components can result if the system is opened. Always replace the receiver drier when the AC system is opened for service.***

To service the compressor: Have a qualified air conditioning technician remove the refrigerant from the system. Disconnect the refrigerant fittings from the compressor and plug the fittings to prevent entrance of dirt. Loosen the 3/8-inch nut securing the eye bolt to the mounting bracket (do not remove the nut completely or the spacer washers will drop into the unit). Disconnect the spring from the compressor and remove the drive belt. Loosen the set screws that secure the compressor to the flats on the pivot shaft. Slide the pivot shaft out and remove the compressor. Use thread locking compound on the set screws when installing the new compressor.

Replace the receiver drier whenever the AC system is opened for service.

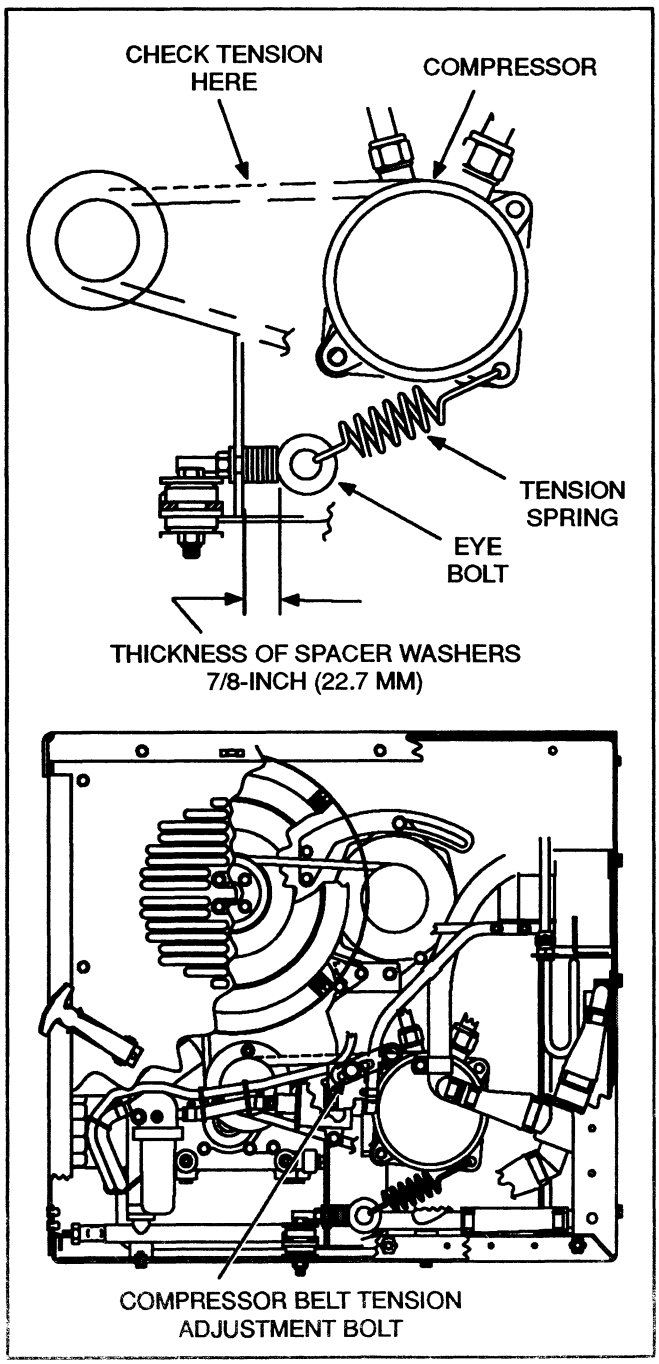


FIGURE 6-3. COMPRESSOR BELT ADJUSTMENT

MAG PICKUP

The most common problem that occurs with the mag pickup is the accumulation of dust or debris. Periodically clean the mag pickup and check or adjust the gap between the mag pickup and the ring gear.

To set the mag pickup gap: Loosen the locking nut and rotate the mag pickup clockwise until it rests against the ring gear. Then rotate it counterclockwise 3/4 to 1 turn and secure with lock nut. Be careful not to allow the mag pickup to rotate while the lock nut is being tightened. (Figure 6-4).

The mag pickup coil can be checked with an ohmmeter. Isolate the mag pickup leads and measure the pickup coil. The resistance should measure between 49 and 60 ohms.

FUEL INJECTION TIMING

This section is a supplement to the information provided in the engine manual. Refer to Figure 6-4 for the location of the fuel injection timing mark.

Refer to the engine service manual for the injector timing check and adjustments.

Attach a spanner to the end of the crankshaft to rotate the engine, or remove the the mag pickup mounting bracket and use a flywheel turning tool. Do not attempt to rotate the engine by turning the cooling fan or it will be damaged.

⚠ CAUTION ***Damage to the cooling fan will occur if the fan is used to rotate the engine.***

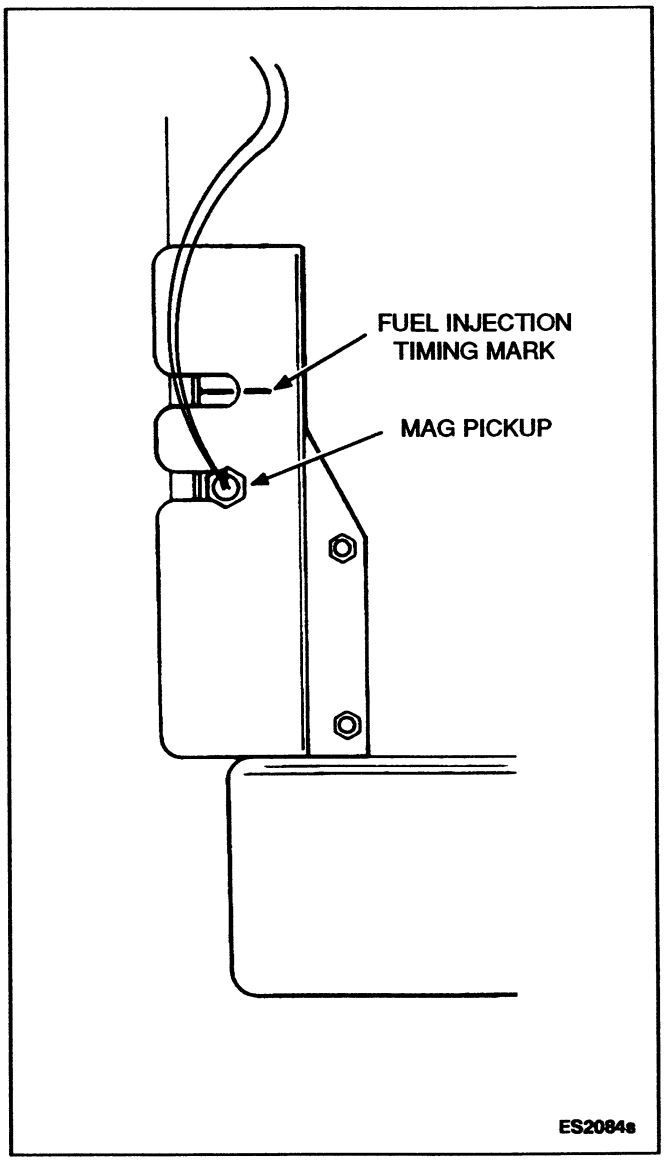


FIGURE 6-4. MAG PICKUP AND TIMING MARK

BYPASS THERMOSTAT

The bypass thermostat circulates coolant from the sleeper heater to either the power unit engine or to the power unit radiator, depending on the coolant temperature.

The bypass thermostat operates at 170°F (75°C). Refer to Figure 6-5 for the direction of flow above and below the operating temperature.

If the power unit is shutting down due to an over heat condition or if the sleeper heater output is low, check the bypass thermostat.

Close the coolant supply and return valves (if equipped) or clamp the coolant hoses outside the power unit to prevent coolant loss. Drain the coolant from the power unit with the coolant drain hose. Remove and inspect the bypass thermostat. At ambient temperature, air should pass between the inlet and the lower coolant outlet (Figure 6-5). Submerged in hot water of at least 170°F (75°C), the thermostat should open. If the thermostat is corroded or sticking, replace it.

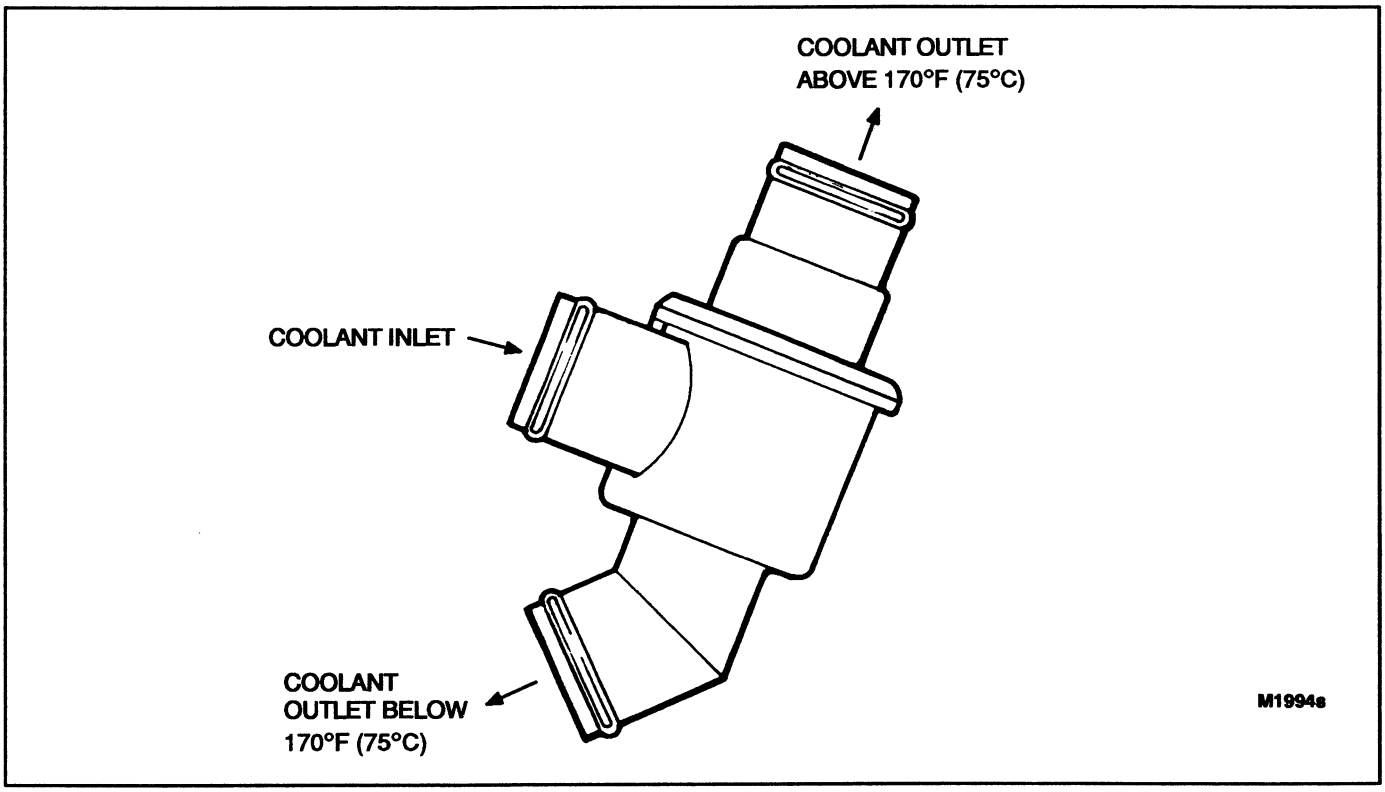


FIGURE 6-5. BYPASS THERMOSTAT

RADIATOR/CONDENSER REMOVAL

To remove the radiator and condenser, it is necessary to remove the alternator, air conditioning compressor and the exhaust manifold. Follow the preceding instructions for removing the compressor and the bypass thermostat. Cover both sides of the radiator and condenser unit with cardboard to prevent injury from sharp fins and to protect the fins.

Disconnect the exhaust pipe and then the exhaust manifold from the engine. Handle the exhaust pipe with gloves because the fiberglass insulation can cause skin irritation.

Disconnect the coolant and refrigerant lines from the radiator/condenser unit. Remove the six mounting bolts from the back of the power unit and carefully lift the assembly out of the power unit (Figure 6-6).

Replace the receiver drier whenever the AC system is opened for service.

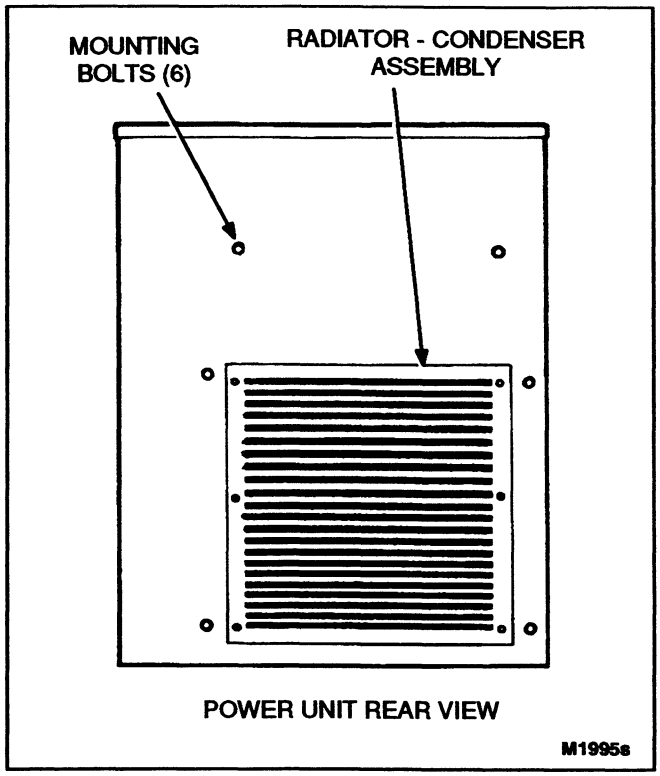


FIGURE 6-6. RADIATOR/CONDENSER ASSEMBLY

ALTERNATOR

The power unit contains a standard 35-amp alternator (Figure 6-7) or optional 90-amp alternator (Figure 6-8). Both alternators are internally regulated. A voltage check of the alternator output can be performed to determine if the alternator is functioning properly.

Make sure that the batteries are in good condition. Turn off headlights and other DC loads. Check the alternator belt to make sure the tension is properly set and the belt is in good condition.

With the power unit off, connect a DC voltmeter positive lead to the BAT (B+) terminal on the alternator (Figure 6-7). Connect the negative lead to a bare metal ground point in the power unit. Route the meter leads so they will not be tangled in moving parts. Use alligator clips to avoid holding the meter leads during the test.

⚠WARNING ***Moving parts can cause severe personal injury. Do not remove any belt guards or covers. Keep your hands and clothing away from moving parts. Do not wear loose clothing or jewelry while working on equipment, because they can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.***

Start the power unit and observe the voltmeter reading. A normal output of 13 to 14.5 VDC should be measured. If an abnormally high or low reading is measured, repair or replace the alternator.

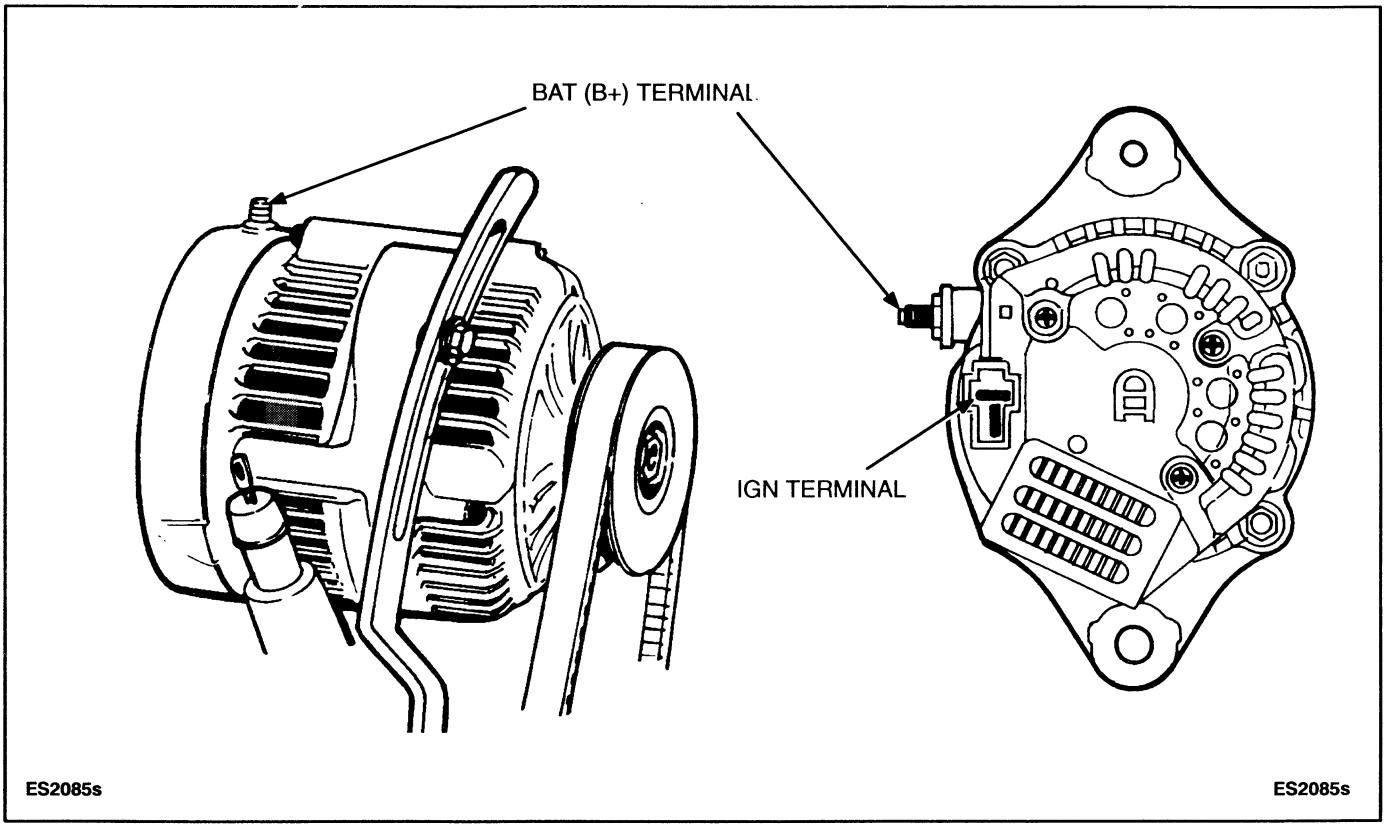


FIGURE 6-7. 35 AMP ALTERNATOR

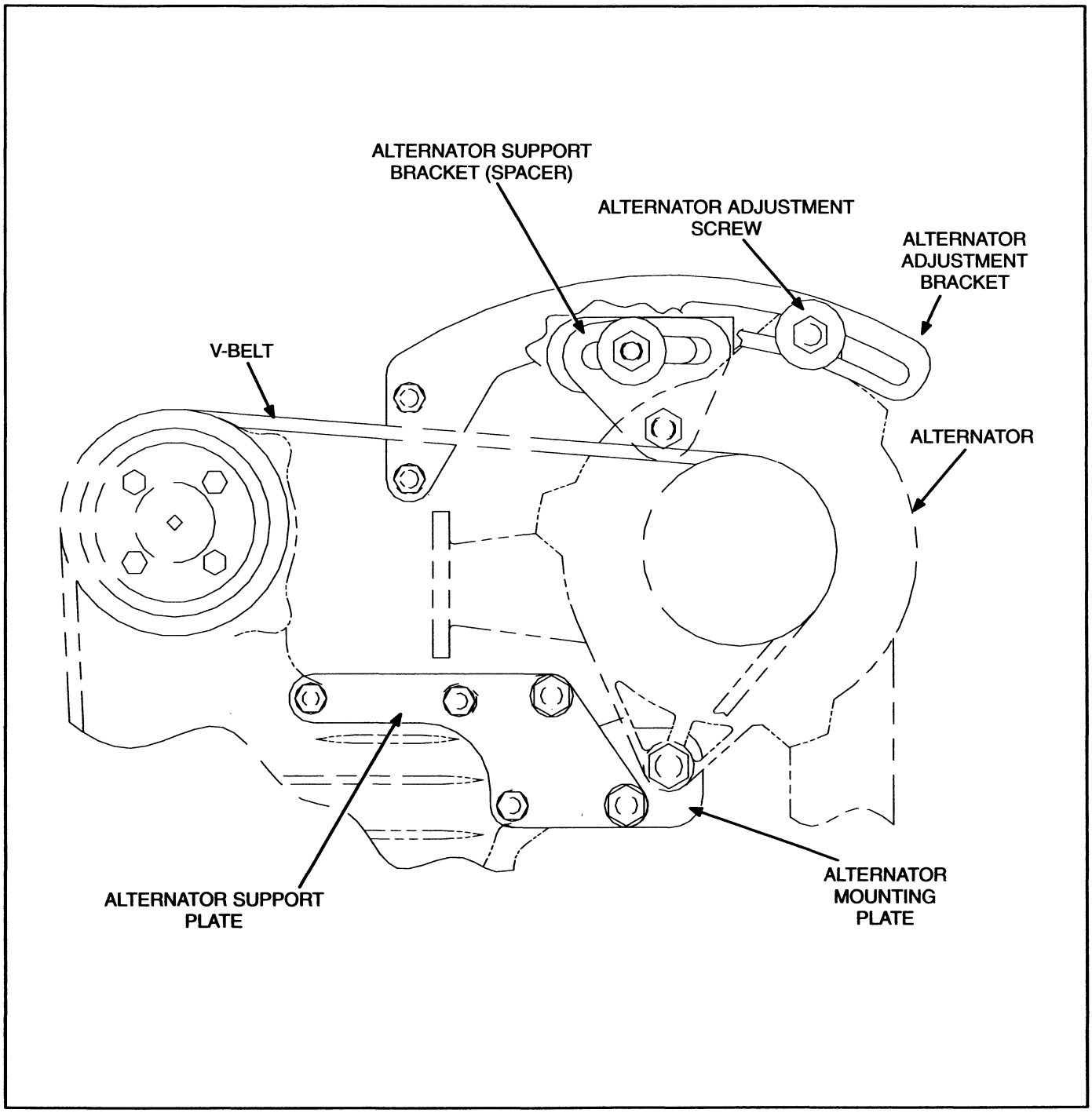


FIGURE 6-8. 90 AMP ALTERNATOR - FRONT VIEW

7. Maintenance

PERIODIC MAINTENANCE

Following the maintenance schedule and using the AUX properly will result in longer life, better performance, and safer operation. Perform each maintenance procedure at the time period indicated or after the number of operating hours indicated, whichever comes first. Refer to the following *Maintenance Procedures* section for instructions.

Log all service and maintenance for warranty support (see the *Maintenance Record* section).

⚠WARNING ***Accidental starting of the AUX during maintenance can cause severe personal injury or death. Disconnect both starting battery cables, before performing maintenance. Remove the negative (–) cable first to reduce the risk of arcing.***

TABLE 7-1. PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	SERVICE INTERVAL				
	Daily or Every 8 hours	Every 250 hours	Every 500 hours	Every 3 Years	PAGE
AUX Inspection	x[1]				7-2
Check Oil Level	x				7-7
Check Coolant Level	x				7-8
Check Fuel Level	x				7-4
Exercise Air Conditioner (monthly)		x			–
Clean Spark Arrester		x			7-3
Replace Fuel Filter		x[2]			7-4
Check / Adjust Drive Belts		x[3]			7-6
Change Crankcase Oil and Filter		x[2]			7-7
Check Coolant Hoses and Clamps		x			–
Replace Air Filter		x[4]			7-3
Replace Fuel Filter (If Needed)			x		7-4
Replace Receiver Drier (yearly)			x		–
Clean Coolant System				x	7-10
Replace Coolant Hoses and Clamps				x	–

1. Check for oil, fuel and exhaust system leaks. Check exhaust system audibly and visually with the power unit running. Repair any leaks immediately. Replace corroded exhaust and fuel line components before leaks occur.
2. Change oil filter and fuel filter after first 50 hours of operation on new units.
3. Adjust compressor belt.
4. Change air filter more frequently in extremely dusty conditions.

INSPECTION

Inspect the APU daily or after every eight hours of operation, whichever comes first. Check the exhaust, fuel, DC electrical systems and mechanical condition as described in the following sections.

Exhaust System

With the unit running, inspect the exhaust system. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. If any leaks are detected, shut down the unit and do not operate until corrected. Replace corroded exhaust components before leaks occur.

⚠WARNING ***Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Repair all leaks immediately.***

Fuel System

With the unit running, inspect the fuel supply and return lines, fuel filter, and fittings for leaks. Check flexible sections for cuts, cracks and abrasions. See that the fuel lines do not rub against anything that could damage them. Replace worn fuel line components before leaks occur.

⚠WARNING ***Fuel leakage will create a fire hazard that can result in severe personal injury or death if ignited. While checking for leaks, do not smoke or allow any spark, flame, pilot light or other ignition source in the area. If any leaks are detected, have them corrected immediately.***

DC Electrical System

With the unit off, check the battery terminals for clean and tight connections. Loose or corroded connections create resistance that can impede starting. Clean and reconnect loose battery cables. Always disconnect the negative (–) battery cables first and connect them last, to reduce the possibility of arcing.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or allow any other ignition source near the battery. Wear goggles, protective rubber gloves and an apron when servicing batteries.***

Coolant Level

⚠WARNING ***Coolant in a warm engine is under pressure and can flash to steam causing severe burns if the radiator cap or drain cock are opened. Let the engine cool down before opening the radiator cap or drain cock.***

Check the entire system for coolant leaks. A small amount of coolant leakage from the water pump weep hole is normal.

The coolant system for the AUX is connected to the tractor engine cooling system. Coolant for the AUX can only be added through the tractor engine cooling system. Check the coolant level in the tractor engine recovery tank (or separate expansion tank) when the system is cold. Engine coolant is at the proper level when the recovery tank level is between the LOW and FULL marks.

Mechanical

Check for any signs of mechanical damage. Start the power unit and listen for any unusual noises that may indicate mechanical problems. Have any problems corrected immediately.

Check the mounting fasteners to make sure the power unit is secure to the vehicle. Check the condition of the mounting brackets and hardware to make sure they are in good condition.

Make sure that the power unit air inlet and outlet areas are not blocked with debris.

Clean the power unit whenever dust and dirt begin to accumulate. Dust and dirt can usually be removed with a damp cloth. Steam cleaning may be needed to remove road contaminants. Do not clean the AUX while the engine is running. Cover the air inlet and outlet areas to protect the inside of the AUX from cleaning solvents. Cleaning solvents can damage electrical connectors.

AIR FILTER

The air filter is a one-piece dry element (Figure 7-1). Change the air filter at the interval indicated in the maintenance schedule. Change the air filter more often when the unit is operated in extremely dusty conditions.

Loosen the screw on the mounting clamp and lift the filter to remove it. Cover the engine air inlet opening to prevent the entrance of dirt or debris.

Keep a spare filter on hand at all times.

Place mounting clamp on filter and reinstall filter. Tighten screw on air filter mounting clamp securely.

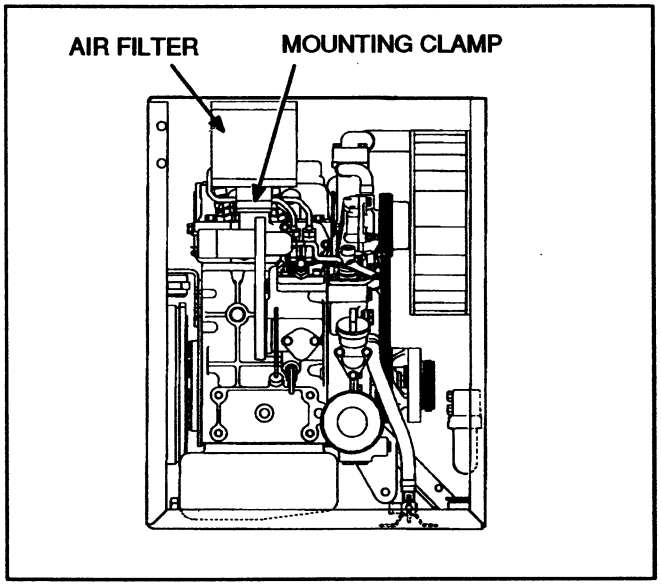


FIGURE 7-1. AIR FILTER

SPARK ARRESTER

The exhaust spark arrester, mounted inside the muffler, requires periodic cleaning for continued safe and efficient operation.

To clean the spark arrester, remove the 1/8-inch pipe plug from the bottom of the muffler (Figure 7-2). Run the power unit with the AUX control set to heat or AC for five minutes. Stop the power unit and allow the muffler to cool. Replace the pipe plug in the muffler.

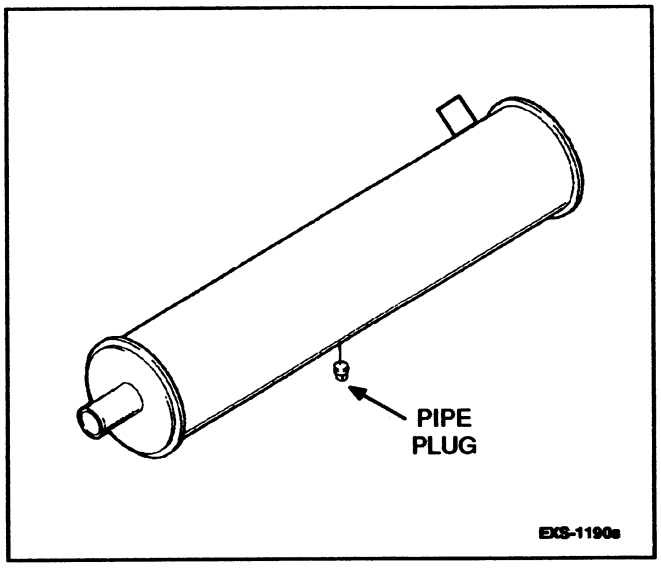


FIGURE 7-2. EXHAUST MUFFLER

FUEL SYSTEM

Use the best fuel available. Fuel quality is important for dependable performance and satisfactory engine life. Figure 7-3 illustrates the fuel system.

⚠WARNING ***Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, pilot light, spark or other igniter near the fuel system.***

Keep the fuel tank(s) full when operating the AUX. In most installations the AUX will run out of fuel when the fuel level is less than 2 inches (51 mm) from the bottom of the tank. If this happens, use the following procedure to prime the fuel system.

Low Pressure Fuel System: The electric fuel pump, fuel filter and injection pump inlet comprise the low pressure fuel system. To prime these components (remove the trapped air), see Priming the Fuel System).

High Pressure Fuel System: The injection pump, fuel injection lines and fuel injectors make up the high pressure fuel system. The high-pressure system is self-priming; trapped air is forced out through the injection nozzles.

Fuel Filter Service

Refer to the *Periodic Maintenance Schedule* for the recommended filter change interval. The wrong fuel or dirty fuel will shorten the life of the fuel filter. Replace the fuel filter as follows:

⚠CAUTION ***Dirt or water in the system will cause severe damage to both the injection pump and the injection nozzles. It is extremely important that the fuel be kept clean and free of water.***

1. Close the fuel shutoff lever (Figure 7-3). Place a container under the fuel filter to collect fuel.
2. Loosen the bleed screw. Remove the screw ring and remove the filter cup.

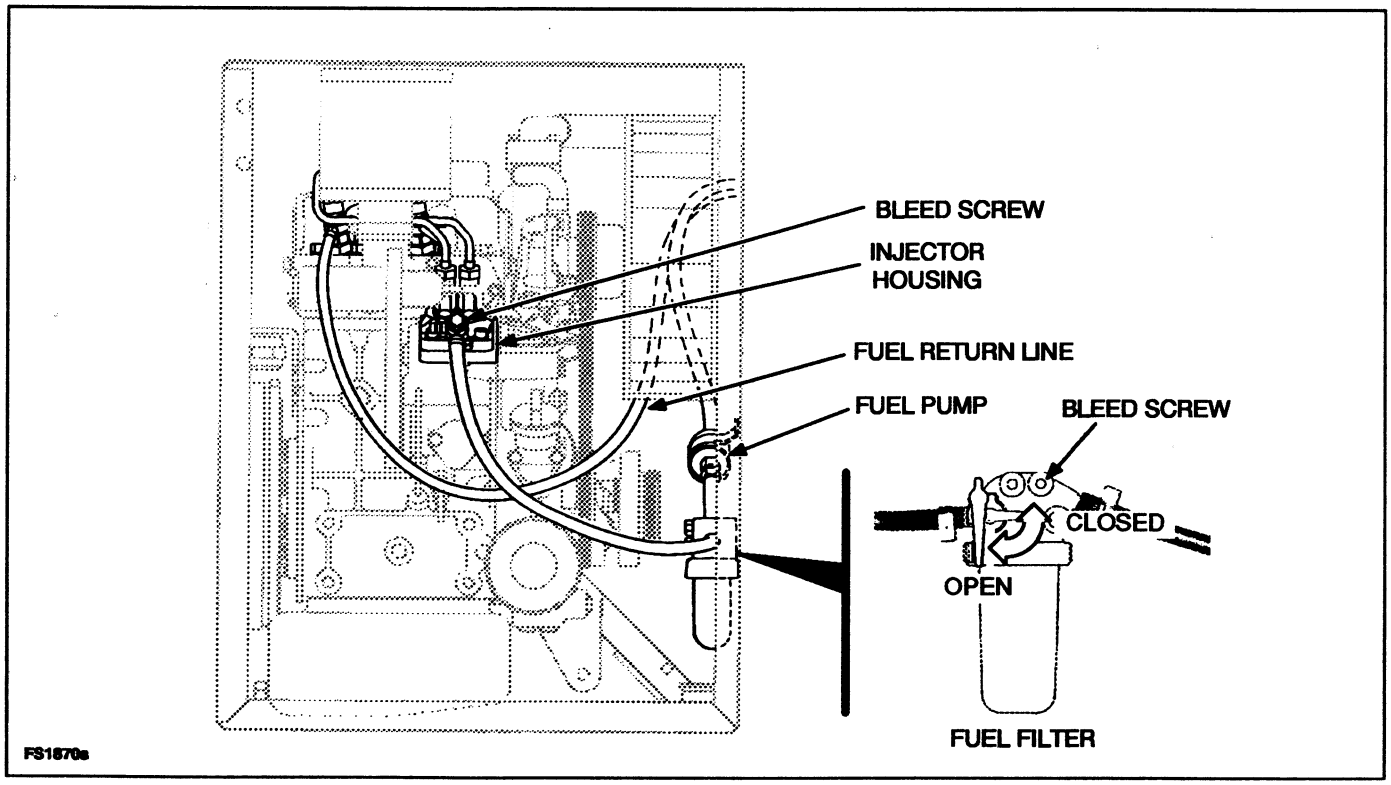


FIGURE 7-3. FUEL SYSTEM

3. Take out the fuel filter and replace it. See Figure 7-4.
4. Lubricate the element and gasket with clean diesel fuel. Install the new filter into the filter cup and reassemble the filter cup to the housing. Tighten the screw ring securely to prevent fuel leakage.
5. Proceed to Priming the Fuel System.

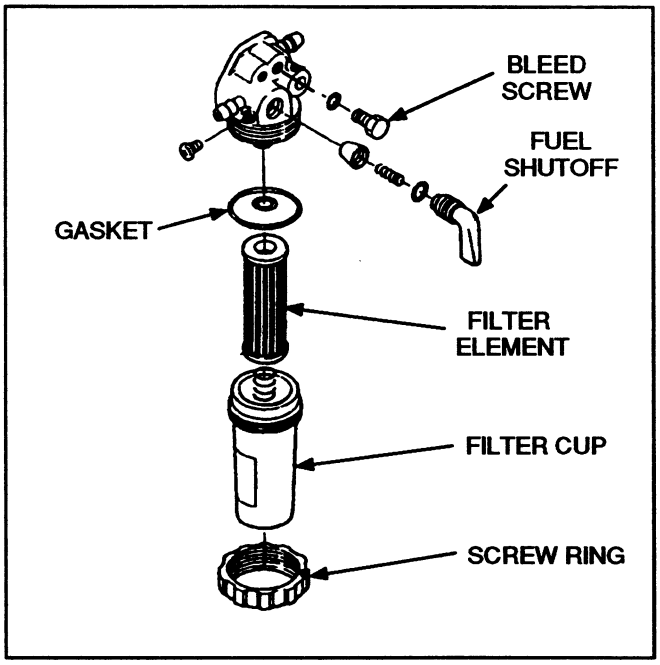


FIGURE 7-4. FUEL FILTER ASSEMBLY

Priming the Fuel System

To prevent accidental starting of the power unit, do not allow anyone inside the sleeper during this operation.

⚠WARNING ***Accidentally starting the power unit can cause severe personal injury or death. Do not allow anyone inside the sleeper during this operation.***

1. Make sure that the fuel shutoff valve is in the open position (Figure 7-3).
2. Place a container under the fuel filter to collect fuel. Loosen the fuel filter assembly bleed screw.
3. Disconnect the tan (positive) lead from the fuel pump at the inline harness connector.
4. Attach a jumper lead with a normally open switch, between the alternator B+ terminal (large top terminal) or the battery positive (+) terminal and the tan fuel pump lead.
5. Close the jumper switch to energize the fuel pump until fuel purges at fuel filter bleed screw opening.
6. Secure bleed screw in the fuel filter housing. Place a container under the injector pump to collect fuel.
7. Loosen the bleed screw on the injector pump housing (Figure 7-3). Close the jumper switch to energize the fuel pump until fuel purges from the bleed screw opening at the injector pump housing.
8. Secure bleed screw in injector pump housing.
9. Remove the jumper lead from the alternator B+ terminal or the battery positive + terminal. Remove the jumper lead from the tan fuel pump lead.
10. Reconnect the fuel pump tan (positive) lead in-line connector to the harness.
11. Wipe the fuel off the engine and fuel filter housing with a clean rag.

DRIVE BELTS

Inspect the fan/alternator and compressor belts for signs of wear or glazing. If either belt is defective, have it replaced by a Cummins service center. Also check belts for tension as follows:

Fan/Alternator Belt

A loose fan/alternator belt can cause the engine to overheat and decreased alternator efficiency. The belt tension must be correct for the unit to run properly.

Disconnect the starting battery cables (negative [–] cables first) to prevent accidental starting.

⚠WARNING ***Accidental starting of the AUX can cause severe personal injury or death. Stop the AUX and disable it by disconnecting the starting battery cables (negative [–] cables first) when maintaining or repairing the AUX.***

To adjust the belt, loosen the bolts that secure the alternator (Figure 7-5). Adjust the position of the alternator until the belt tension is correct. Belt tension is correct when a finger pressure of 22 pounds (10 kg) at the middle of the belt deflects it about 0.4 inch (10 mm). A belt tension gauge can also be used to check the belt tension.

Tighten the bolt on the adjustment bracket first, then tighten the lower mounting bolt.

Compressor Belt

Improper belt alignment and tension can cause inefficient compressor clutch operation and reduced bearing life. The compressor is mounted on a spring bracket that is designed to maintain proper belt tension.

1. Remove the hole plug from the air inlet side of the power unit (Figure 7-5).
2. Loosen the adjustment bolt located behind the access hole approximately two turns counterclockwise. (Requires a 17 mm socket.) The tension spring will set the compressor belt to the proper tension. Retighten the belt tension adjustment bolt.
3. Insert the hole plug back into the side panel.

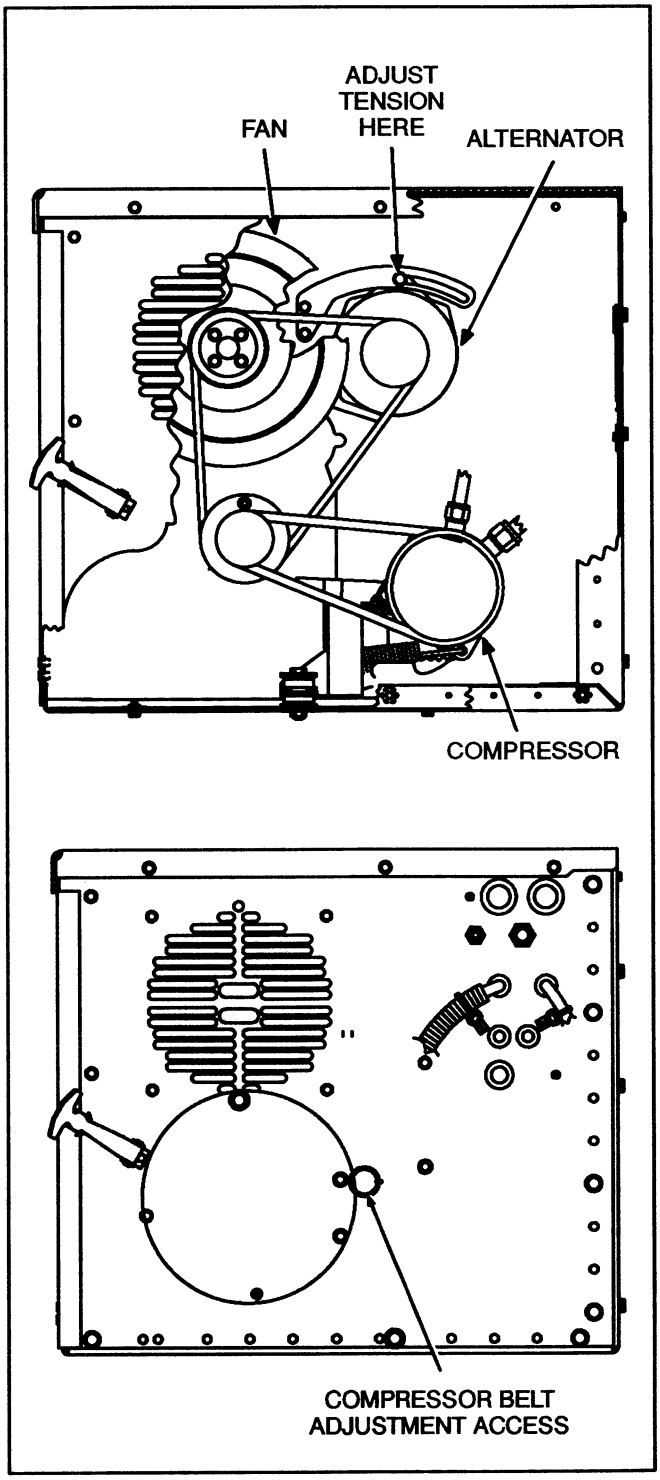


FIGURE 7-5. DRIVE BELT ADJUSTMENT

OIL AND OIL FILTER CHANGE

Change the oil and filter at the intervals listed in the Maintenance Schedule. Use oil that meets the API classification and SAE viscosity grade indicated in the *Pre-Start* section.

⚠WARNING ***Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.***

⚠WARNING ***State or federal agencies have determined that prolonged contact with used engine oil can cause cancer or reproductive toxicity. When adding, changing or working with used oil, take care not to breathe, ingest or come into excessive contact with these substances. Wash hands after use. Wear protective clothing and equipment. Provide adequate ventilation.***

Run the engine until thoroughly warm. Stop the engine. Remove the drain plug from the end of the oil drain hose (Figure 7-6). Drain the oil into a container. After draining, securely install the drain plug onto the end of the drain hose.

Remove the oil filter and discard it. Thoroughly clean the filter mounting surface. Apply a thin film of oil to the filter gasket, and screw in the filter by hand until the gasket just touches the mounting pad. Then turn an additional 3/4 turn. Do not over-tighten the filter.

Used oil is harmful to the environment. Collect used oil in a sealed container and deliver it to the nearest recycling center or automotive service station.

Fill the lubrication system with the recommended oil. The engine oil capacity is 5 quarts (4.7 liters).

Install the service cover on the power unit, start the power unit and run it for two minutes. Open the service access cover and check for leakage around the filter gasket. Tighten the filter only enough to eliminate leaks. Reinstall the service cover.

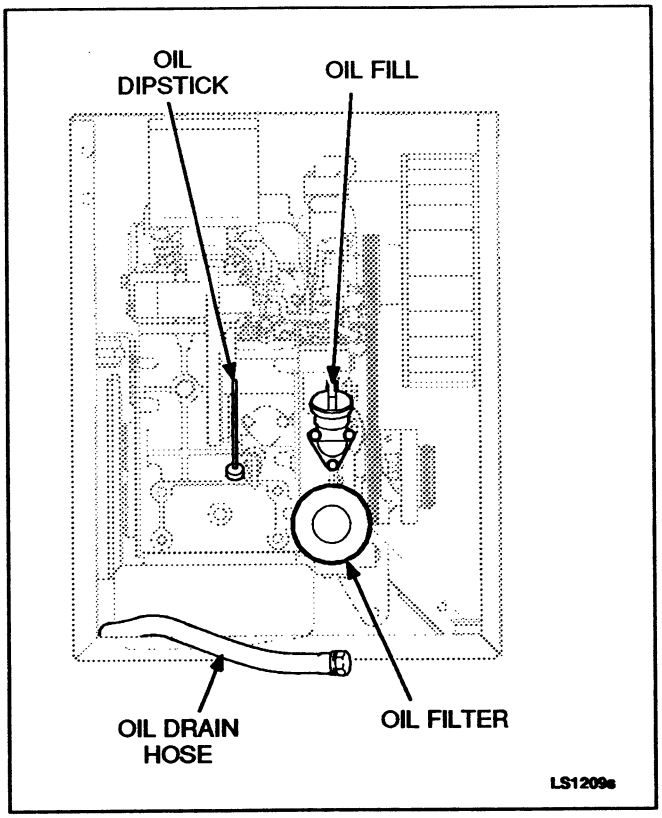


FIGURE 7-6. OIL AND OIL FILTER CHANGE

COOLING SYSTEM

Cooling systems vary with tractor engine types: for this reason it is recommended that the cooling system be serviced by Cummins service centers. The cooling system capacity for the AUX is listed in the *Specifications* section.

Coolant Requirements

Engine coolant must inhibit corrosion and protect against freezing. A 50/50 mixture of ethylene glycol anti-freeze and water is recommended for normal operation and storage. Use a good brand of heavy duty low silicate antifreeze that contains a rust and corrosion inhibitor. The antifreeze should not contain a stop-leak additive. Refer to the truck Operator's manual for the recommended antifreeze.

Do not exceed a 50/50 mixture of ethylene glycol and water. A higher proportion of ethylene glycol will alter the heat transfer properties of the coolant. A 50/50 mixture will provide freeze protection to -34°F (-37°C).

Water used for engine coolant should be clean, low in minerals, and free of corrosive chemicals. Use distilled or soft water if available. Avoid the use of well water, which may contain minerals that can clog the heat exchanger core and reduce cooling efficiency.

Filling the Cooling System

The coolant system will be filled through the main truck engine radiator or expansion tank. Refer to the main truck engine Operator's manual for antifreeze type, mixture and engine coolant filling procedure.

A special access valve is located on top of the power unit radiator and on the standalone sleeper heaters to bleed air from the system (Figures 7-7 and 7-8).

⚠WARNING ***Accidentally starting the power unit while working on it can cause severe personal injury or death. Disconnect the 3-pin connector inside the power unit any time the top cover is removed.***

1. Remove the power unit top cover. Disconnect the 3-pin connector inside the power unit to prevent accidental power unit starting during this procedure.
2. If the coolant was not drained from the main truck engine, proceed to step three.

   If the coolant was drained from the main truck engine, close all coolant drain valves. Close coolant hose supply and return shutoff valves (keep cutoff clamps on hoses, if used). Fill the main truck engine coolant system according to the main truck engine Operator's manual.
3. Check all hose fittings to make sure they are tightly secured with a hose clamps. If shutoff valves are used to isolate the power unit plumbing from the main engine, open the supply valve. Keep the return valve closed.
4. Start the main truck engine and run it at a minimum speed of 1000 rpm. **NOTE: In some applications it may be necessary to increase engine speed to high idle (governed speed) to purge the heater core of air.**
5. Bleed the power unit engine by loosening the hose clamp at the thermostat housing. Loosen the hose from the fitting just far enough to bleed the system. Resecure the hose clamp.
6. Remove the cap from the access valve on the top of the power unit radiator (located in the top right hand corner of the power unit). A 14 mm flexible socket with adhesive tape can be used to remove and install the valve cap. Depress the valve pin with a screw driver to bleed the air from the radiator. Reinstall the valve cap.
7. Reconnect the 3-pin connector inside the power unit and install the power unit top cover.
8. Open the main engine coolant return valve, if equipped. Add coolant to the main coolant system. Lower the cab on cabover models.
9. Put the sleeper Temp control to the hottest setting and cycle the Heat/Off/AC switch between the Heat and Off position or until the heater blows warm air.
10. Refer to the Power Unit Starting Procedure section for starting instructions and important safety precautions. Check to make sure the covers are installed on the power unit. Start the auxiliary power unit.

11. After the Power unit has run for five minutes, cycle the Heat/Off/AC switch between the Heat and Off position for three one minute cycles.
12. Turn off the main truck engine and monitor the power unit operation. If the power unit shuts down by itself, the most likely cause is air trapped in the system. If this happens proceed to step 13 and then repeat this procedure.
13. Allow the cooling system time to cool down and fill the coolant system.

Coolant Level

Check the coolant level at the intervals specified in the Maintenance Schedule. Check by observing the coolant level in the tractor engine recovery tank (or separate expansion tank) when the system is cold. Engine coolant is at the proper level when the recovery tank level is between the LOW and FULL marks.

⚠WARNING ***Coolant in a warm engine is under pressure and can flash to steam causing severe burns if the radiator cap or drain cock are opened. Let the engine cool down before opening the radiator cap or drain cock.***

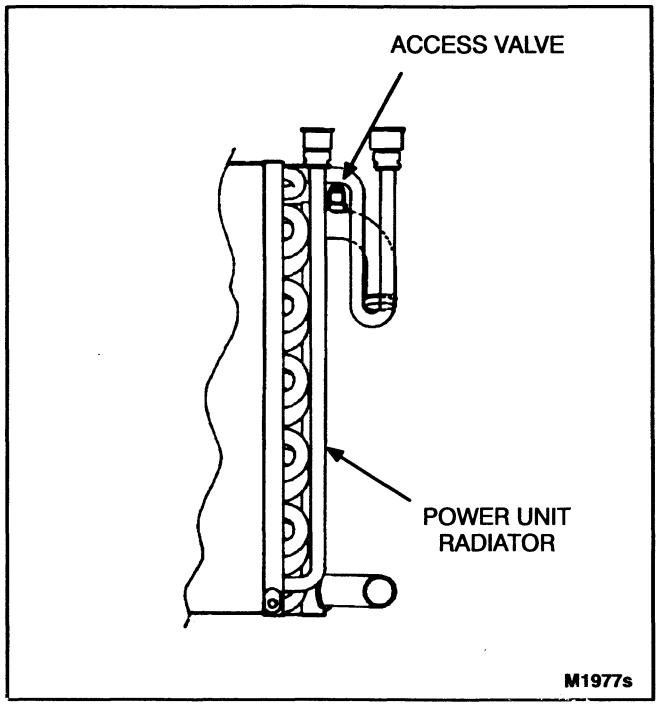


FIGURE 7-7. BLEEDING THE POWER UNIT RADIATOR

Flushing and Cleaning

Drain, flush and refill the AUX cooling system with new coolant at the intervals listed in the Maintenance Schedule. (Refer to the truck operator's manual for instructions on flushing and cleaning the truck engine). To drain the AUX system, open the radiator drain and the engine block coolant drain (Figure 7-8). Be aware that the main truck coolant system will be drained through the AUX coolant drain if the coolant hoses to the AUX are not closed off.

⚠WARNING ***Contact with hot coolant can cause severe burns. Do not bleed hot, pressurized coolant from the cooling system.***

Chemical Cleaning: Rust and scale slow heat absorption and can block coolant flow. Clean the cooling system if rust and scale have collected on the engine water jacket or in the heat exchanger. Use a good cleaning compound and follow the tractor engine manufacturer's instructions.

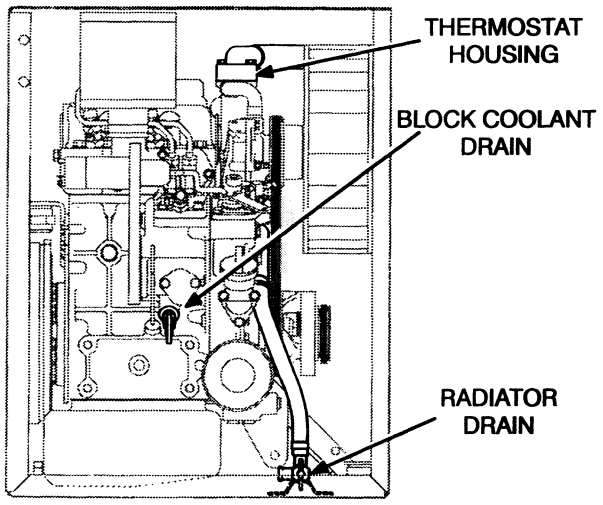


FIGURE 7-8. COOLING SYSTEM

Flushing: After cleaning, drain the system and fill with clean water. Run the unit for 10 minutes, then drain the system completely. Refill with the coolant mixture (refer to Filling the Cooling System).

⚠CAUTION ***Never pour hot water into a cold engine or cold water into a hot engine. Doing so can crack the head or the cylinder block. Do not operate the unit without water for even a few minutes.***

Clean the radiator and condenser fins inside the power unit and on the outside of the power unit.

Power Unit Engine Thermostat

If the engine overheats or does not reach and maintain a minimum operating temperature, remove and test the thermostat as follows:

1. Let the engine cool, then drain the cooling system.
2. Remove the capscrews and washers that secure the thermostat cover to the water pump housing.
3. Raise the thermostat cover with its radiator hose intact, and position it to one side.
4. Remove the thermostat cover gasket and thermostat.
5. Clean, inspect, and remove any gasket material from the thermostat cover and housing.
6. Attach a string to the thermostat and lower it into water that has been heated to at least 170°F (77°C): the thermostat should gradually open.

Replace the thermostat if it is broken, corroded, or if it sticks in the open or closed position. Use a new gasket when replacing the thermostat.

Refer to section six for information on the bypass thermostat in the power unit.

Hoses and Clamps

Replace hoses and clamps at the interval indicated in the Maintenance Schedule, or sooner if hoses are swollen, hardened or cracked.

⚠CAUTION ***Damage to the fan can occur if lower hose clamp interferes with fan rotation. Install lower heater hose clamp with tightening screw oriented to the bottom of the hose to provide clearance for the cooling fan.***

8. Wiring Diagrams

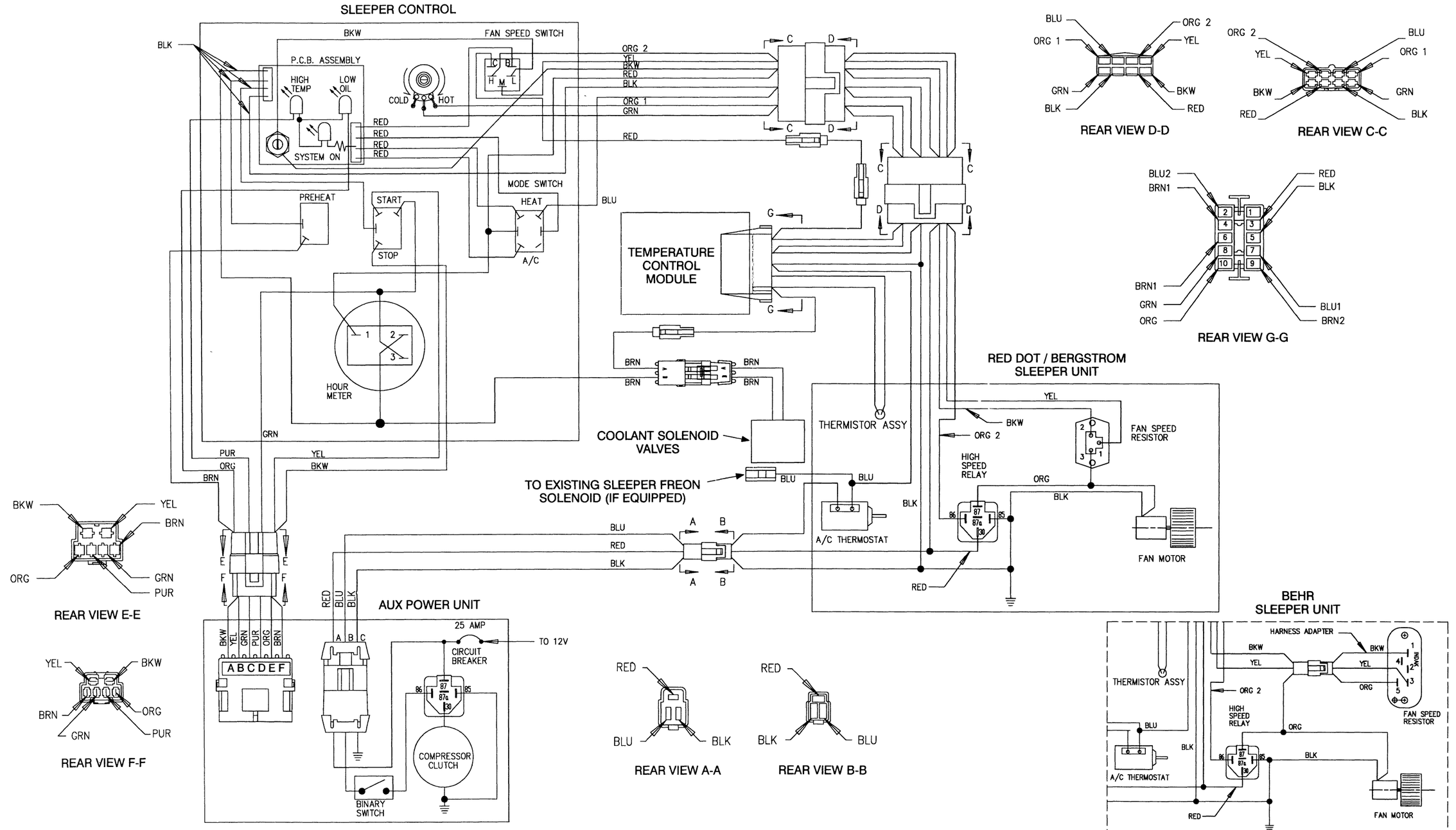


FIGURE 8-1. AUX SYSTEM WIRING DIAGRAM (SPEC A)

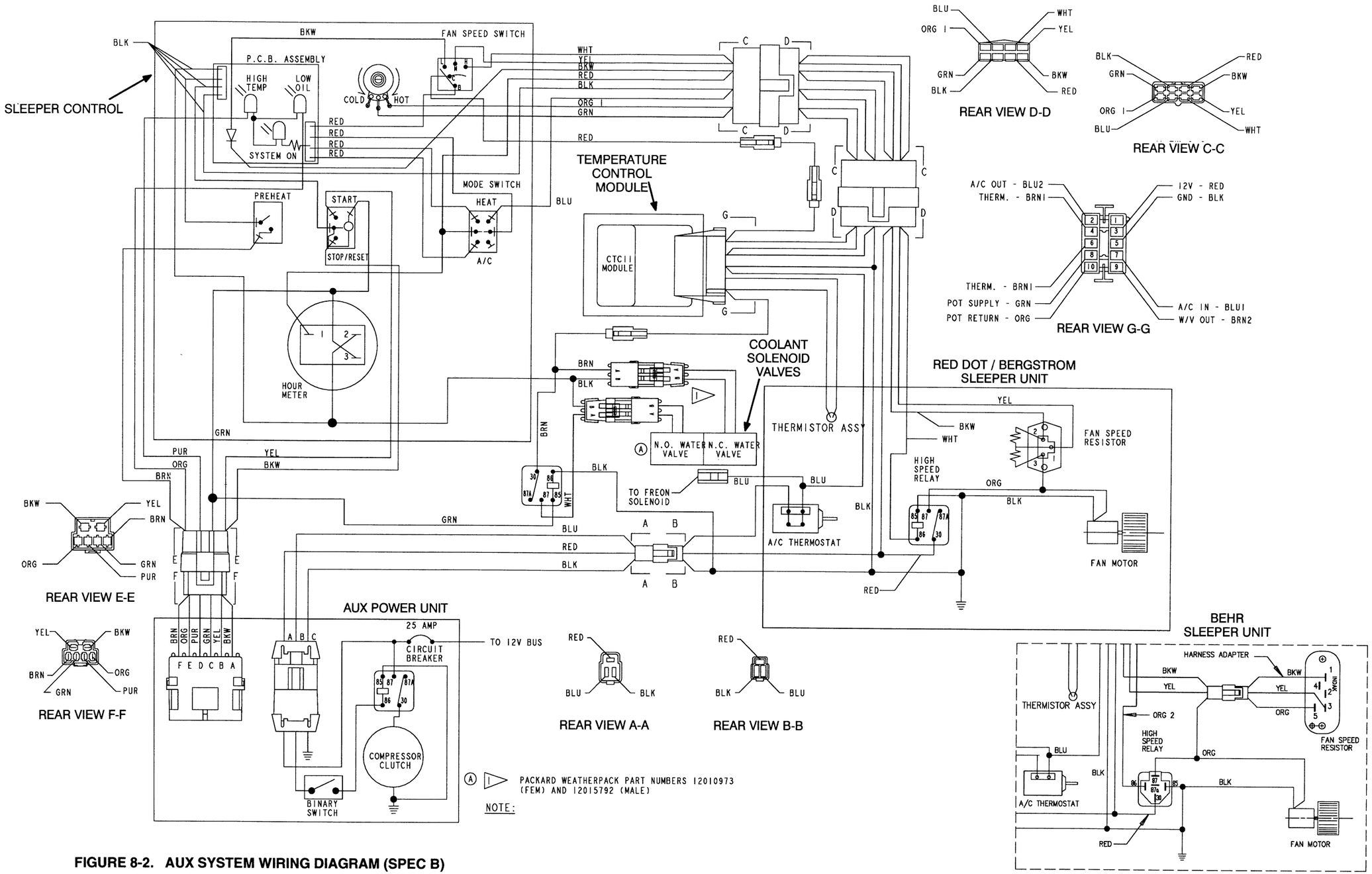
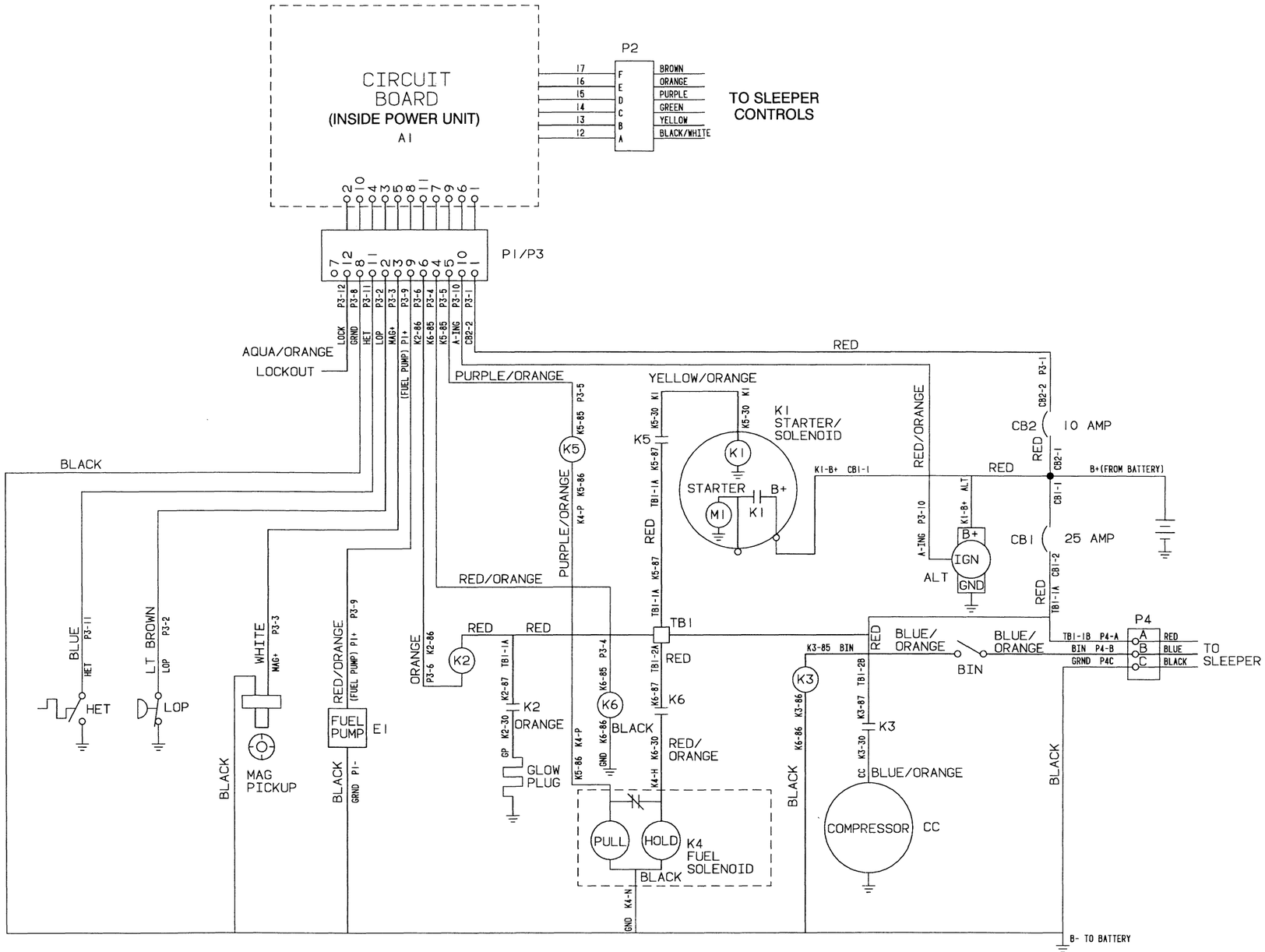


FIGURE 8-2. AUX SYSTEM WIRING DIAGRAM (SPEC B)



BIN	BINARY SWITCH
A1	CONTROL ASSY-ECOMAX (REF)
CB1,2	CIRCUIT BREAKER
LOP	SWITCH-LOW OIL PRESSURE
HET	SWITCH-HIGH ENGINE TEMPERATURE
MAG	MAGNETIC PICKUP
K2,3,5,6	RELAY
K1	STARTER/SOLENOID
K4	FUEL SOLENOID
E1	FUEL PUMP
ALT	ALTERNATOR
TB1	TERMINAL BLOCK
GP	GLOW PLUG
CC	COMPRESSOR (CLUTCH)
P1,2,3,4	CONNECTORS

FIGURE 8-3. POWER UNIT WIRING DIAGRAM (SPECS A AND B)

Appendix A. Filling Refrigerant and Cooling Systems

GENERAL

Perform each of the steps in this section in sequence. Some refrigerant will be installed prior to operating the power unit and filling the coolant system, this is done to protect the compressor.

Evacuating and charging the air conditioning system must be performed by a certified air conditioning service technician. Before starting, make sure that all the necessary equipment is available.

⚠WARNING ***Inhalation of refrigerant R-134a can induce anesthetic effects such as giddiness, weakness, dizziness, nausea and unconsciousness. It can cause asphyxiation by limiting available oxygen. In susceptible individuals, epinephrine-like compounds can result in fatal cardiac arrhythmia. Do not release refrigerant R-134a into the air. Use a recovery system to remove refrigerant from the system. Make sure that the shop area has fresh air ventilation.***

Perform a preliminary check on the power unit and the systems installed to this point.

NOTE: Early Spec A AUX power units were intended for R-12 refrigerant. Later Spec A units and Spec B units are intended for use with R-134a refrigerant. Know which refrigerant is correct for the unit before beginning the refilling procedure.

For additional troubleshooting information, consult Red Dot Heavy Duty Vehicle Air Conditioning and Heating Systems Manual (Onan p. n. 981-0515).

PRELIMINARY CHECKS

1. Check the oil level in the power unit engine. Remove and clean the oil level indicator. Fully insert the oil level indicator and then remove it to check oil level. If low, add oil very slowly until the Full mark is reached. Insert the oil level indicator securely to prevent oil leakage.
2. Make sure all of the electrical connections are made including the battery connection (described in section 11).
3. Make sure the fuel valve on the fuel filter is open and that the fuel system has been primed (described in section 12). Also make sure the fuel tank is adequately filled.
4. Check each of the coolant hose connections to make sure they are secure.
5. Check each of the refrigerant hose connections to make sure they are secure.

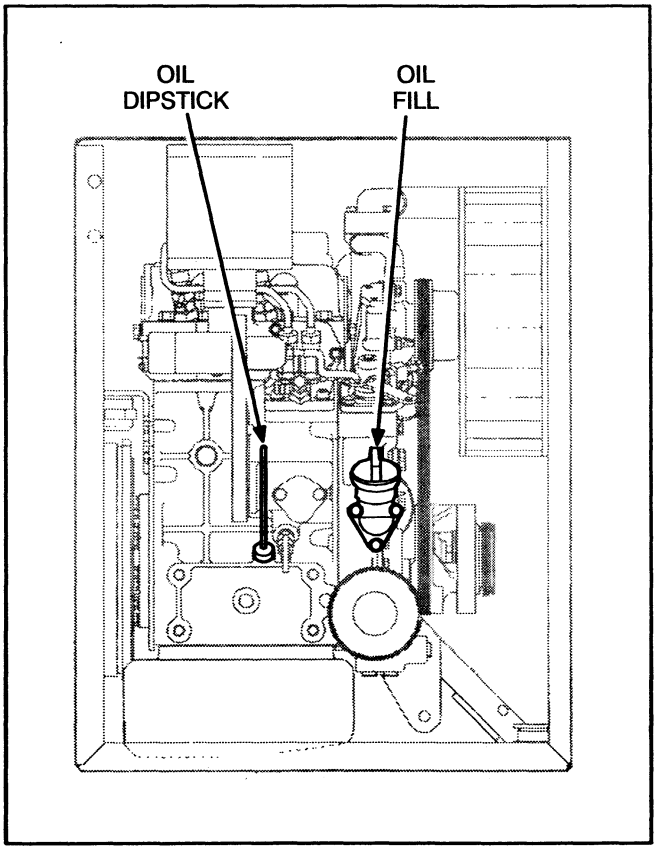


FIGURE A-1. OIL LEVEL CHECK

CABOVER INSTALLATION COMPRESSOR OIL REQUIREMENTS

Cabover installations use longer refrigerant lines that require more refrigerant and more compressor oil. Refer to Table A-1 to determine approximately how much additional compressor oil must be added to the system. Measure only the length of the number 10 hose to obtain oil requirements.

⚠ CAUTION ***Refrigerant R-134a uses a special lubricant, mixing lubricant intended for R-12 or other systems will cause equipment damage. Only use lubricant designed for use with refrigerant R-134a.***

TABLE A-1. ADDITIONAL COMPRESSOR OIL REQUIREMENTS FOR CABOVER INSTALLATIONS

#10 HOSE LENGTH IN FEET	ADDITIONAL OIL IN FLUID OUNCES (ml)
8	0 (0)
9	0.20 (5.92)
10	0.31 (9.18
11	0.41 (12.14)
12	0.51 (15.1)
13	0.61 (18.06)
14	0.72 (21.31)
15	0.82 (24.27)
16	0.92 (27.23)
17	1.03 (30.49)
18	1.13 (33.45)
19	1.23 (36.41)
20	1.34 (39.66)
21	1.44 (42.62)
22	1.54 (45.58)
23	1.64 (48.54)
24	1.75 (51.8)
25	1.85 (54.76)

Adding Compressor Oil

⚠ WARNING ***Opening the oil fill on the compressor when the system is charged can cause severe personal injury or death. Refrigerant and oil are released under pressure If a charged system is opened. Do not open the oil fill in a charged system. Evacuate the system per the instructions in the Air Conditioning Service Manual if the system is charged.***

Before operating the power unit or evacuating and charging the AC system, add compressor oil to the system as follows:

1. Measure the length of the larger #10 refrigerant hose from the power unit to the evaporator in the sleeper. (Do not include the length of the smaller #6 hose in this calculation.)
2. Refer to Table A-1 to determine the amount of oil to add to the system.
3. Remove the top cover from the power unit and locate the AC compressor. Carefully remove the oil fill cap (Figure A-2). Use a clean syringe to add the required amount of oil. Securely reinstall the oil fill cap.

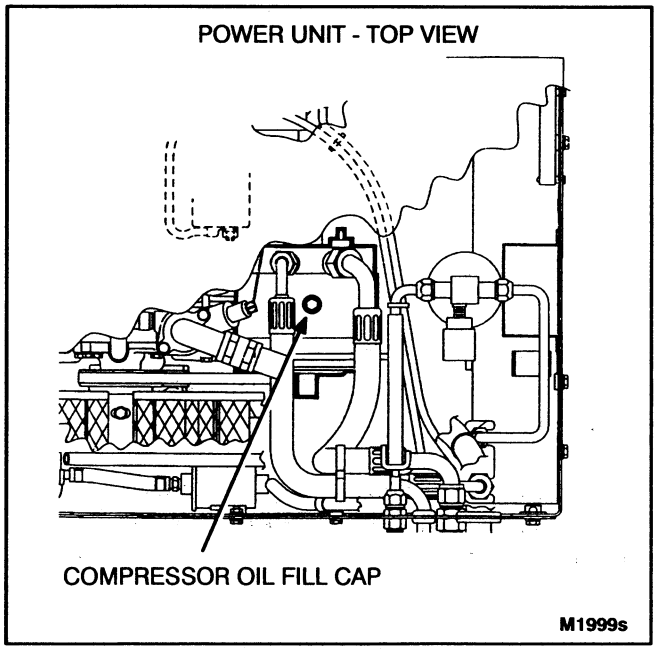


FIGURE A-2. COMPRESSOR OIL FILL

EVACUATING THE AC SYSTEM

Make sure that the AC hose fittings are secure at the evaporator and at the power unit. Attach a gauge set to the high pressure (HP) and low pressure (LP) sides of the system at the refrigerant quick connect access valves next to the power unit. Attach a vacuum pump to the center hose of the gauge set. Figure A-3 shows the gauge set and vacuum pump connected to the system.

Note: It is very important to run the vacuum pump long enough to remove the moisture from the system.

Open the fitting on the pump housing to operate the vacuum pump no load. Start the pump and open the hand valves on the manifold, then close the no load fitting on the pump housing. Run the pump for five minutes and then close the hand valves and shut off the pump.

Observe the gauge readings for a few minutes. If the gauge needles move up, it means there is a leak, air and moisture are being sucked into the system by the vacuum. Check all of the fittings and tighten all connections that may be loose, re-start the pump and open the hand valves on the gauges again. If a leak was indicated and repaired, run the vacuum pump for five more minutes and repeat the leak check.

Run the vacuum pump for an hour to remove the moisture from the system. The moisture must turn to gas before the pump can pull it out. It takes time for the moisture to boil away and be drawn out of the system; therefore, it is important to allow enough time to evacuate the system.

After one hour, observe the gauge readings, the LP side should read a minus (-) 29 inches Hg and the HP side should read less than zero PSI. (Reading may vary ± 1 depending on the accuracy of the gauge set. Altitude may cause the reading to vary; -29 inches may not be possible in high altitudes.) Close the hand valves and proceed to Charging the Air Conditioning System section.

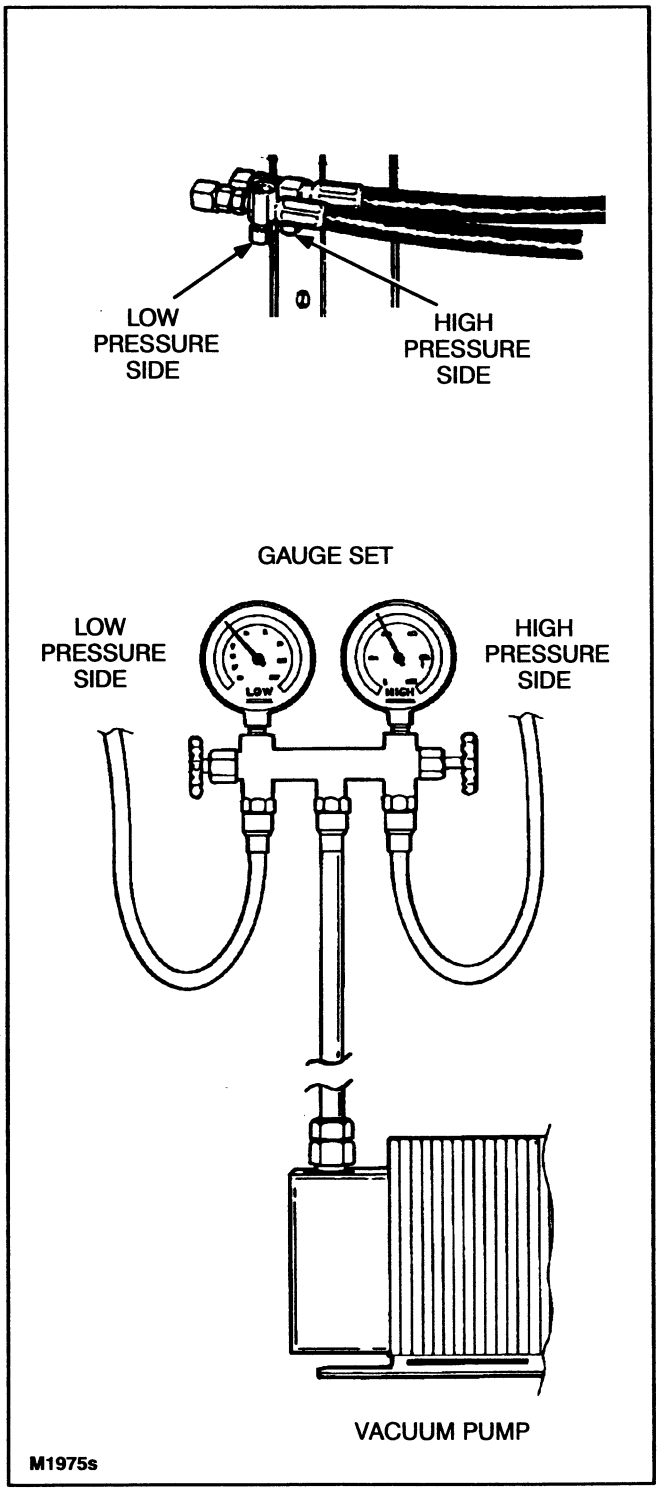


FIGURE A-3. GAUGE AND VACUUM PUMP CONNECTIONS

CHARGING THE AIR CONDITIONING SYSTEM

After the system has been evacuated, the AC system can be charged. Fill the system part way with liquid refrigerant (R-134a or R-12 as appropriate) through the HP side. The rest of the charge will be added as vapor through the LP side after the coolant system is filled. Adding refrigerant as a liquid can damage the compressor if not done correctly. Follow the procedures carefully and observe all safety precautions.

A normal installation of approximately eight feet of refrigerant hose will use approximately two pounds and six ounces of R-134a or R-12 refrigerant. With a charging meter or station you can select the exact amount of refrigerant required. The alternative is to use a refrigerant container and a scale to measure refrigerant charge weight.

CHARGING THE HIGH PRESSURE SIDE WITH LIQUID R-134a OR R-12

⚠ CAUTION ***Improper system filling can cause equipment damage. Do not operate the power unit engine. No more than one pound of refrigerant R-134a or R-12 charge should be added at this time.***

⚠ WARNING ***Refrigerant can cause frostbite and severe eye damage. If inhaled, Refrigerant can cause respiratory problems that can lead to death. Wear protective clothing including gloves and goggles when working with refrigerant. Also be careful not to discharge refrigerant into the air.***

Begin by connecting the center service hose from the gauge set to the refrigerant container dispensing valve. Always purge the hose of any air using refrigerant gas pressure from the container.

R-134a or R-12 liquid is added through the refrigerant access valve on the HP side of system.Turn the refrigerant container upside down and open the refrigerant dispensing valve and HP side hand valve on the gauge set. Liquid refrigerant will flow into the system. Figure A-4 illustrates how the manifold gauge set is connected when adding liquid refrigerant at the compressor (or accumulator).

When you have added approximately one pound of R-134a or R-12 liquid, close the refrigerant supply. Proceed to the Filling the Coolant System section.

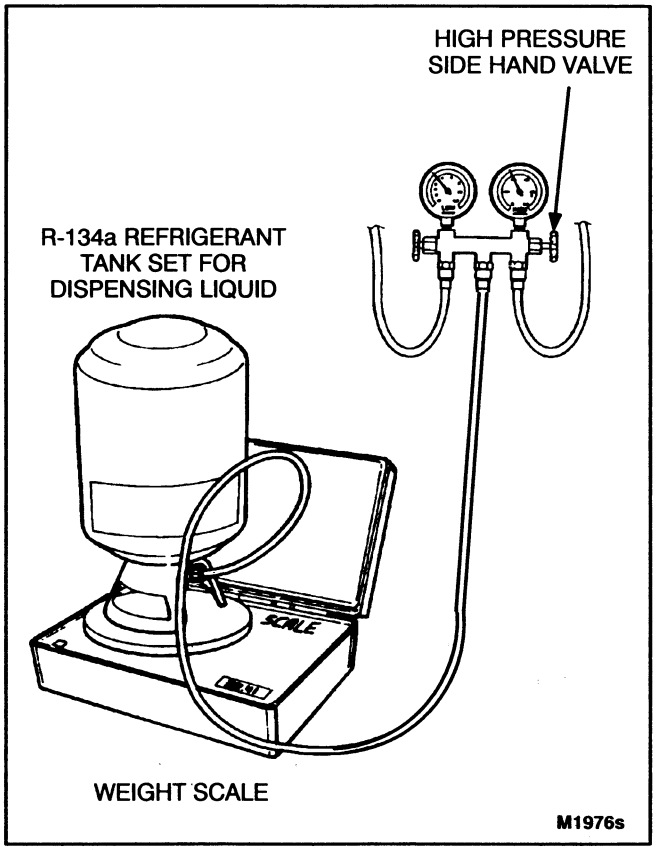


FIGURE A-4. FILLING THE HIGH PRESSURE SIDE WITH R134-a LIQUID

FILLING THE COOLANT SYSTEM

Cabover and Standard Installations:

The coolant system will be filled through the main truck engine radiator or expansion tank. Refer to the main truck engine Operator's manual for antifreeze type, mixture and engine coolant filling procedure.

A special access valve is located on top of the power unit radiator and on some standalone sleeper heaters to bleed air from the system (Figures A-5 and A-6).

⚠WARNING ***Accidentally starting the power unit while working on it can cause severe personal injury or death. Disconnect the 3-pin connector inside the power unit any time the top cover is removed.***

1. Remove the power unit top cover. Disconnect the 3-pin connector inside the power unit to prevent accidental starting during this procedure.
2. If the coolant was not drained from the main truck engine, proceed to step three.
   If the coolant was drained from the main truck engine, close all coolant drain valves. Close coolant hose supply and return shutoff valves (keep cutoff clamps on hoses, if used). Fill the main truck engine coolant system according to the main truck engine Operator's manual.
3. Check all hose fittings to make sure they are tightly secured with a hose clamps. If shutoff valves are used to isolate the power unit plumbing from the main engine, open the supply valve. Keep the return valve closed.
4. Start the main truck engine and run it at a minimum speed of 1000 rpm. **NOTE: In some applications it may be necessary to increase engine speed to high idle (governed speed) to purge the heater core of air.**
5. Bleed the power unit engine by loosening the hose clamp at the thermostat housing. Loosen the hose from the fitting just far enough to bleed the system. Resecure the hose clamp.

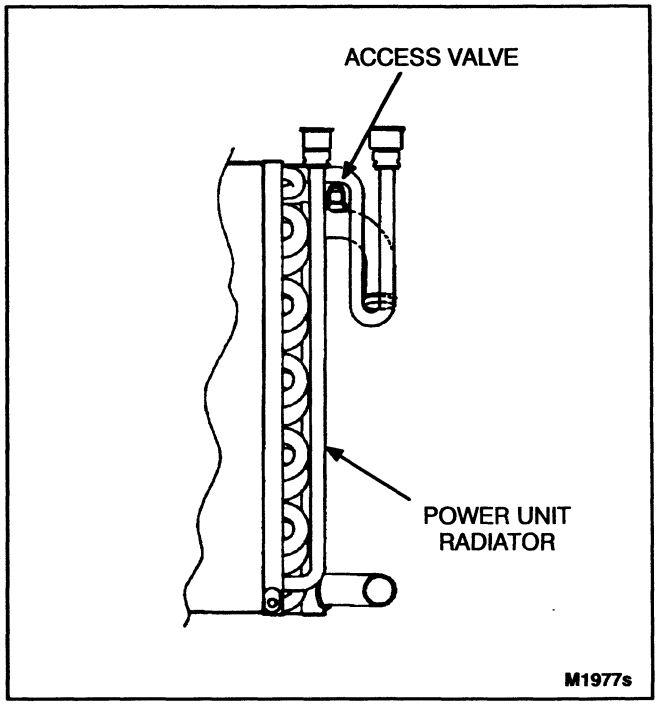


FIGURE A-5. BLEEDING THE POWER UNIT RADIATOR

6. Remove the cap from the access valve on the top of the power unit radiator (located in the top right hand corner of the power unit). A 14 mm flexible socket with adhesive tape can be used to remove and install the valve cap. Depress the valve pin with a screw driver to bleed the air from the radiator. Reinstall the valve cap.
7. Reconnect the 3-pin connector inside the power unit and install the power unit top cover.
8. Open the main engine coolant return valve, if equipped. Add coolant to the main coolant system. Lower the cab on cabover models.
9. Put the sleeper Temp control to the hottest setting and cycle the Heat/Off/AC switch between the Heat and Off position or until the heater blows warm air.
10. Refer to the Power Unit Starting Procedure section for starting instructions and important safety precautions. Check to make sure the covers are installed on the power unit. Start the auxiliary power unit.

11. After the Power unit has run for five minutes, cycle the Heat/Off/AC switch between the Heat and Off position for three one minute cycles.
12. Turn off the main truck engine and monitor the power unit operation. If the power unit shuts down by itself, the most likely cause is air trapped in the system. If this happens proceed to step 13 and then repeat this procedure.
13. Allow the cooling system time to cool down and fill the coolant system.

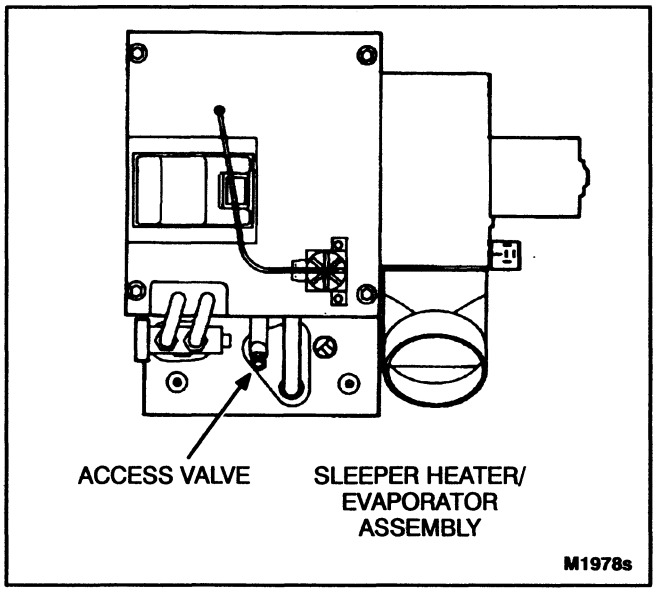


FIGURE A-6. BLEEDING THE SLEEPER HEATER

HEATING SYSTEM PERFORMANCE CHECK

1. Put the Heat/Off/AC switch in the Heat position. Set the Temp control to the hottest setting and set the Fan switch to High.
2. Allow the power unit to operate for 5 more minutes. Measure the heat output from the sleeper duct. The temperature at the air outlet should be 120°F (49°C) or more.
3. If no heat is produced, the solenoid valve assembly may not be operating or the coolant level may not be adequate. If heat output is low, the coolant level may be low or the heater hoses may have a restriction.
4. If service is required, press the sleeper control Start/Stop switch to Stop. Disconnect the battery negative (-) cable(s) from the battery pack, to prevent accidental start-up.
5. Allow the coolant system time to cool down. Check for coolant leaks and repair any leaks immediately. Check the main truck coolant level and add coolant, if necessary.

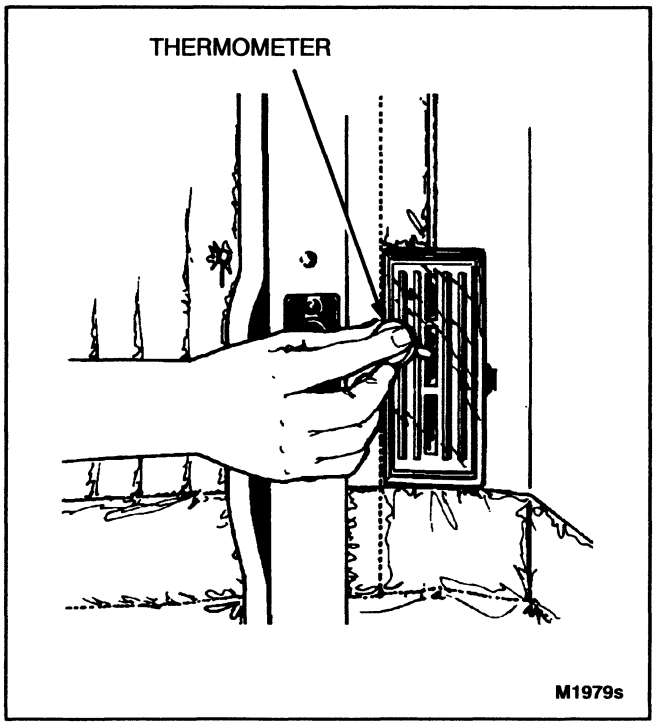


FIGURE A-7. MEASURE HEAT OUTPUT FROM THE SLEEPER DUCT

⚠WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and Sleepiness***
- ***Throbbing in Temples***
- ***Muscular Twitching***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Be sure to park in open areas where exhaust gases can not accumulate and enter the sleeper or cab. A carbon monoxide detector with an audible alarm is recommended. Protection against carbon monoxide inhalation also includes proper exhaust system installation and visual and audible inspection of the complete exhaust system at the start of each power unit operation.

AUX-1

POWER UNIT STARTING PROCEDURE

⚠WARNING ***Contact with hot parts and moving parts can cause severe personal injury. Do not operate the power unit with the access cover or top cover removed.***

⚠WARNING ***Do not use ether or any starting fluid as a starting aid. Use of ether or starting fluid can cause an explosion resulting in severe personal injury and equipment damage.***

⚠CAUTION ***Operating the power unit with the access cover removed will cause overheating, engine shutdown and can result in reduced engine life. Make certain that the access cover is in place during operation.***

1. Put the Heat/Off/AC switch in the center Off position. Press the Start/Stop switch to Start. Release the switch when the engine starts. The indicator light on the switch lights up when the engine is running.

   For stating at temperatures below 50°F (10° C) refer to Operator's manual for preheat use.

   ⚠CAUTION ***Excessive cranking can overheat the starter, damaging it. Do not engage the starter longer than 10 seconds. Wait 30 seconds between starting attempts to allow the starter to cool down.***

2. If the engine does not start after cranking for 10 seconds, release the switch. Wait for 30 seconds, then press the Start switch again.

3. If the engine still does not start, wait for 30 seconds, hold the Preheat switch and the Start switch in at the same time.

4. If the engine does not start on the third try:
   - Check the fuel supply
   - Make sure the fuel system has been primed
   - Check the oil level

   If the engine stops running shortly after starting, check the oil, fuel and coolant level. Make sure that the access cover is securely installed and see that nothing is blocking the air inlet. See the *Troubleshooting* section in the Operator's manual for additional checks.

Proceed to the System Checks section.

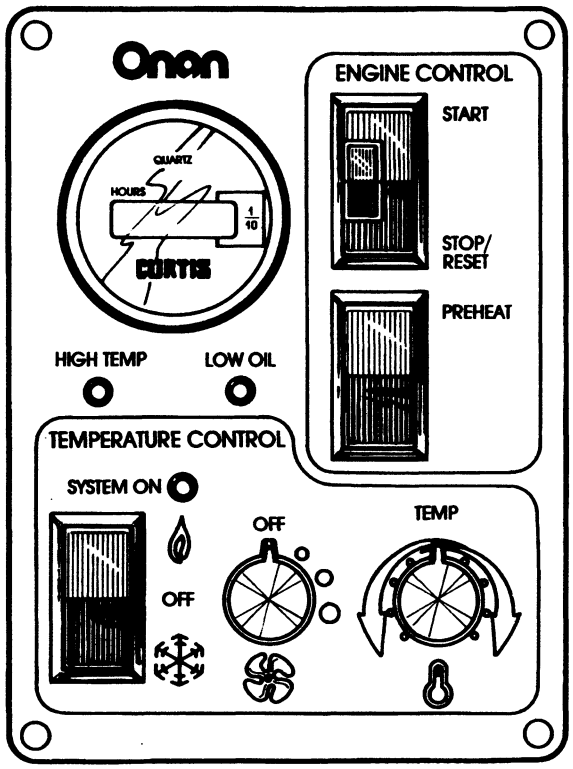


FIGURE A-8. AUX CONTROL PANEL

SYSTEM CHECKS

1. Check for fuel leaks. If any leaks are found, stop the power unit immediately and repair the leak.

   ⚠WARNING ***Fuel presents the hazard of explosion or fire that can result in severe personal injury or death. If a fuel leak is found, stop the power unit and have the leak repaired immediately.***

   ⚠WARNING ***A hot power unit can cause severe burns. Always allow the power unit to cool down before performing service.***

2. Check for coolant leaks. If any leaks are found, stop the power unit immediately and repair the leak.
3. Examine the exhaust system for leaks. If any leaks are found, stop the power unit and repair the exhaust system.

   ⚠WARNING ***Exhaust gas presents the hazard of severe personal injury or death. Inspect the exhaust system audibly and visually. Do not operate the power unit if it leaks or is excessively noisy. Repair any exhaust problems.***

4. If service is required, press the Start/Stop switch to Stop. Disconnect the battery negative (-) cable from the battery pack, to prevent accidental start-up.

   ⚠WARNING ***Accidental starting of the power unit during maintenance procedures can cause severe personal injury or death. Disconnect the power unit starting battery, negative (-) cable first, before performing service.***

5. If no problems are found, proceed to Charging the LP Side with R134-a or R-12 Gas.

CHARGING THE LOW PRESSURE SIDE WITH R-134a GAS OR R-12 GAS

⚠WARNING ***Refrigerant can cause frostbite and severe eye damage and when inhaled, it can cause respiratory problems that can lead to death. Wear protective clothing including gloves and goggles. Also be careful not to discharge refrigerant into the air.***

Start the power unit engine and set the Heat/Off/AC switch to AC. Set the Fan Speed switch to High.

Place refrigerant container in an upright position so no liquid is drawn into the system. Refrigerant vapor is added through the refrigerant access valve on the LP (suction) side of system. Open the dispensing valve and then the LP side hand valve on the manifold. Figure A-9 illustrates system charging with refrigerant gas entering the compressor on the LP (suction) side of the system.

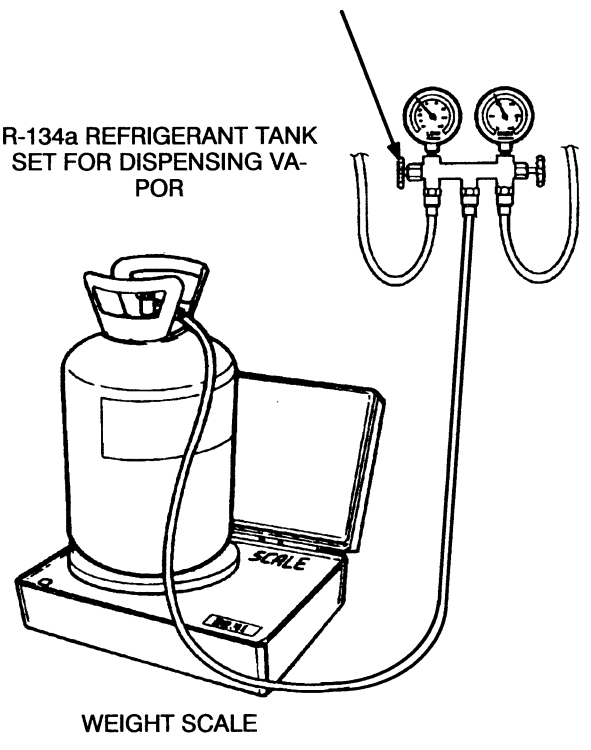


FIGURE A-9. CHARGING THE LOW PRESSURE SIDE WITH R134-a OR R-12 GAS

Cabover Refrigerant Requirements

Cabover installations use longer refrigerant lines that require more refrigerant. Refer to Table A-2 to determine approximately how much refrigerant will be required. Measure only the length of the number 10 hose to obtain oil requirements.

TABLE A-2. REFRIGERANT REQUIREMENTS FOR CABOVER INSTALLATIONS

#10 HOSE LENGTH IN FEET	TOTAL REFRIGERANT, WEIGHT IN OUNCES (kg)
8	38 (1.06)
9	38.82 (1.09)
10	39.65 (1.11)
11	40.47 (1.13)
12	41.29 (1.16)
13	42.12 (1.18)
14	42.94 (1.2)
15	43.76 (1.23)
16	44.59 (1.25)
17	45.41 (1.27)
18	46.24 (1.29)
19	47.06 (1.32)
20	47.88 (1.34)
21	48.71 (1.36)
22	49.53 (1.39)
23	50.35 (1.41)
24	51.18 (1.43)
25	52.00 (1.46)

Gas Charging Instructions

When you are close to adding two pounds and six ounces of refrigerant (or approximate total weight from Table A-2), check the pressure gauge, air duct outlet temperature and ambient temperature. When readings compare with readings in Table A-3 (R134-a) or Table A-4 (R12), close the dispensing valve on the refrigerant container. Close the hand valve on the gage set and check the gauge readings. The HP gauge should read approximately ten times the LP gauge reading.

TABLE A-3. R134-a TEMPERATURE/PRESSURE CHART

AMBIENT AIR TEMPERATURE	AIR INTO THE EVAPORATOR	AIR OUT OF THE EVAPORATOR	MAXIMUM HIGH SIDE PRESSURE	MAXIMUM LOW SIDE PRESSURE
110°F (43°C)	70°F (21°C)	45-55°F (7-13°C)	250 psi (1724 kPa)	24 psi (165 kPa)
100°F (38°C)	70°F (21°C)	45-55°F (7-13°C)	220 psi (1517 kPa)	22 psi (152 kPa)
90°F (32°C)	70°F (21°C)	45-55°F (7-13°C)	200 psi (1379 kPa)	20 psi (138 kPa)
80°F (27°C)	70°F (21°C)	45-55°F (7-13°C)	180 psi (1241 kPa)	18 psi (124 kPa)

TABLE A-4. R12 TEMPERATURE/PRESSURE CHART

AMBIENT AIR TEMPERATURE	AIR INTO THE EVAPORATOR	AIR OUT OF THE EVAPORATOR	MAXIMUM HIGH SIDE PRESSURE	MAXIMUM LOW SIDE PRESSURE
110°F (43°C)	70°F (21°C)	45-55°F (7-13°C)	240 psi (1756 kPa)	24 psi (267 kPa)
100°F (38°C)	70°F (21°C)	45-55°F (7-13°C)	210 psi (1549 kPa)	22 psi (253 kPa)
90°F (32°C)	70°F (21°C)	45-55°F (7-13°C)	190 psi (1411 kPa)	20 psi (239 kPa)
80°F (27°C)	70°F (21°C)	45-55°F (7-13°C)	170 psi (1273 kPa)	18 psi (225 kPa)

AC SYSTEM PERFORMANCE CHECK

Monitor the temperature of the air outlet in the sleeper. Close the doors to the sleeper and allow the power unit to run for 20 minutes. Check the air outlet temperature. The temperature at the air outlet should be 45°F to 55°F (7.2°C to 10°C) with an ambient air of 65°F to 75°F (18°C to 24°C).

If the air outlet temperature is not satisfactory, check for pinched or kinked AC hose. Also check for refrigerant leaks with a leak detector. Make sure that heated coolant is not flowing through the heater core.

Set the Heat/Off/AC switch to the Off position and turn the Fan Speed switch Off. Turn off the AUX power unit engine. Check for refrigerant leaks with a leak detector. If the system checks OK, remove the manifold gage set hose fittings. Remove the manifold hose fittings quickly and carefully. Use a glove or shop towel to protect your hand and wear

goggles. Replace the protective caps on the refrigerant access valves.

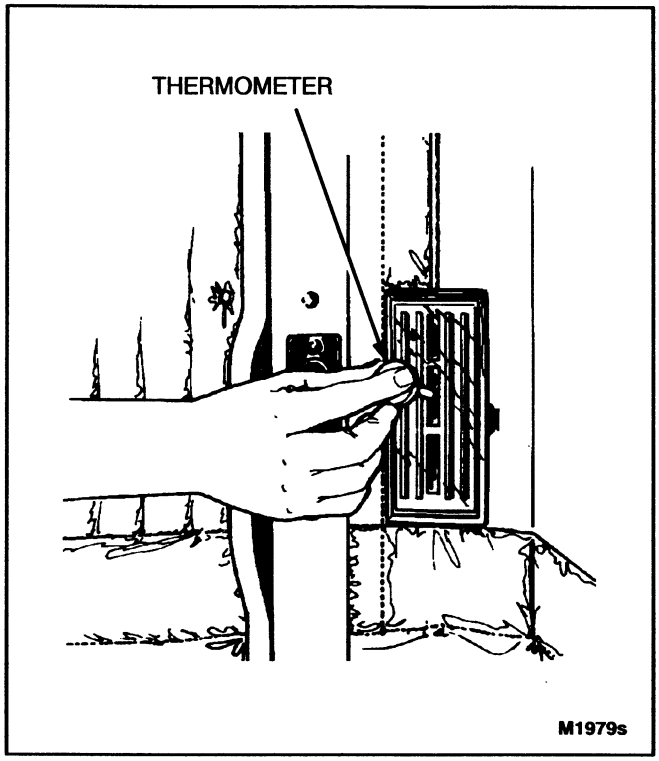


FIGURE A-10. MEASURE COOLING OUTPUT FROM SLEEPER DUCT

Onan Corporation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
1-800-888-ONAN
612-574-5000 International Use
Telex: 275477
Fax: 612-574-8087