INSTALLATION AND SERVICE MANUAL
PROHEAT X45

Rev. H

CONTENTS

A. SAFETY

Throughout this manual, you will see notes labeled **DANGER**, **WARNING**, **CAUTION** and **NOTICE** to alert you to special instructions or precautions concerning a particular procedure that would be hazardous if performed incorrectly or carelessly.

Observe them carefully!

These safety alerts alone cannot eliminate all hazards. Strict compliance with these special instructions and common sense are major accident prevention measures.

⚠ DANGER

Immediate hazards that will result in severe injury or death.

⚠ WARNING

Hazards or unsafe practices that could result in severe personal injury or death.

⚠ CAUTION

Hazards or unsafe practices that could result in minor injury or product or property damage.

NOTICE

Information that is important to proper installation or maintenance, but is not hazard-related.

SAFETY CONSIDERATIONS

⚠ WARNING

Exhaust

Inhalation of exhaust gas (containing carbon monoxide) may cause severe personal injury and/or death. Anyone suspected of suffering from CO inhalation should be removed from the hazardous area and given medical assistance immediately.

⚠ WARNING

Explosion Hazard

Do not operate heater where combustible fumes or airborne particles, such as sawdust, are present.

⚠ WARNING

Fuel

Exercise extreme caution when working near fuel or fuel-filled equipment. Do not operate heater during fueling operations. In addition, do not smoke or handle open flame equipment, such as a blowtorch, around fuel.

⚠ WARNING

Fire Hazard

Do not place any flammable items around the heater and exhaust pipe.

⚠ WARNING

Batteries

Wear hand and eye protection when working near batteries. Do not smoke or use open flames near batteries.

⚠ WARNING

Electrical

Electric shock can cause severe personal injury, burns, and death. Before working on any unit, disconnect the batteries. Use only approved materials and methods when working on the electrical system and follow local electrical codes. Never work with electricity in wet conditions or when you are feeling fatigued.

⚠ WARNING

Poisons/Toxins

Fuel and coolant are toxic and in some cases, carcinogenic. Wear eye and hand protection at all times. Remove contaminated clothing immediately and wash contaminated skin. Do not breathe in vapors.

⚠ WARNING

Moving/Hot Parts

Moving/hot parts can cause severe injury and or death. Before working on any unit, shut it off. Do not operate any unit until protective covers have been replaced. Always ensure bolts and clamps are correctly torqued and secured. Inspect mechanical components periodically for damage and corrosion.

⚠ WARNING

Coolant

Never remove the filler cap when the engine is hot – escaping steam or scalding water could cause serious personal injury. The coolant level in the expansion tank should be checked at least weekly (more frequently in high mileage or arduous conditions). Always check the level *when the system is cold*. Unscrew the filler cap slowly, allowing the pressure to escape before removing completely. Never run the engine without coolant.

Prevent anti-freeze coming in contact with the skin or eyes. If this occurs, rinse immediately with plenty of water. Anti-freeze will damage painted surfaces.

Never top-up with salt water. Even when travelling in territories where the water supply contains salt, always ensure you carry a supply of fresh (rain or distilled) water.

⚠ DANGER

California Proposition 65 Warning

Do not operate heater in garages or in other closed or unventilated areas.

Diesel exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Electrical components in this product may contain lead, a chemical known to the State of California to cause cancer and birth defects and other reproductive harm.

B. INTRODUCTION

PROHEAT Model X45

This manual is provided to assist an authorized PROHEAT dealer to install and service a PROHEAT heater. Although trucks have been used in the examples, applications for PROHEAT are by no means limited to trucks. PROHEAT heaters are designed to be used on any diesel equipped vehicle including: trucks, buses (school, transit and coach), construction equipment, off road equipment, military equipment and cargo.

PROHEAT heaters are used in the following applications:

(1) Engine Block Heat – PROHEAT will preheat an engine block to ensure reliable starting in cold weather. At the same time it may be used throughout the year to reduce the wear associated with cold starts.

(2) Cab or Sleeper Heat (engine off) – PROHEAT will supply heat to the cab or sleeper. Drivers can sleep in comfort not only in the cold of winter but also in the spring and fall when the weather is miserable. Substantial savings through reduced fuel consumption and engine wear can be obtained by not idling the engine.

(3) Supplemental Heat (engine running) – as the efficiency of modern diesel engines are improved there is no longer adequate reject heat available to heat the vehicle's interior. This is particularly true for buses. PROHEAT can be used while the vehicle is operating to provide supplemental heat for the interior.

(4) Cargo Heat – PROHEAT can be used to provide heat to protect valuable cargo such as produce or beverages from damage due to freezing.

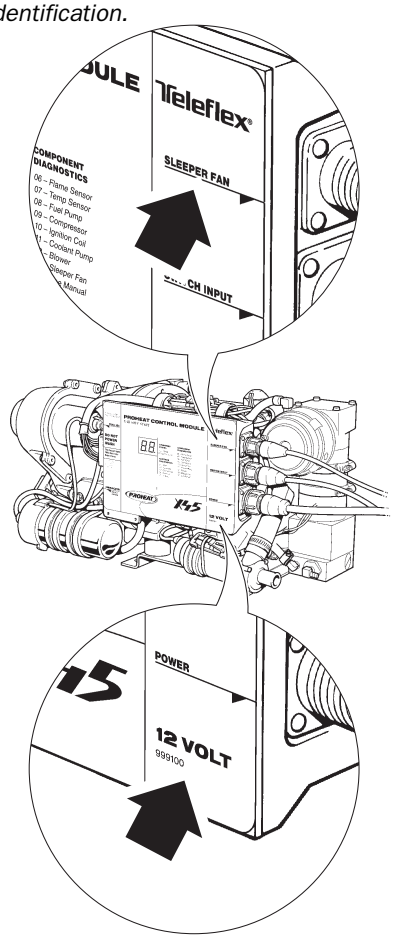
(5) Marine – Marine applications typically involve the engineering and installation of a complete hot-water heating system of which PROHEAT is only one component. Proheat recommends that only an expert in marine hot-water heating systems install a PROHEAT on a boat. It is the installer's responsibility to ensure that the installation complies with all applicable regulations.

C. MODEL DESCRIPTIONS

This manual covers all models of PROHEAT X45. Please refer to the X45 Parts Book at www.proheat.com for detailed part descriptions and part numbers. Included in the parts book are optional features such as a timer, sleeper fan control kit, impact switch (for school bus applications) and associated installation and maintenance tools.

The following information describes the three general characteristics of X45 models covered in this manual: voltage, enclosure and Proheat Control Module (PCM) options.

Sleeper Fan Output or Auxiliary Input Identification.



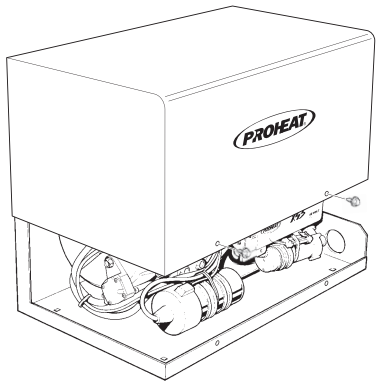
Voltage Identification.

PROHEAT CONTROL MODULE (PCM): SLEEPER FAN OUTPUT OR AUXILIARY INPUT

The PCM comes in either a sleeper fan output or auxiliary input model. The sleeper fan model is limited to a 3 amp output and is generally installed on trucks that require sleeper fan power (it is only available on 12 V models). The Auxiliary Input model uses two special input pins that allow for a Preheat Mode and Supplemental Mode. This operation is typically used for transit and coach installation. Refer to page 4-2 for more information.

VOLTAGE CONFIGURATION: 12 V OR 24 V

The X45 is available in either a 12 V or 24 V models.



ENCLOSURE

An optional enclosure provides environmental protection.

1.0 TECHNICAL SPECIFICATIONS

	X45 12V	X45 24V
RATING	45,000 BTU (13 kW)	
SYSTEM VOLTAGE Nominal Voltage Range	10 –15 VDC	20 – 30 VDC
CURRENT DRAW	7.5 Amps	3.75 Amps
FUEL CONSUMPTION (Average to Maximum)	0.1 – 0.45 gal/hr. (0.4 – 1.7 L/hr.)	
COOLANT FLOW	8.0 gal/min. (30 L/min.)	
COOLANT TEMPERATURE (at Heater)	150°F to 185°F (65°C to 85°C)	
OPERATING TEMPERATURE RANGE	-40°F to +122°F (-40°C to +50°C)	
IGNITION TYPE	Electronic Spark Ignition	
HEAT EXCHANGER CAPACITY	1 quart (0.95 L)	
WEIGHT Heater ONLY	40 lbs (18 Kg)	
WEIGHT Heater with Enclosure	55 lbs (25 Kg)	
DIMENSIONS – HEATER (L x W x H)	18.9 x 11.2 x 10.6 inches (520 x 320 x 280 mm)	
DIMENSIONS – ENCLOSURE (L x W x H)	20.2 x 12.3 x 10.5 inches (513 x 313 x 267 mm)	
WARRANTY	Two years parts and labor	

⚠ DANGER

DO NOT use gasoline.

FUEL TYPES	
COMPATIBLE	Diesel (ULSD, #1, #2, Arctic), JP8, Jet A1 Bio Fuels – Contact Proheat www.proheat.com

SYSTEM OUTPUTS	
HOUR METER (AUXILIARY OUTPUT)	Same as System Voltage Maximum 1 Amp draw (over-load shut-off protection) High-side switched
SWITCH/TIMER POWER	Same as System Voltage Maximum 1 Amp draw (over-load shut-off protection) High-side switched
SLEEPER FAN (Certain Models Only)	Same as System Voltage Maximum 3 Amp draw (over-load shut-off protection) High-side switched
INDICATOR LIGHT	Same as System Voltage Maximum 1 Amp draw (over-load shut-off protection) High-side switched

SYSTEM INPUTS	
SWITCH	10 – 15 VDC (12V X45) I 20 – 30 VDC (24V X45) Standard Run Mode Preheat Run Mode (Certain Models Only) Supplemental (Certain Models Only)
POWER	12 VDC or 24 VDC

1.1 PHYSICAL – X45

1.1.1 X45 HEATER

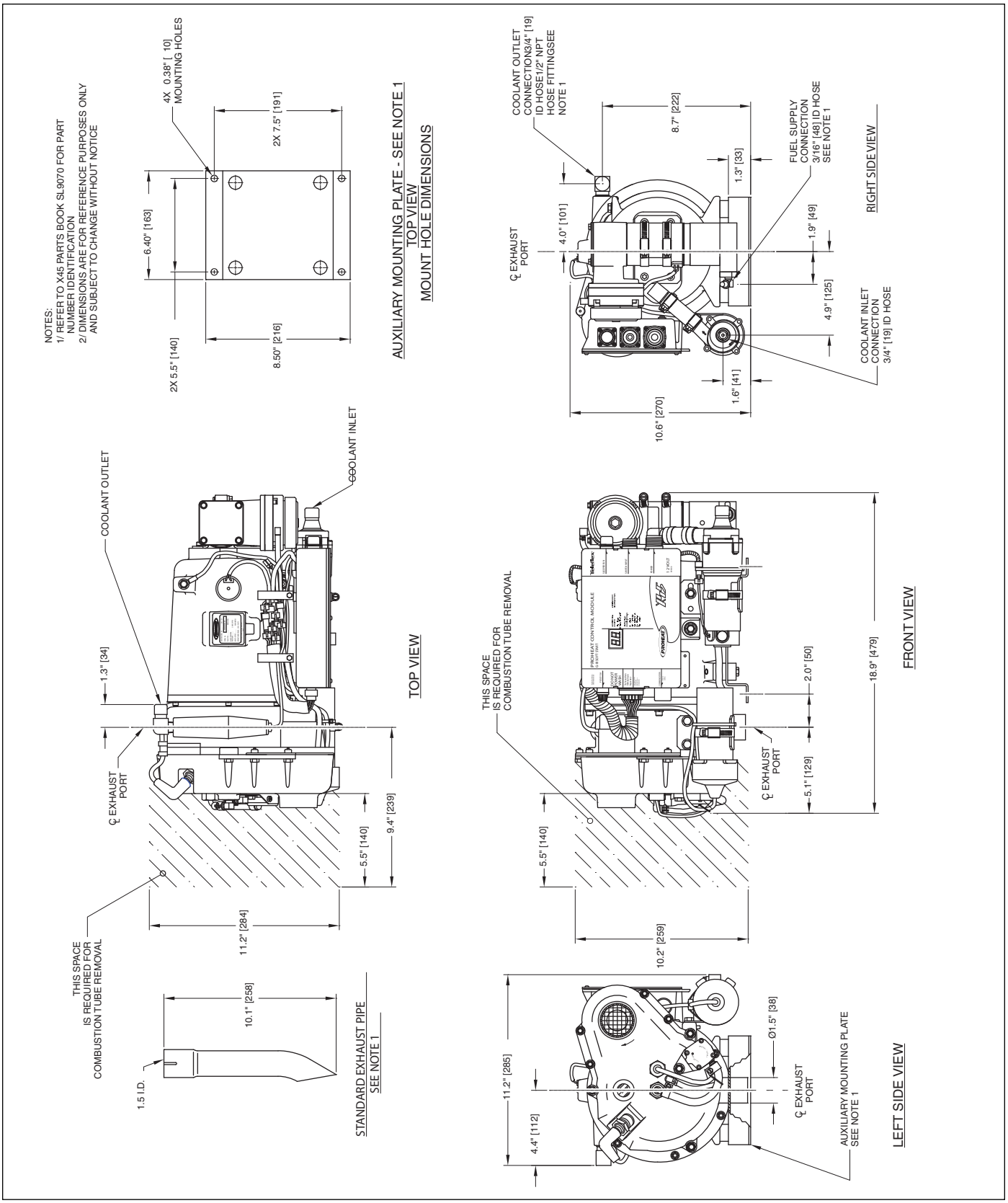


Figure 1-1 Heater Dimensions – X45

1.1.2 X45 WITH ENCLOSURE

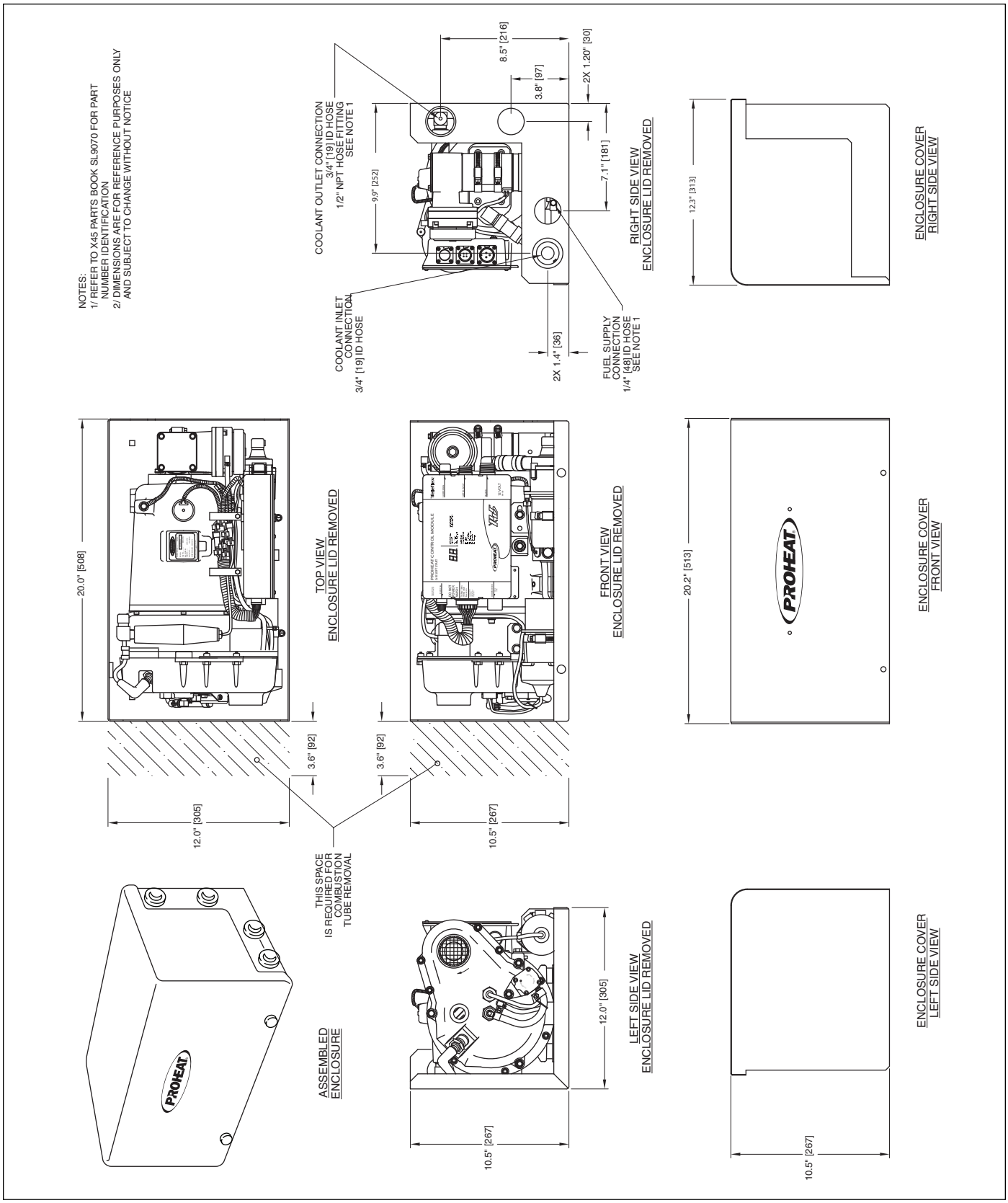


Figure 1-2 Heater Dimensions including Enclosure – X45

1.2 ELECTRICAL – X45

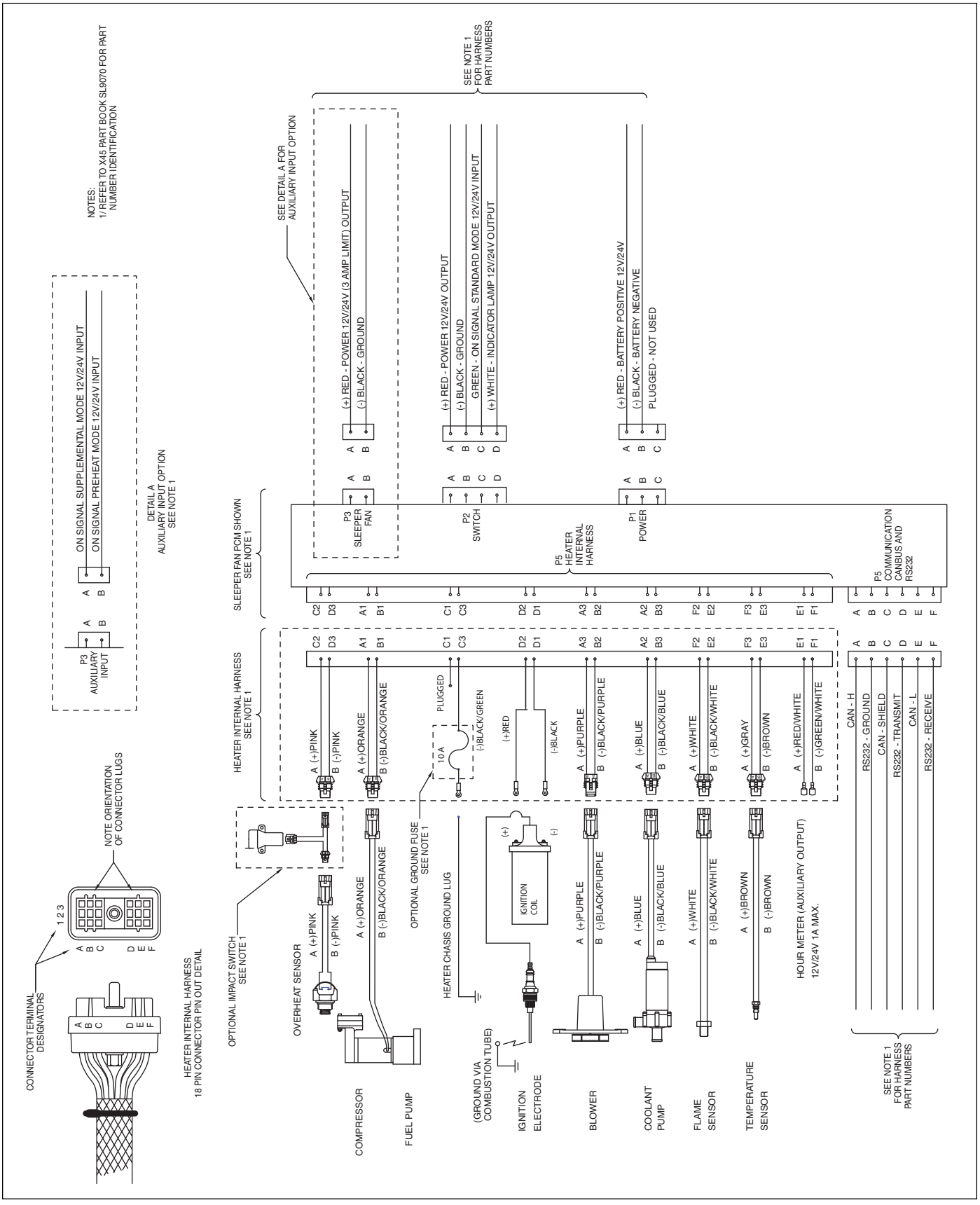


Figure 1-3 Wiring Diagram – X45

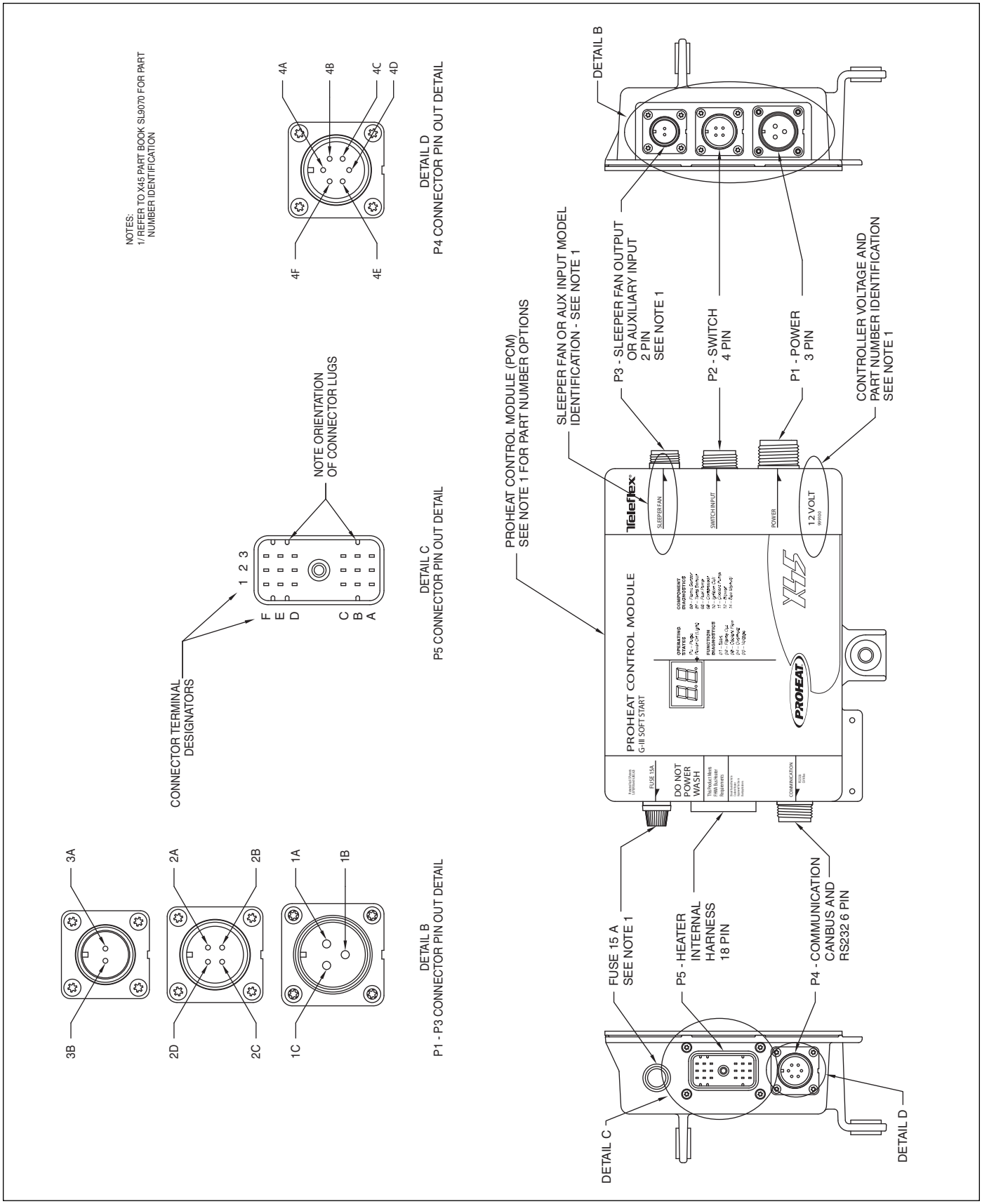
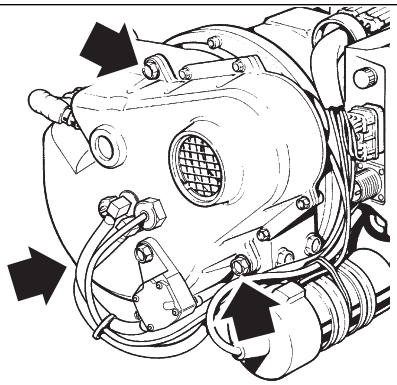


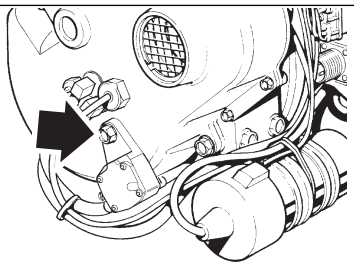
Figure 1-4 PCM Electrical Connections – X45

1.3 TORQUE SPECIFICATIONS



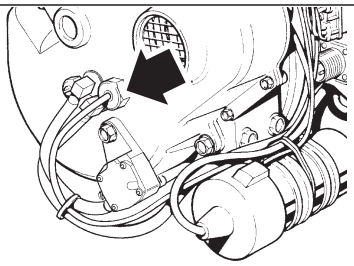
FAN END CASTING

- Apply anti-seize to bolts (3)
- Torque bolts (3) to 75±5 in/lbs (8.5±0.5 Nm)



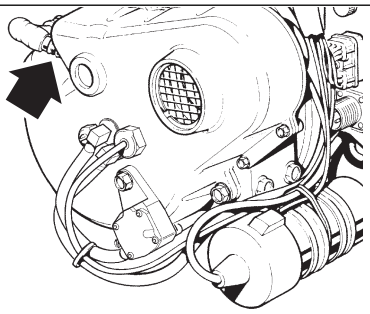
REGULATOR

- Apply anti-seize to cap screw
- Torque cap screw to 94±6 in/lbs (10.6±0.7 Nm)



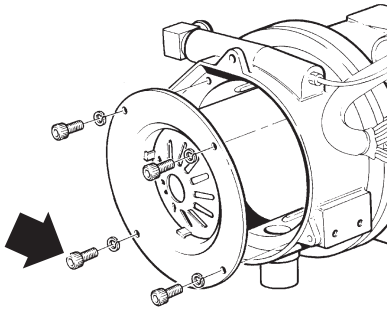
FLAME SENSOR

- Torque sensor to 25±3 in/lbs (2.8±0.3 Nm)



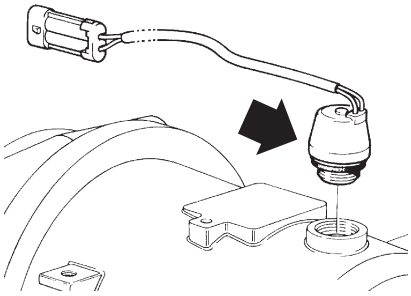
IGNITER

- Apply anti-seize to igniter threads
- Ensure gasket is present before installing
- Torque igniter to 50±5 in/lbs (5.6±0.6 Nm)



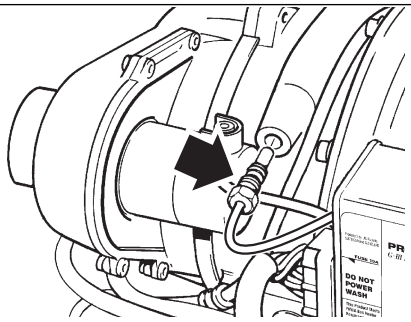
COMBUSTION TUBE

- Apply anti-seize to cap screws
- Torque cap screws (4) to 25±3 in/lbs (2.8±0.3 Nm)



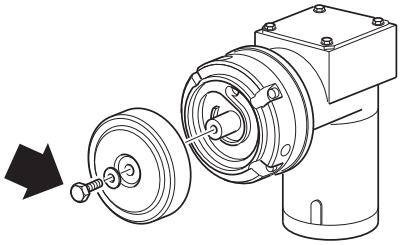
OVERHEAT SENSOR

- Lubricate o-ring with o-ring lubricant
- Torque senor to 500±50 in/lbs (56±5.6 Nm)



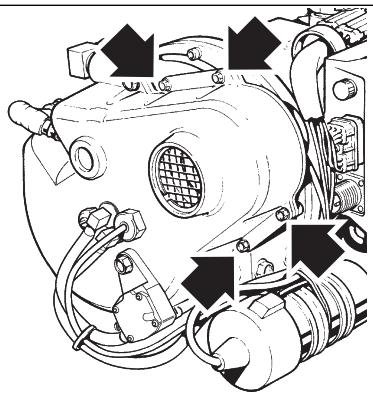
TEMPERATURE SENSOR

- Lubricate o-ring with o-ring lubricant
- Torque senor to 25±3 in/lbs (2.8±0.3 Nm)



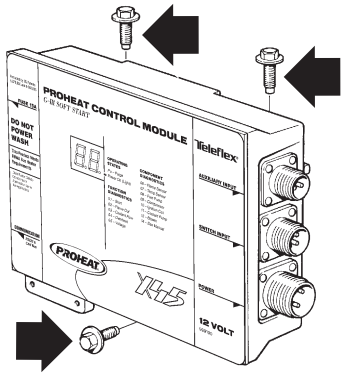
AIR FILTER

- Torque cap screw to 50±5 in/lbs (5.6±0.6 Nm)



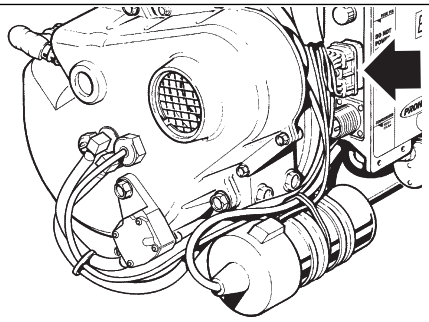
BLOWER ASSEMBLY

- Apply anti-seize to bolts (4)
- Torque bolts (4) to 25±3 in/lbs (2.8±0.3 Nm)



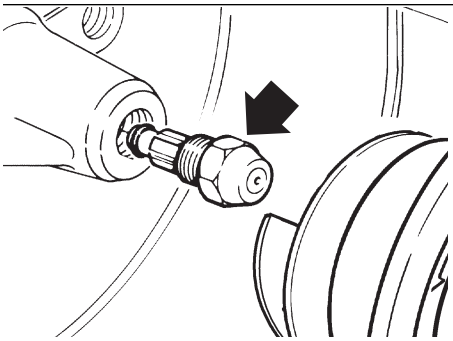
PROHEAT CONTROL MODULE (PCM)

- Apply anti-seize to bolts (3)
- Torque bolts (3) to 75±7 in/lbs (8.5±0.8 Nm)



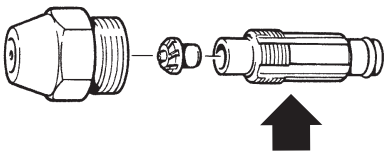
MAIN INTERNAL HARNESS

- Torque bolt (1) to 10±2 in/lbs (1.1 +/- 0.2)



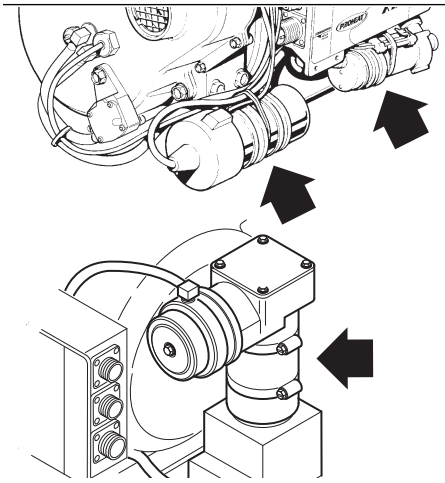
NOZZLE TO FAN END

- Lubricate o-ring on nozzle with diesel
- Torque nozzle to 150±10 in/lbs (17±1.1 Nm)



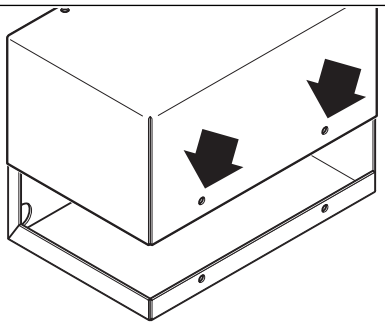
NOZZLE REASSEMBLY

- Torque nozzle (1) to 30±3 in/lbs (3.4±0.3 Nm)



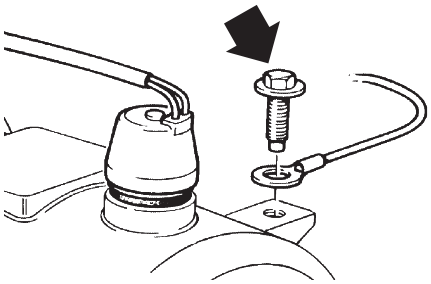
BAND CLAMPS

- Torque clamps (4) to 25±3 in/lbs (2.8±0.3 Nm)



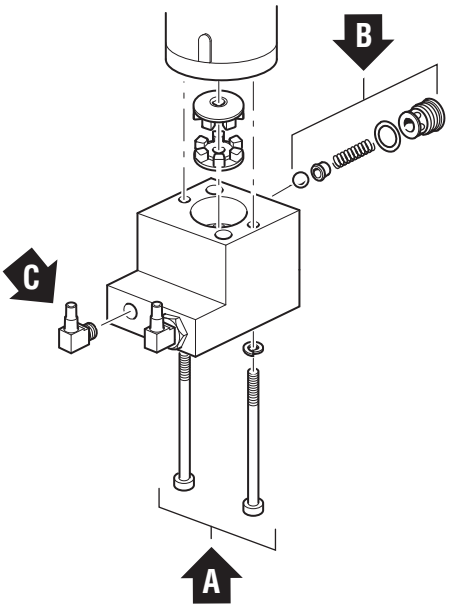
ENCLOSURE LID (Optional)

- Anti-seize recommended on bolts
- Torque clamps (2) to 30±3 in/lbs (3.4±3.4 Nm)



HARNESS GROUND LUG

- Apply anti-seize to bolt
- Torque bolt (1) to 75±5 in/lbs (8.5±0.5 Nm)



FUEL PUMP ASSEMBLY

A

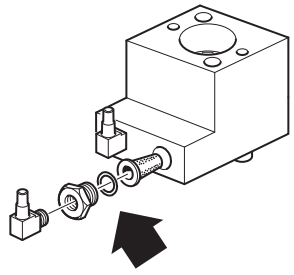
- Apply Loctite 242 to threads
- Torque bolts (2) to 25±3 in/lbs (2.8±0.3 Nm).

B

- Lubricate o-ring with diesel fuel
- Torque relief valve to 22±2 in/lbs (2.5±0.2 Nm).

C

- Apply Loctite 59241 sealant to threads
- Torque elbow (1) to 55±5 in/lbs (6.2±0.5 Nm) minimum or until elbow is at correct orientation



FUEL FILTER

- Lubricate o-ring with diesel fuel
- Torque nut (1) to 150±10 in/lbs (17±1.1 Nm)

2.0 OPERATING YOUR PROHEAT HEATER

NOTICE

These instructions cover Standard Mode operation that are normally installed on trucks. To operate your heater in Preheat or Supplemental, refer to page 3-18 to page 3-20 and page 4-6 to page 4-7.

NOTICE

Regular use of your PROHEAT throughout the year will improve its reliability. Weekly operation is recommended.

NOTICE

The PROHEAT heater can be operated by either using a toggle switch or a 7 day timer.
Refer to page 3-10 for WIRING & ELECTRICAL CONNECTIONS.

ENGINE HEAT ONLY

1. Switch the ON/OFF switch located in the vehicle dash to "ON."

The switch will light and the heater will cycle on. It will continue to operate until the coolant reaches 185˚F (85˚C) at the heater outlet and then cycle "OFF."

When the coolant temperature falls below 150˚F (65˚C) at the heater outlet, it will refire and repeat the cycle.
It will continue to cycle until:

a) the heater is switched "OFF,"
b) the heater runs out of fuel,
c) the vehicle battery voltage drops below 10.0 Volts, or
d) an error occurs and the switch light flashes
(See Troubleshooting & Repair, Section 5)

NOTE: The PROHEAT may be operated if the engine is running or not running.

2. When engine preheat is no longer required, switch the PROHEAT heater "OFF."

ENGINE AND SLEEPER HEAT

1. Switch the ON/OFF switch located in the vehicle dash to "ON."

The switch will light and the heater will cycle on. It will continue to operate until the coolant reaches 185˚F (85˚C) at the heater outlet and then cycle "OFF."

When the coolant temperature falls below 150˚F (65˚C) at the heater outlet, it will refire and repeat the cycle.
It will continue to cycle until:

a) the heater is switched "OFF,"
b) the heater runs out of fuel,
c) the vehicle battery voltage drops below 10.0 Volts, or
d) an error occurs and the switch light flashes
(See Troubleshooting & Repair, Section 5)

NOTE: The PROHEAT may be operated if the engine is running or not running.

2. For sleeper heat – set the thermostat in the sleeper to the desired temperature. If the set temperature is higher than the temperature in the sleeper the fan will cycle "ON." When the air reaches the set temperature the fan will cycle "OFF." The fan will cycle "ON" and "OFF" to maintain the set temperature.

3. When engine and/or sleeper preheat is no longer required, switch the PROHEAT heater "OFF."

3.0 INSTALLATION

NOTICE

If additional installation information is required please contact your PROHEAT Dealer regarding your specific application.

For more technical information, please contact PROHEAT Product Support at www.proheat.com

The installation details described in this manual focuses on truck applications and does not cover all of the possible installations. As seen in the figures below, the PROHEAT X45 is installed on a variety of equipment including trucks, school buses, coaches, drill rigs, mine dump trucks and excavators. In these cases the manual should be used as a guideline only.

There are seven major steps that must be completed to successfully install the PROHEAT heater.

Prior to the installation of your PROHEAT, consult your engine owner's manual or engine manufacturer for any restrictions or changes that may apply to plumbing into the engine coolant system.

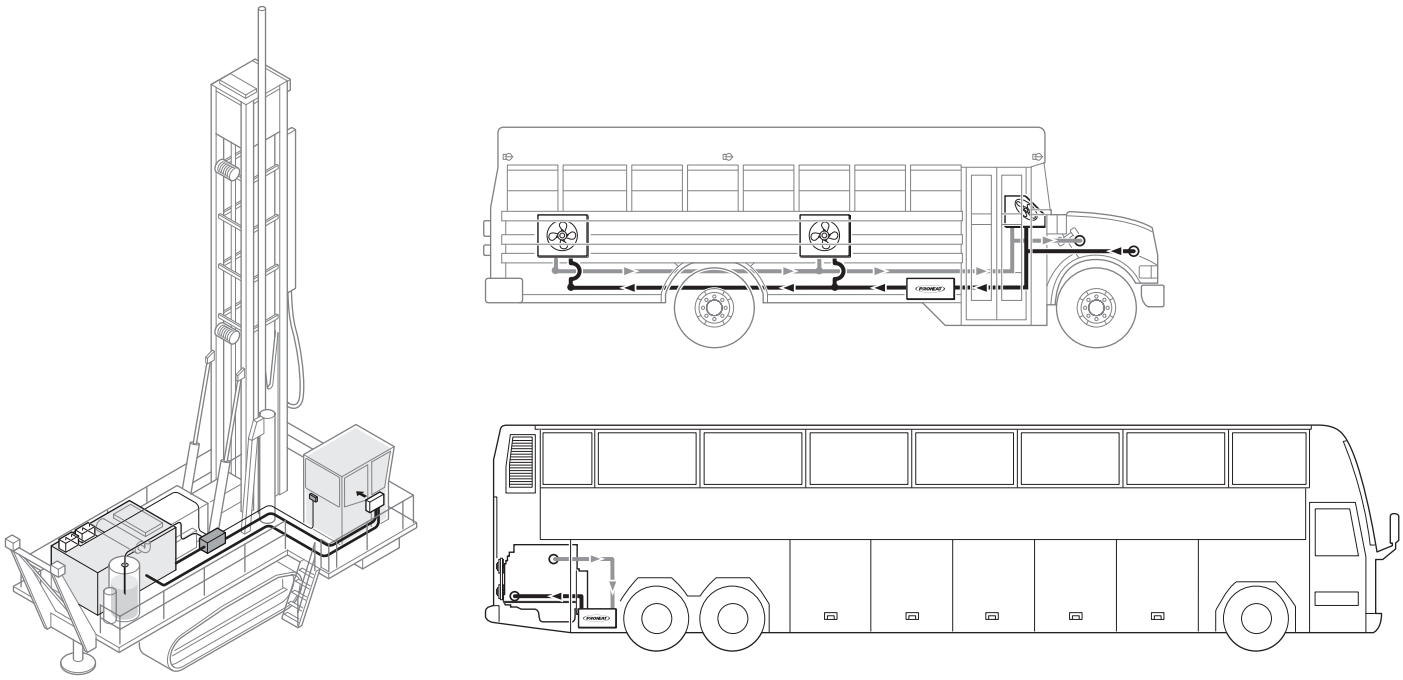


Figure 3-1 Other Applications.

3.1 LOCATING THE HEATER

3.1.1 SELECT YOUR LOCATION

You Choose ☞

The most suitable location for mounting the heater will vary depending on the type of vehicle. Recommended mounting locations are:

- Behind the cab across the frame rails (1).
- On either side of the frame rails (2).
- In an existing enclosure on the vehicle (step or toolbox) (3).

⚠ CAUTION

Do not weld PROHEAT heater mounting brackets to the vehicle frame.

If repairs to the vehicle require welding, disconnect the PROHEAT power cable at the PCM. This will prevent damage to the PROHEAT electronics.

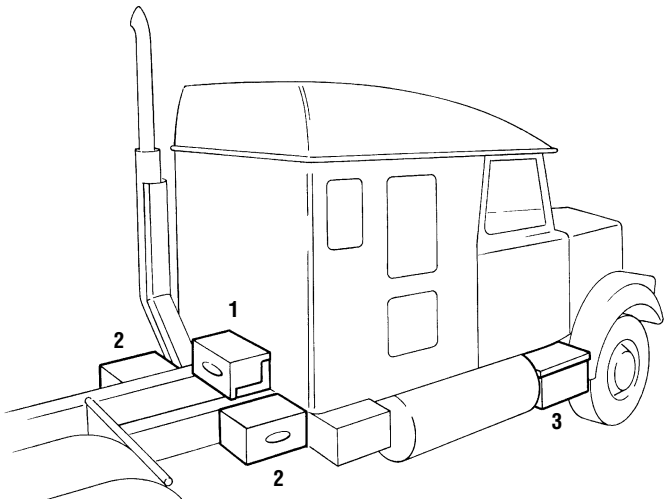


Figure 3-2 Recommended Mounting Positions

3.1.2 GENERAL CONSIDERATIONS

- Never mount the heater to two separate parts of the vehicle.
- Avoid mounting the heater in areas of excessive vibration.
- Do not mount the heater directly to the engine.
- Do not mount the heater beneath a wood floor without a proper fire wall above the heater.
- Avoid mounting the heater in areas of excessive dust, dirt and moisture accumulation.
- The heater must be easily accessed for service.

⚠ WARNING

Never locate the heater inside the vehicle cab. *(See Figure 3-3)*

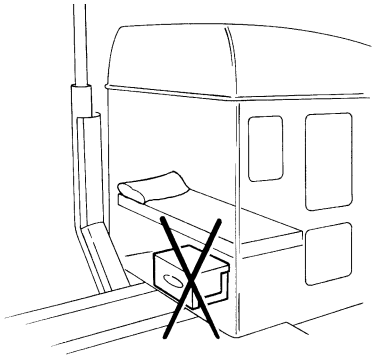


Figure 3-3

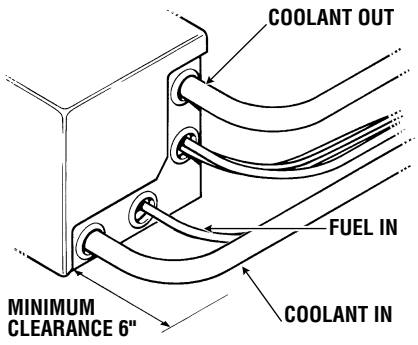


Figure 3-4 Allow minimum 6" clearance for hose connections.

Heater must be mounted below the highest point in the cooling system. An expansion tank may be added to the coolant system above the heater if this is not possible.

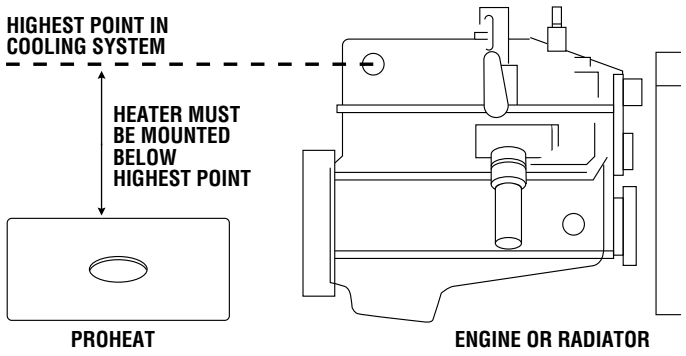


Figure 3-5 Height Requirement

3.1.3 MOUNTING THE PROHEAT HEATER IN AN ENCLOSURE

Do not locate the heater in an airtight enclosure. If the heater is to be mounted in an enclosure other than the PROHEAT enclosure, adequate air flow must be provided to ensure proper combustion. The enclosure must also be adequately ventilated so that the ambient temperature inside the enclosure does not exceed 185 °F (85 °C). The openings must be positioned to prevent moisture dirt and snow from accumulating in the enclosure. The heater enclosure must be easily accessed for servicing of the heater.

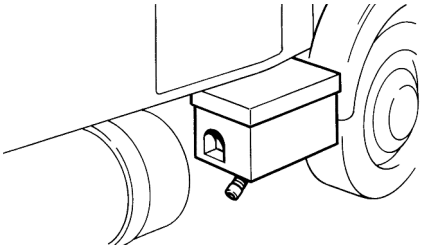


Figure 3-6 Adequate Air Flow

Heater must be mounted within 5˚ of horizontal, as shown.

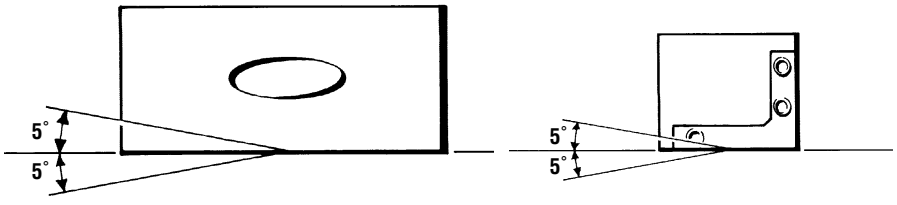


Figure 3-7 Mounting Angle

3.2 MOUNTING THE HEATER

Select Your Mounting Option

3.2.1 OPTION A – Heater With Enclosure

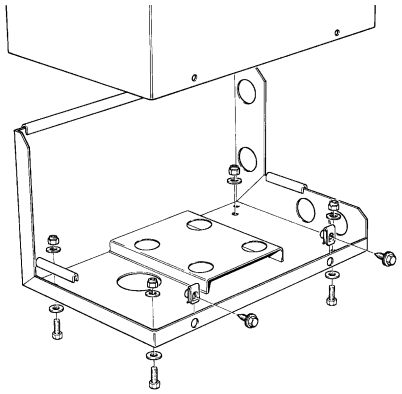


Figure 3-8 Mounting Tray

1. Remove the enclosure cover.
2. Drill the (4) mounting holes and exhaust pipe clearance hole.
3. Using the bolts supplied, fasten the enclosure to the mounting tray or brackets.
4. **Ensure that the combustion tube can be removed for service.** See Figure 1-2 on page 1-3 for service space requirements.

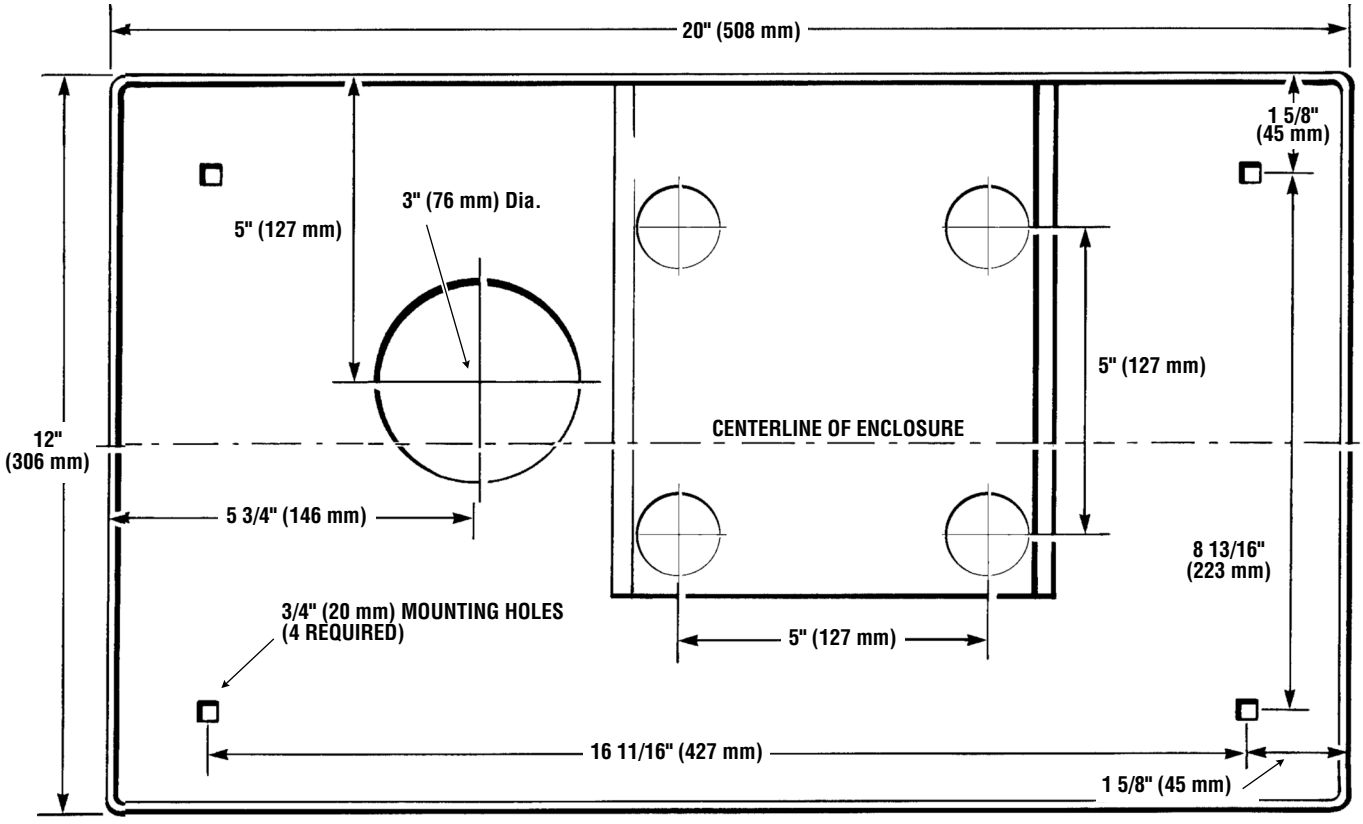


Figure 3-9 X45 Enclosure Base Dimensions

3.2.2 OPTION B – Heater Without Enclosure

NOTICE

Use anti-seize compound on fasteners to prevent galling and corrosion.

Heater supplied without an enclosure (mount in an existing enclosure on the vehicle ie. tool box). Heater supplied with an auxiliary mounting plate.

1. Ensure that the proposed enclosure is big enough for the heater. 12 ½W x 11H x 20 ½L inches (318 x 280 x 521 mm)
2. Using the indicated dimensions, drill the (4) mounting holes and exhaust pipe clearance hole.
3. **Ensure that the combustion tube can be removed for service.** See Figure 1-2 on page 1-3 for service space requirements.

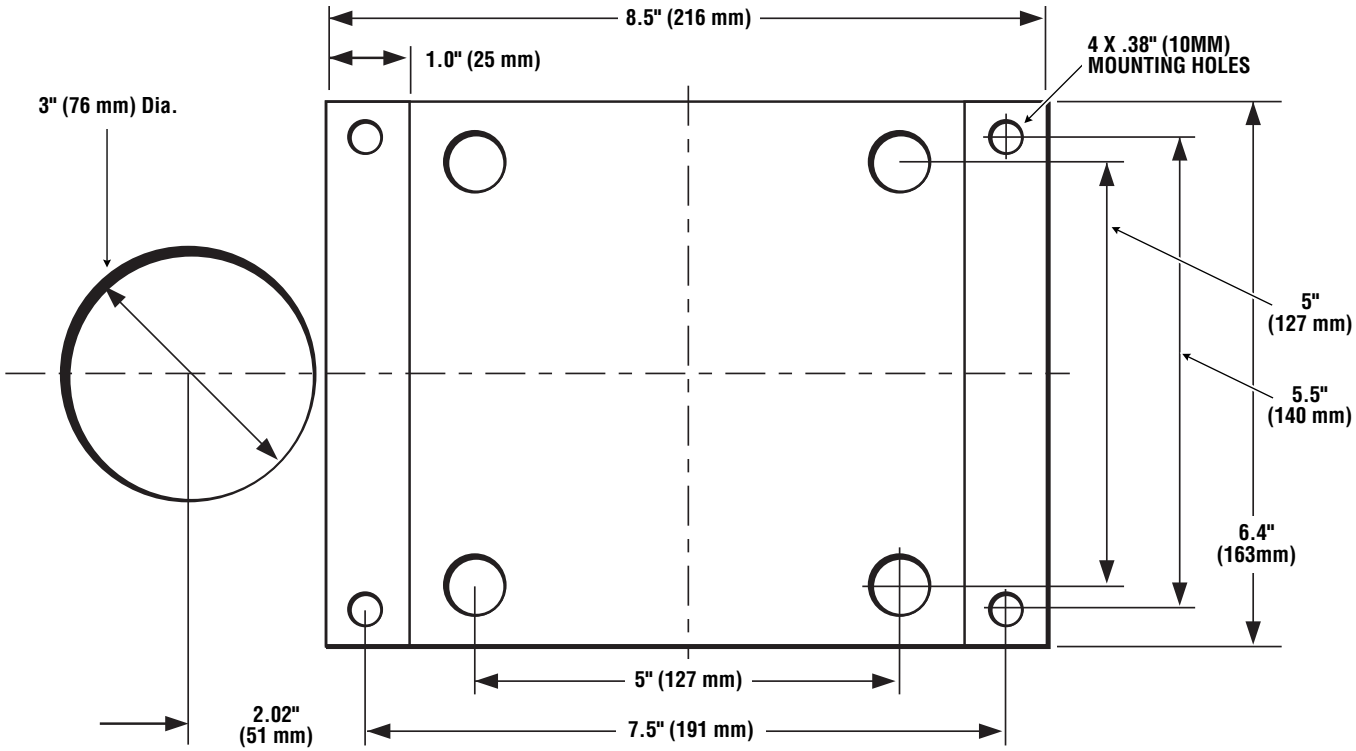


Figure 3-10 X45 Mounting Plate Dimensions & Exhaust Hole

3.3 EXHAUST PIPE CONNECTION

NOTICE

If additional information is required, please contact your PROHEAT Dealer regarding your specific application. Alternatively, please contact PROHEAT Product Support at www.proheat.com.

1. Push the exhaust pipe through the hole in the enclosure and onto the exhaust outlet port of the heater. Ensure that the pipe is pushed onto the spigot at least 1½" (38 mm).
2. Route the exhaust pipe such that:
   - exhaust gasses do not enter the passenger compartment.
   - exhaust gasses do not enter the heater's combustion air inlet
   - exhaust system does not rest against or be directed toward any parts of the vehicle that may be damaged by heat (i.e. brake lines, seals, wires, rubber hoses or bumpers). The exhaust pipe may be have to be insulated if it's within 6" of combustible materials or composite body parts
   - the exhaust outlet does not face the same direction as vehicle travel
   - debris and snow will not plug the outlet
   - the exhaust pipe is protected from curb damage
   - the exhaust system should have a downwards slope for condensation to drain. If needed a 3/8" hole should be drilled into the exhaust pipe at the lowest point so that the condensation will drain.
3. Disassemble the exhaust pipe clamp and apply anti-seize compound to the threads.
4. Assemble the exhaust clamp over the exhaust pipe (clamp goes inside the enclosure) and tighten the nuts.

NOTE: 1½" exhaust pipe should not exceed 5 ft and have no more than 180 degrees of bends. The bends must be formed for best results. Do not use 90 degree welded pipe to turn corners.

⚠ WARNING

Exhaust gases must not enter the vehicle interior. Direct exhaust pipe away from vehicle.

NOTICE

Use of muffler or other restrictions in the exhaust system is not recommended.

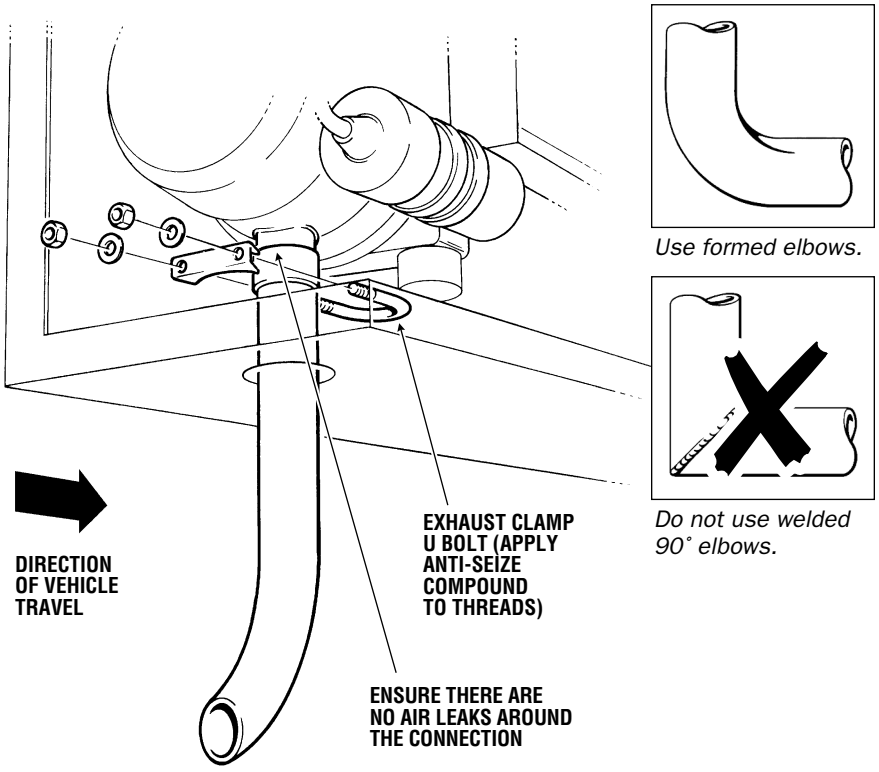


Figure 3-11 Exhaust Pipe

3.4 PLUMBING THE SYSTEM

3.4.1 GENERAL CONSIDERATIONS

Coolant flow must be maintained throughout the coolant system under all conditions.

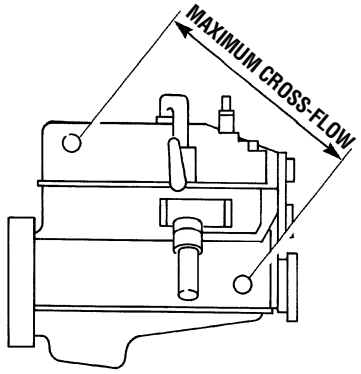


Figure 3-12 Maximum cross-flow

- Keep the engine inlet and outlet ports as far apart as possible to maximize cross-flow through engine.
- Coolant pump and engine water pump must flow in the same direction.
- Ensure that no sharp kinks or bends exist in the hoses which may restrict coolant flow.
- Avoid high points in the hose routing to prevent air traps.
- For systems requiring more than 50 feet of coolant line, contact Proheat Product Support at www.proheat.com for coolant pump recommendations.

For plumbing the system use:

½" NPT pipe fittings or bigger.

¾" ID heater hose.

NOTE: Use of silicone hose requires special hose clamps.

Shut-off valves are not required at the engine inlet and outlet connections but may be used if desired. They should be left open at all times so that the heater can be operated throughout the year.

Select Your Plumbing Option

You Choose

Option A: Engine heat or supplemental heat.

The PROHEAT heats the engine block only.

NOTE: When the engine block is preheated you will have nearly instant heat from the dash heat exchanger.

Option B: Engine and sleeper heat.

The PROHEAT heats the engine block and the sleeper.

NOTE: Plumbing the PROHEAT through the dash fan is not recommended.

Instructions for Options A and B

⚠ WARNING

Opening the radiator cap when the engine is hot may cause serious injury.

1. Remove the radiator cap to release the system pressure.
2. Drain the coolant system.
3. Plumb the system as per *Figure 3-13* or *Figure 3-15*
4. Add engine coolant to the system as per the specific engine manufacturer's recommendations and re-install the radiator cap.

NOTE: Plumbing the PROHEAT through the dash fan is not recommended.

3.4.2 OPTION A – Engine Heat or Supplemental Heat

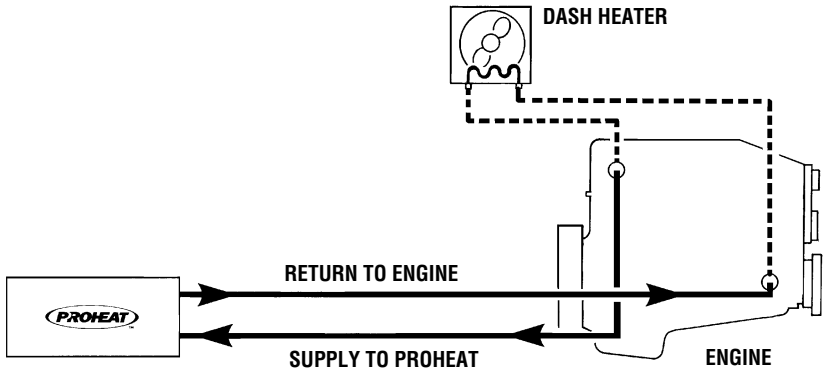


Figure 3-13 Engine Heat or Supplemental Heat

NOTE: On coolant systems where the return from the PROHEAT is plumbed to the bottom of the main coolant supply line from the radiator to engine pump, the return line must be moved to avoid loss of heat through the radiator.

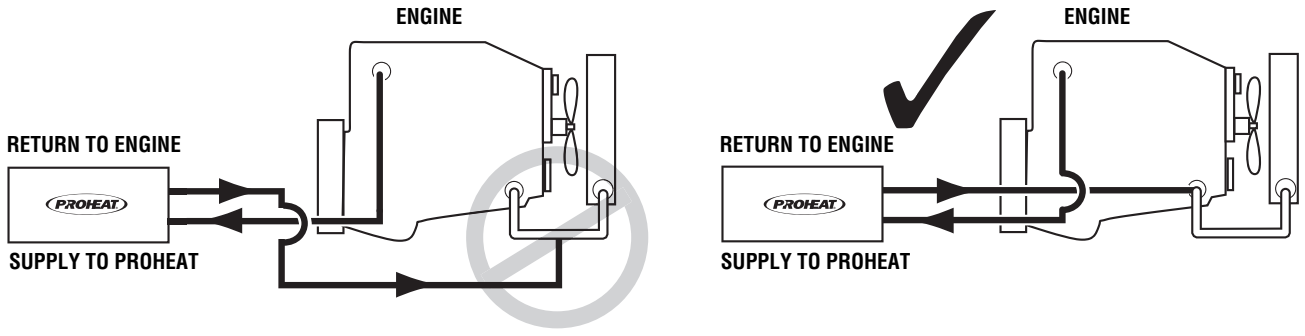


Figure 3-14 Correct Return Line Plumbing

3.4.3 OPTION B – Engine and Sleeper Heat

For best results these vehicles should use an auxiliary heater.

International with single heater

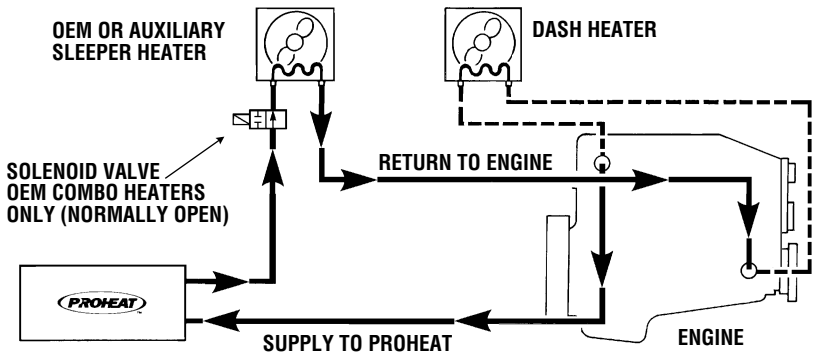


Figure 3-15 Engine and Sleeper Heat

NOTE: Vehicles equipped with a combination heater/air-conditioner will have a solenoid operated shut-off valve in the heater unit. Typically this valve is normally open with the truck engine turned off and the key removed. *(See Figure 3-16 for plumbing)*

Due to the many options available in vehicle heating and air conditioning systems, the installer should be looking for any restrictions that may affect coolant flow, with vehicle ignition in the "OFF" position.

For vehicles with solenoid valves in the normally closed position.

Western Star

NOTICE

The PROHEAT PCM sleeper fan circuit has a one minute delay during ignition. Power to open a sleeper fan coolant valve must be taken from another source such as the wire for the hour meter (auxiliary output). *(See PROHEAT Wiring Diagram on page 1-4.)*

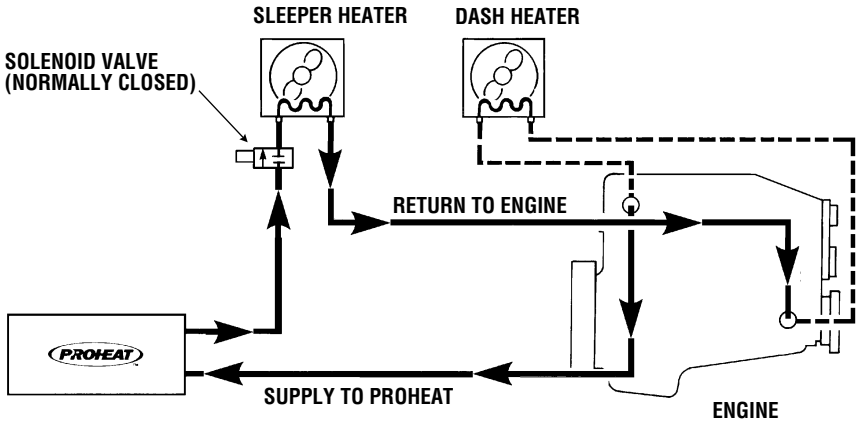


Figure 3-16 Engine and Sleeper Heat

3.5 WIRING & ELECTRICAL CONNECTIONS

3.5.1 GENERAL CONSIDERATIONS

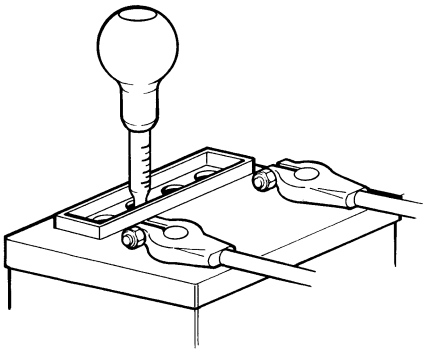


Figure 3-17 Test Battery

- Prior to installation of the PROHEAT Heater system, ensure that the vehicle batteries are in good condition.
- Do not kink or abrade wires when routing them through the vehicle during installation.
- Ensure wires are well supported and secured with tie-wraps.
- Do not use acid core solder when making solder connections.

Major Electrical Connections Required

⚠ WARNING

Do not use on positive ground vehicles.

⚠ CAUTION

If repairs to the vehicle require welding, disconnect the PROHEAT power cable at the PCM. This will prevent damage to the PROHEAT electronics.

⚠ CAUTION

Vehicles using ground side battery disconnect switches must install an in-line 10 Amp fuse on the internal harness (Proheat part # PK0310). This will prevent damage to the harness and PCM, (refer to Service Bulletin SB0003 in Appendix).

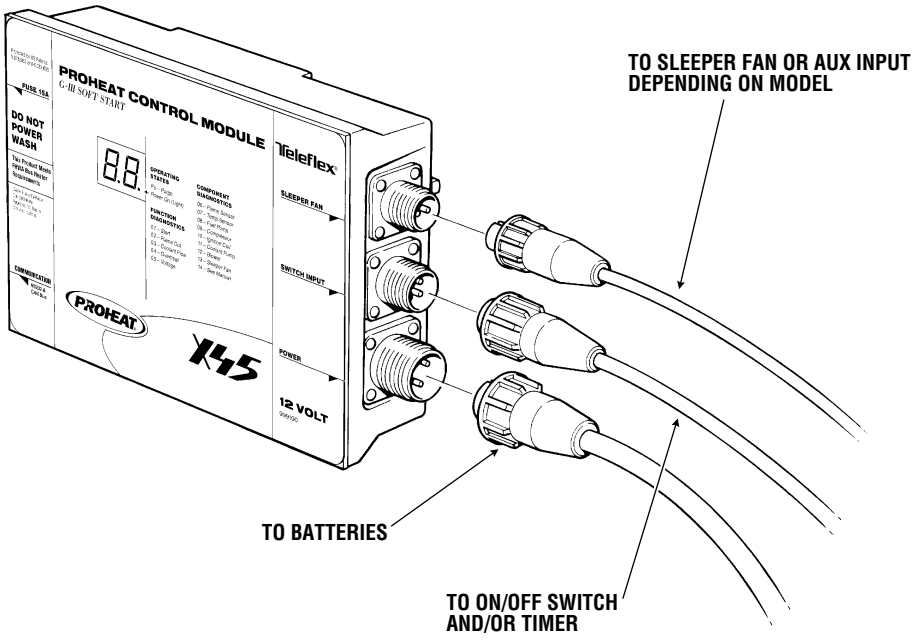


Figure 3-18 Major Electrical Connections

3.5.2 POWER CONNECTION TO BATTERIES

⚠ CAUTION

12 Volt products should not use power split from a 24 Volt system. This will cause uneven charging of the batteries.

NOTICE

Systems providing heat to both engine and sleeper require four (4) batteries.

1. Route wire harness from PCM to the battery. Cut the harness to length as required.
2. Strip outer wire jacket of harness back to expose the positive (red) and negative (black) leads. Strip the leads as shown and crimp the ring tongue terminals supplied to the wires. Connect the leads to the battery terminals. *(See Figure 3-19.)*
3. Leave power harness disconnected. *(See Figure 3-19.)* Do not install until PROHEAT coolant pump system has been purged of air. *(See First Time Startup, page 3-26)*

NOTE: When power is connected to the PCM, all segments of the LED will flash on the PCM. This indicates that power has been supplied. See page 5-4 for more information.

NOTE: Ensure the battery terminals are clean and free of corrosion. Remove and clean. Prior to re-connecting grease terminals with electrically conductive grease.

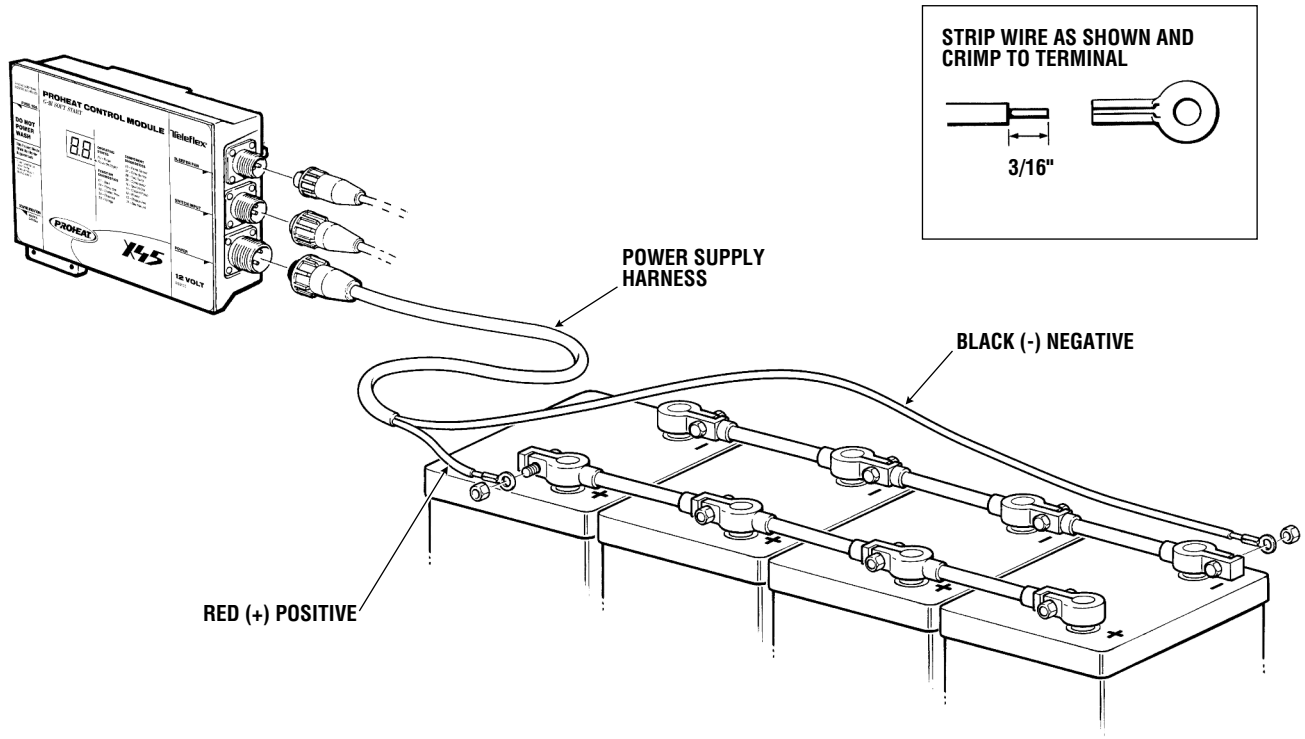


Figure 3-19 Power Connection to Battery

3.5.3 TIMER CONNECTIONS (OPTIONAL)

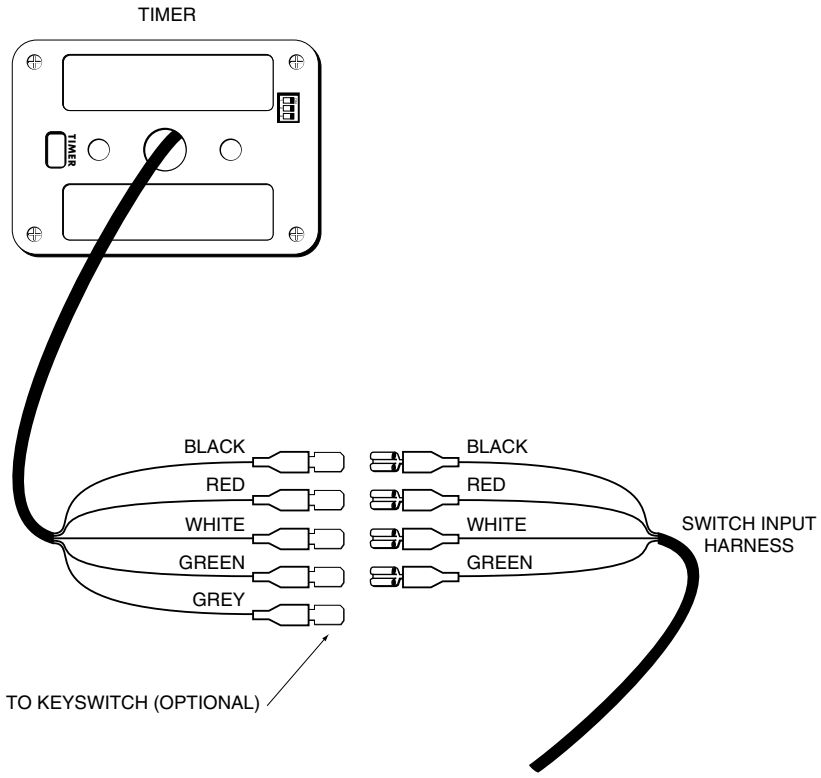
⚠ CAUTION

The switch input circuit should only be used to supply power to the ON/OFF Switch, the Timer, or as a signal to trip a relay. Failure to follow this installation practice will result in damage to the PCM.

NOTICE

The PCM must be reset (power disconnected and reconnected) when changing from a Timer to an ON/OFF Switch or from an ON/OFF Switch to a Timer.

Do not connect an ON/OFF Switch and a Timer in the same circuit.



Black wire	Ground
Red wire	Power
White wire	Operational signal from heater
Green wire	“ON” Signal to heater
Grey wire	Keyswitch backlighting (optional)

Figure 3-20 Timer Connections

3.5.4 ON/OFF SWITCH CONNECTIONS

⚠ CAUTION

The switch input circuit should only be used to supply power to the ON/OFF Switch, the Timer, or as a signal to trip a relay. Failure to follow this installation practice will result in damage to the PCM.

NOTICE

The PCM must be reset (power disconnected and reconnected) when changing from a Timer to an ON/OFF Switch or from an ON/OFF Switch to a Timer.

Do not connect an ON/OFF Switch and a Timer in the same circuit.

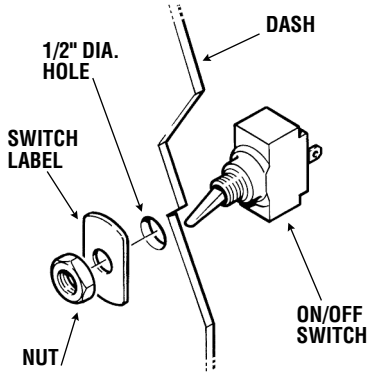


Figure 3-21 ON/OFF Switch Assembly

1. Select a suitable location in the vehicle dash for the ON/OFF Switch.

NOTE: Many dash panels have switches which are not utilized. It may be convenient to remove one and replace it with the PROHEAT switch.

2. Drill a ½" diameter hole through the dash for the switch. Make sure you have clearance behind the dash for the switch wires and connections. Install the switch as per the diagram. *(Figure 3-21)*
3. Route the switch wire harness from the PCM to the dash panel. You will have to pass the wire harness through the vehicle firewall. If possible use an existing hole. Use a grommet to prevent the wire from being damaged when it is passed through the hole.
4. Cut the harness to length.
5. Strip outer wire jacket of harness back to expose the 4 wires. Strip the wires as shown and crimp the supplied ¼" spade terminals.

NOTE: Use fully insulated disconnects when connecting Switch.

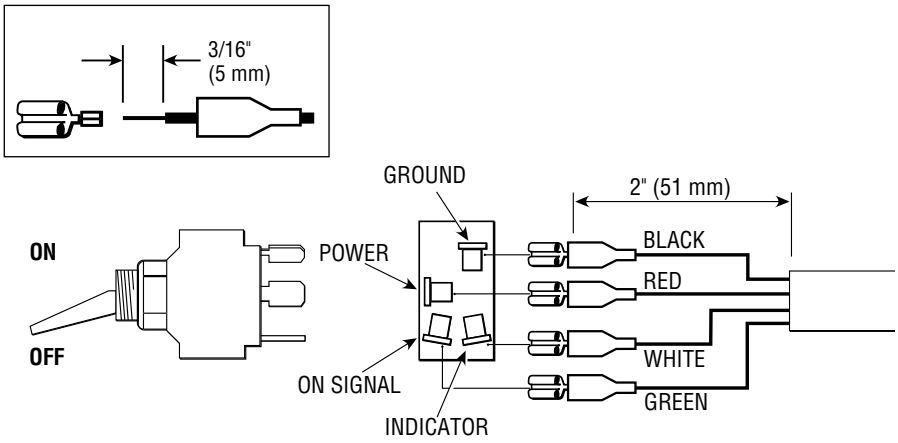


Figure 3-22 ON/OFF Switch Connections

6. Connect the terminals to the switch as shown. *(Figure 3-22)*

NOTE: The PCM must be reset (power disconnected and reconnected) when changing from a Timer to an ON/OFF Switch or from an ON/OFF Switch to a Timer. Connecting an ON/OFF Switch and a Timer in the same circuit will cause the indicator light to flash incorrectly.

3.5.5 SLEEPER FAN MODEL HEATER WIRING DETAILS

NOTICE

These instructions require a Sleeper Fan model. For more information see page 4-2.

These installation options allow the operator to:

1. Run the PROHEAT with the ignition key in the “OFF” position.
2. Return full control to the OEM system in normal operation mode.

You Choose ☞

Select one of the following wiring options

NOTICE

Sleeper Fan output does not supply power during ignition (1 minute after switch ON). DO NOT use for controlling coolant valves. See page 4-5 for operational sequence information.

The Hour Meter (Auxiliary) Output may be used to control supplemental relays to turn on coolant valves.

If additional installation information is required, please contact your PROHEAT Dealer or Product Support at www.proheat.com

NOTE: PROHEAT IS NOT RESPONSIBLE FOR CHANGES IN SLEEPER FAN SYSTEMS BY ORIGINAL EQUIPMENT MANUFACTURING COMPANIES.

Due to the wide variety of wiring schematics that exist, we emphasize that if you are in any doubt you should contact your dealer or PROHEAT Product Support at www.proheat.com

Option A: Used when climate control systems in sleepers require one or more of the following features to be controlled.

1. Normal OEM fan speed selection.
2. A separate thermostat is required to turn the sleeper fan motor “ON” and “OFF” because the OEM system uses a constant running fan.
3. A valve in the sleeper heater coolant line regulates the flow and must be fully opened when the PROHEAT is running.
4. Prevent possible back-feeding on ground side switched systems.

Option B: Used in larger sleepers requiring greater fan speed to provide sufficient air movement to the sleeper. This allows the driver to select the fan speed.

Option C: Used when a dedicated auxiliary heater is required.

Option D: Limits the power provided to the sleeper fan motor to 3 Amps. With this system the total electrical draw is controlled by PROHEAT.

NOTE: For larger systems in the latest model trucks this may not provide enough fan speed and therefore Option A, B or C should be used.

3.5.6 OPTION A – OEM Heater & Proheat Thermostat

Please go to www.proheat.com for equipment specific installation instructions.

3.5.7 OPTION B – OEM Heater & Thermostat

1. Make sure the vehicle ignition is switched “OFF.”
2. Locate the PROHEAT thermostat in a central area of the sleeper, approximately 12" above the bunk. Avoid direct air flow from sleeper fan ducts. *(Figure 3-25)*
3. Remove the adjusting knob and face cover. Mark and drill mounting holes. Mount thermostat using the screws provided. *(Figure 3-27)*
4. Install relay 1, always between OEM sleeper fan control and OEM thermostat.

NOTE: The constant power supply wire must be of sufficient size to handle sleeper fan motor electrical current draw.

5. Route sleeper fan harness from PCM to PROHEAT thermostat. Cut to length. Connect white wire to terminal 1 of the thermostat.
6. Route a wire from terminal 2 of the thermostat to relay 1 (can be cut from left over wire harness). Ground the relay using PROHEAT sleeper fan ground wire (black).

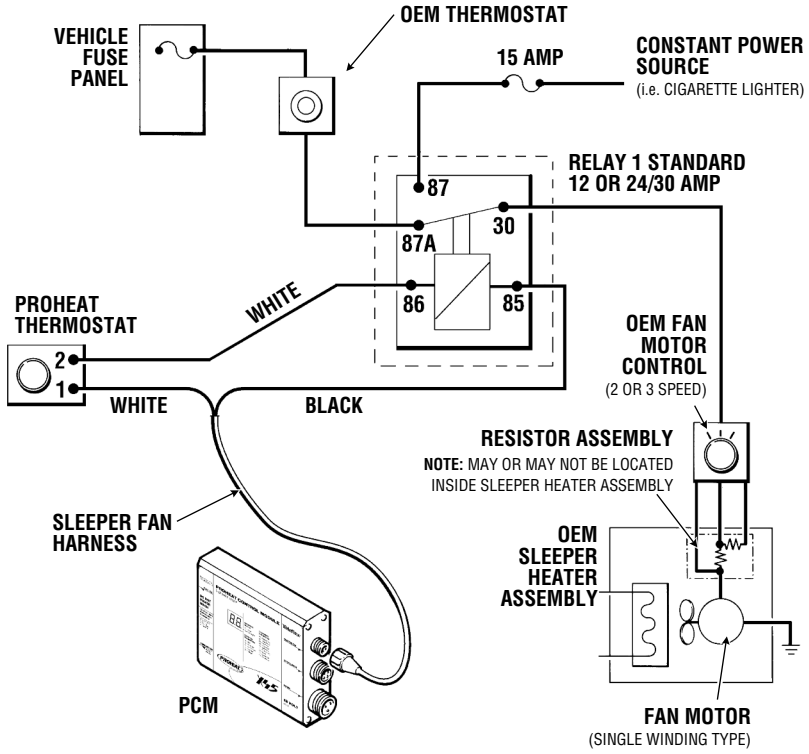


Figure 3-23 Option B

3.5.8 OPTION C – Auxiliary Sleeper Heater

1. Make sure the vehicle ignition is switched “OFF.”
2. Locate the auxiliary heater in a suitable area of the vehicle. Install plumbing and air duct connections as per the manufacturer’s recommendations.
3. Locate the PROHEAT thermostat in a central area of the sleeper, approximately 12" above the bunk. Avoid direct air flow from sleeper fan ducts. *(Figure 3-25)*
4. Remove the adjusting knob and face cover. Mark and drill mounting holes. Mount thermostat using the screws provided. *(Figure 3-27)*
5. Route sleeper fan harness from PCM to PROHEAT thermostat. Cut to length. Connect white wire to terminal 1 of the thermostat using the fork terminal provided. Black wire is not used.
6. Route a wire from terminal 2 of the thermostat to an appropriate wire on the sleeper fan motor. Make a splice connection and seal the splice with tape or heat shrink.

NOTE: The electrical power and operation in this option is controlled by the PROHEAT. See Option B should a relay be required to provide more electrical power.

⚠ WARNING

Systems using a ground side battery disconnect must install a 10 Amp fuse to protect the sleeper fan harness.

Thermostat Wire Connection Detail

Screw #	Wire Colour
1	White (from PCM)
2	White (to sleeper heater)
3	Not used
4	Not used

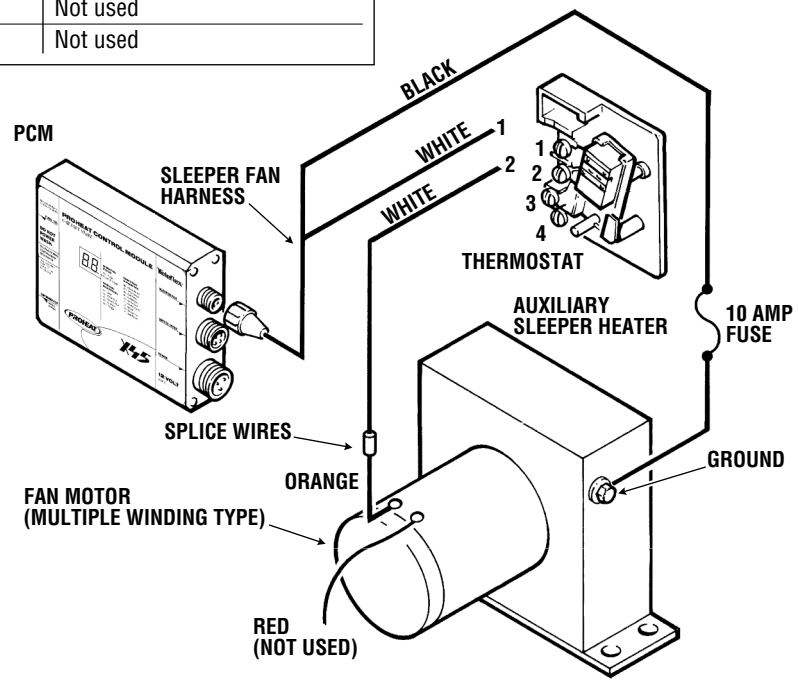


Figure 3-24 Option C

3.5.9 OPTION D – Auxiliary Sleeper Heater Current Limited

NOTICE

Sleeper Fan output does not supply power during ignition (1 minutes after switch ON). DO NOT use for controlling coolant valves. DO NOT use for controlling coolant valves. See page 4-5 for operational sequence information.

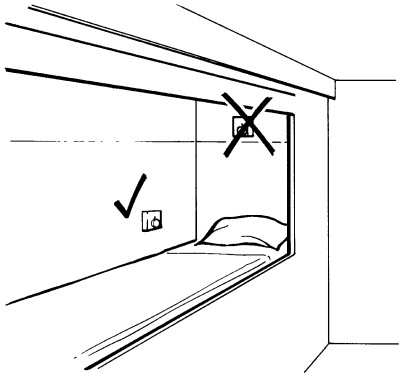


Figure 3-25 Thermostat Location

1. Make sure the vehicle ignition is switched "OFF."
2. Mount the isolator in the sleeper fan motor area to a solid metal surface with the screw provided. Cut OEM wire to sleeper fan motor and connect isolator in series. Connect using ¼" spade connectors provided. *(Figure 3-26)* Wire end from resistor pack connected to isolator terminal marked "IGNITION." Wire end from sleeper fan motor connected to isolator terminal marked "FAN."
3. Locate PROHEAT thermostat in central area of sleeper, approximately 12" above the bunk. Avoid direct air flow from sleeper fan ducts. *(See Figure 3-25.)*
4. Remove the adjusting knob and face cover. Mark and drill mounting holes. Mount thermostat using the screws provided. *(Figure 3-27)*
5. Route sleeper fan harness from PCM to PROHEAT thermostat. Cut to length. Connect white wire to terminal 1 of the thermostat. Use fork terminal provided. Black wire not used.
6. Route a wire from terminal 2 of the thermostat to the isolator terminal marked "HEATER." Connect using fork and spade terminal provided. *(Can be cut from left over wire harness.)*

NOTE: For large sleepers this **MAY NOT** provide enough fan speed and therefore option A, B or C should be considered.

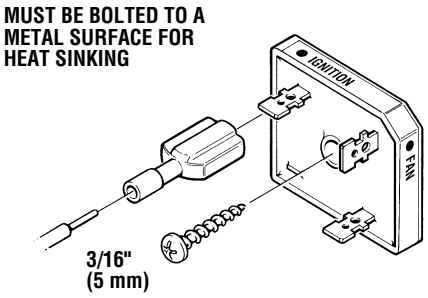


Figure 3-26 Isolator Detail

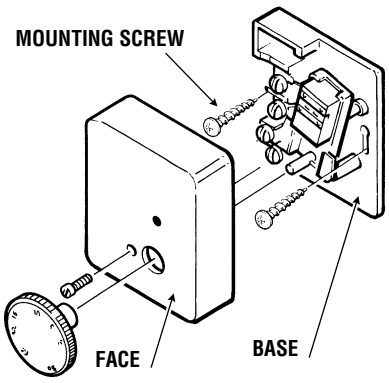


Figure 3-27 Thermostat Detail

Thermostat Wire Connection Detail

Screw #	Wire Colour
1	White (from PCM)
2	White (to isolator)
3	Not used
4	Not used

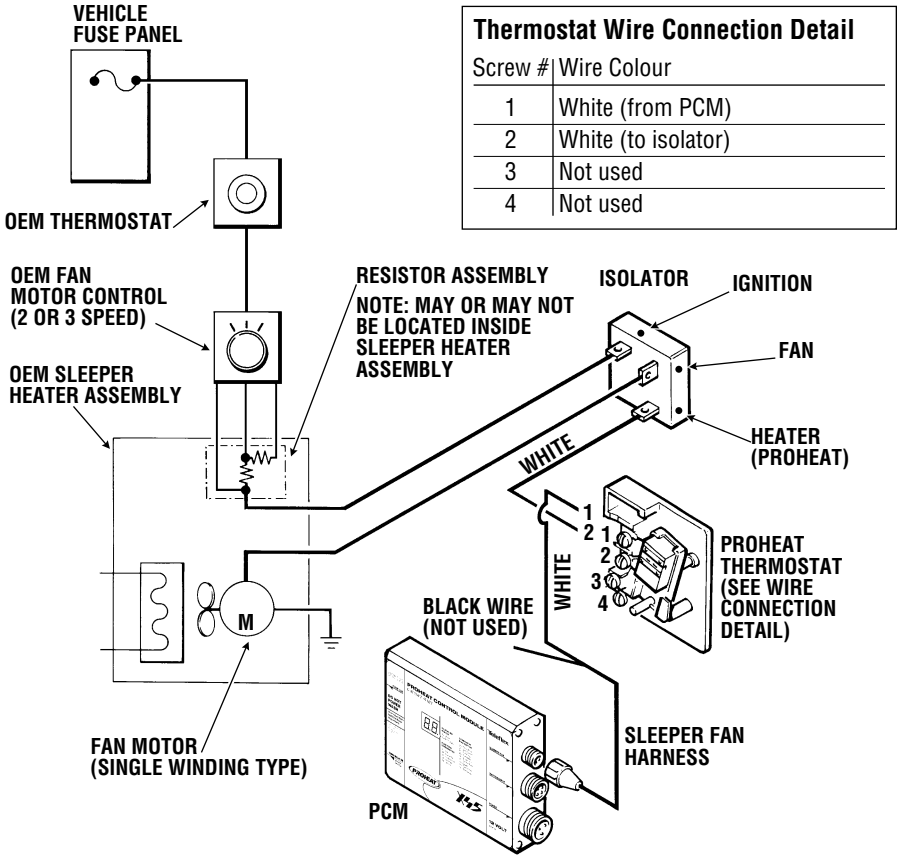


Figure 3-28 Option D

3.5.10 AUXILIARY INPUT MODEL HEATER WIRING DETAILS

NOTICE

These instructions require a Auxiliary Input model. For more information see page 4-2.

NOTICE

The Preheat and Supplemental modes are generally used by transit and coach applications.

These installation options allow the operator to:

1. Run the PROHEAT in Preheat Mode or Supplemental Mode alone.
2. Run the PROHEAT in the Preheat and Supplemental Mode.
3. Run the PROHEAT in Standard Mode (Proheat Timer option) and using the Supplemental Mode.

In addition to the Standard Operating Mode, there are two other operating modes: Preheat and Supplemental. One operating mode is for one button preheating the engine and the second is for supplemental heat while the vehicle is being operated. The benefits include easier operation for the driver; simplified installation; eliminates need for extra control relays; and increases reliability by reducing unnecessary heater operation.

The feature that makes this Auxiliary Input Model unique is that the PCM (Proheat Control Module) has three inputs to turn the heater on; one for each operating mode. The following is a description of the three operating modes.

Standard Heat Mode

Coolant temperature is monitored via a built in sensor. When the temperature at the Proheat is below 150° F (65° C)* the Proheat operates, heating the coolant to 185° F (85° C) at which point it stops burning fuel and goes into Standby with only the coolant pump running. Standard Heat Mode is typically activated by use of a toggle switch which must be manually switched off. If the switch is not turned off the heater will continue to run overnight. Since the coolant pump runs continuously in this mode, It is possible to accumulate a high number of coolant pump operating hours vs heater run hours. Use of supplemental mode is recommended in conjuction with standard mode in many cases.

NOTICE

Supplemental operation will not override the Standard Mode operation (Proheat Timer runs in Standard Mode).

Supplemental Heat Mode

The amount of heat required varies depending on engine load, outside temperature, frequency of door opening, etc. Recognizing this varying demand for heat, the Proheat monitors the conditions and supplies heat only when required. When heat is not required, the Proheat puts itself into supplemental standby, shutting off the coolant pump, thereby avoiding additional run hours on the pump. This is ideal for transit and coach applications.

In order to simplify operation, this function is fully automatic and invisible to the operator. The Proheat picks up a signal that the engine is running, and then monitors the coolant temperature via a built-in sensor. If the coolant temperature at the Proheat is below 150° F (65° C)* the coolant pump is activated for three minutes*. This causes coolant in the engine to be circulated through the Proheat. If after three minutes* the coolant temperature is above 150° F (65° C)*, the Proheat will turn off the coolant pump and return to supplemental standby. If the coolant temperature remains below 150° F (65°C)*, the Proheat will operate and continue to supply heat to the system until the coolant temperature reaches 185° F (85° C). The Proheat then shuts itself off, returns to supplemental standby, deactivates the coolant pump and waits for the coolant temperature to fall below 150° F (65° C)*, and the cycle is repeated.

NOTICE

The PROHEAT must have coolant flowing through it when it is monitoring temperature.

The Proheat switches off when the engine stops, thus avoiding the problem of the driver forgetting to switch the unit off and leaving it running overnight.

Note also that the Supplemental Heat Mode has priority over the Preheat Mode and will cause the Preheat Mode to drop out.

NOTE: There is a thirty second delay in response to both an "ON" and "OFF" signal*. This is to allow time for the vehicle to start before the heater is activated in Supplemental Heat Mode.

** There are special OEM versions for Supplemental Mode. For example, temperature thresholds may have a low threshold of 160ºF (71ºC) rather than 150ºF (65ºC) and a reduced coolant pump Pre-run time of 30 seconds rather than three minutes. Please contact Proheat Technical Support for more information.*

Preheat Mode

For those fleets with outdoor parking, preheating is often essential in order to start the engine in cold weather. Since much of an engine's wear occurs during start-up, preheating. Preheating reduces this wear and contributes to longer engine life and reduced operating costs.

The Preheat Mode is activated by use of a momentary contact switch. This will typically be activated each morning by the maintenance personnel an hour or so prior to pull out. The Proheat then runs in a mode similar to Standard Heat Mode, heating the coolant which is circulated through the engine block. The advantage of this system is the manner in which it is switched off. No operator input is required. The Proheat has a built in time-out feature to prevent the heater from running indefinitely. If the bus is not needed for pull-out, the Proheat will switch itself off after 90 minutes of operation. Starting the engine will also cause the preheat mode to end (if Supplemental mode is wired). To manually end preheat mode simply depress the momentary contact switch.

Please refer to the wiring diagrams on page 1-4 and page 3-21.

You Choose ☞

Select one of the following wiring options

NOTE: PROHEAT IS NOT RESPONSIBLE FOR CHANGES IN ELECTRICAL SYSTEMS BY ORIGINAL EQUIPMENT MANUFACTURING COMPANIES.

Option A: Run the PROHEAT in Preheat Mode or Supplemental Mode alone.

Option B: Run the PROHEAT in the Preheat and Supplemental Mode.

Option C: Run the PROHEAT in Standard Mode (Proheat Timer optional) and using the Supplemental Mode.

3.5.11 OPTION A – Preheat Mode or Supplemental Mode Operation

The instructions below are general in nature. It is up to the installer to select appropriate switches and use proper electrical connection methods. If more information is required, contact your Authorized Proheat Dealer or Proheat Product Support at www.proheat.com

⚠ WARNING

When wiring for Supplemental Mode, ensure to install Mechanic's Disable Switch in order to disable Supplement Mode for safety requirements.

1. Select the operation mode of choice. Note that Preheat may be wired as Preheat Option 1 or Preheat Option 2 as shown in Figure 3-29. In addition, note to that the engine run signal may be off the alternator, multiplex or others.
2. Wire the Preheat Mode or Supplemental Mode as shown in Figure 3-29. Install hardware as required on the vehicle.
3. Install an Indicator Light near the vehicle operator.

3.5.12 OPTION B – Preheat and Supplemental Mode

The instructions below are general in nature. It is up to the installer to select appropriate switches and use proper electrical connection methods. If more information is required, contact your Authorized Proheat Dealer or Proheat Product Support at www.proheat.com

⚠ WARNING

When wiring for Supplemental Mode, ensure to install Mechanic's Disable Switch in order to disable Supplement Mode for safety requirements.

1. Identify engine run signal. This may be off the alternator, multiplex or others.
2. Install hardware as required on the vehicle as shown in Figure 3-29.
3. Choose either Preheat Option 1 or Preheat Option 2. Install hardware as required on the vehicle as shown in Figure 3-29.
4. Install an Indicator Light near the vehicle operator.

3.5.13 OPTION C – Standard Mode (Proheat Timer Optional) and Supplemental Mode

The instructions below are general in nature. It is up to the installer to select appropriate switches and use proper electrical connection methods. If more information is required, contact your Authorized Proheat Dealer or Proheat Product Support at www.proheat.com

NOTICE

Supplemental operation will not override the Standard Mode operation (Proheat Timer runs in Standard Mode).

1. Install the timer as per Section 3.5.3 or the switch as per Section 3.5.4. See Figure 3-29.
2. Identify engine run signal. This may be off the alternator, multiplex or others.
3. Route and connect engine run signal to wire A on the auxiliary input connector. Install hardware as required on the vehicle.

⚠ WARNING

DO NOT connect an ON/OFF Switch and a Timer in the same circuit.

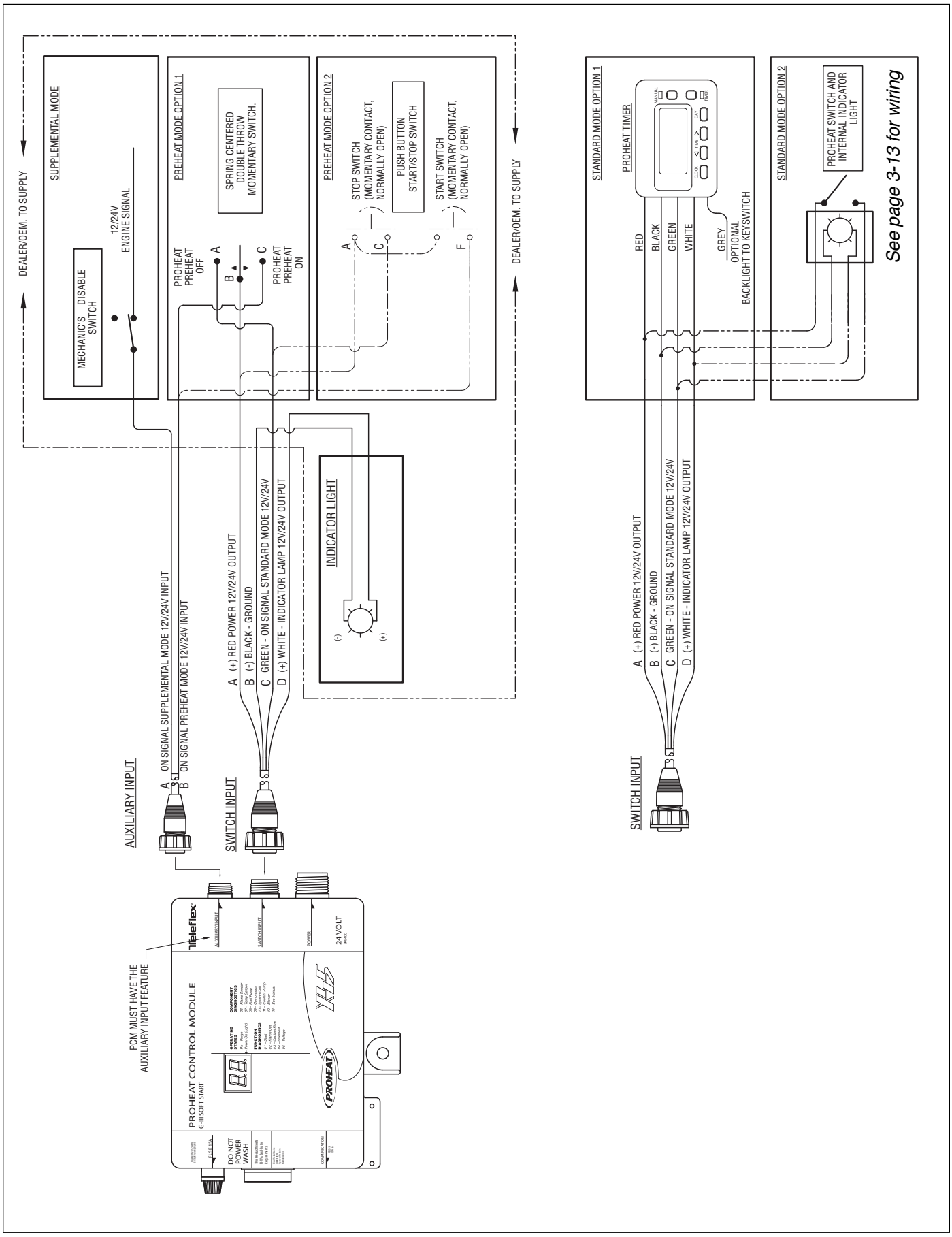


Figure 3-29 Preheat and Supplemental Wiring Diagram.

3.6 FUEL SYSTEM

3.6.1 GENERAL CONSIDERATIONS

- Use a dedicated 1/4" ID fuel line between the fuel tank and heater meeting SAE 30R9. (Fuel line length not to exceed 50' with a maximum rise of 10'.)

Ensure fuel lines are routed away from all heat sources, well secured and will not abrade.

⚠ CAUTION

DO NOT use fuel lines and pick-up tubes less than 1/4" ID or greater than 3/8" ID. Failure to use the correct line size may result in heater malfunction.

- Ensure clamps are secure at fuel pump and fuel pick-up.
- Ensure the proper fuel line clamps with uniform 360° compression are used.
- Use of a fuel filter is not recommended. All models have a built in fuel filter at the fuel inlet fitting on the heater.

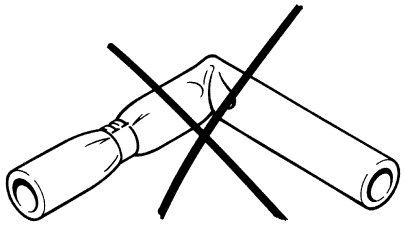


Figure 3-30 Do not kink or pinch fuel line when routing lines.

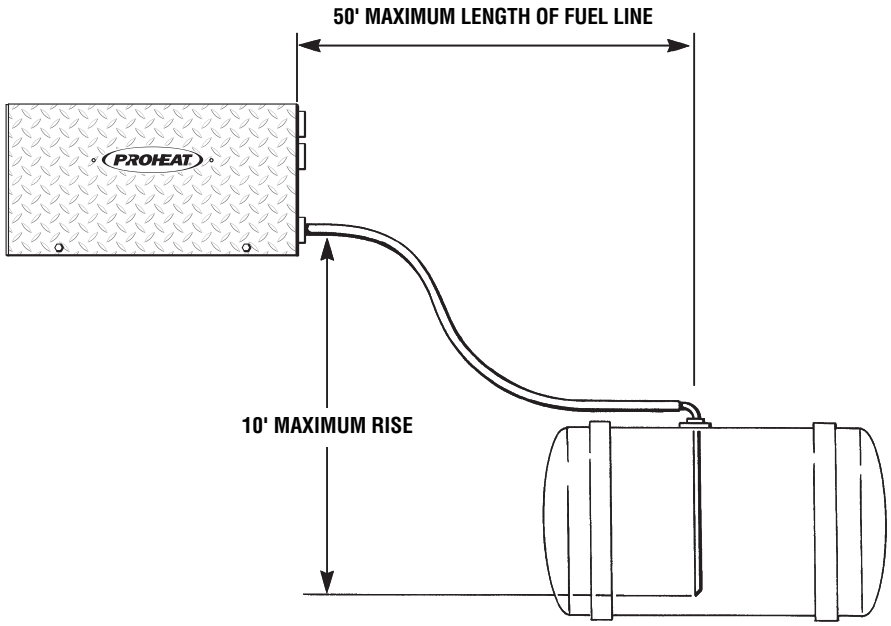


Figure 3-31 Fuel Supply Height Requirement

You Choose ☞

Select Your Fuel Pick-up Installation Option

Option A: Fuel pick-up to be installed in an existing ¼"or ½" NPT port in fuel tank.

Option B: Fuel pick-up to be installed in an existing blank fuel sender cover plate.

Option C: Fuel pick-up to be installed in a hole drilled into the fuel tank.

3.6.2 OPTION A – 1/4" or 1/2" NPT Port

Locate an existing pipe thread port in the vehicle fuel tank and select the ¼" or ½" NPT portion of the fuel pick-up that fits into that port. Apply a pipe sealant paste to the fuel pick-up pipe threads prior to installation.

⚠ CAUTION

Do not use teflon tape as this will contaminate the heater and engine fuel system.

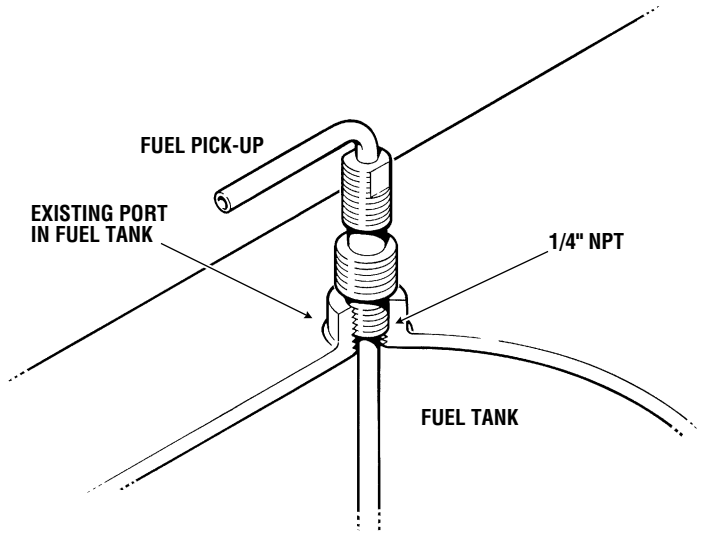


Figure 3-32 ¼" NPT Port

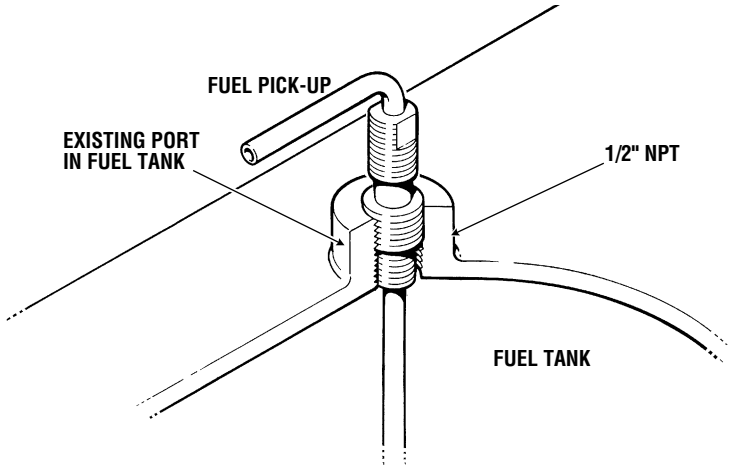


Figure 3-33 ½" NPT Port

3.6.3 OPTION B – Existing Blank Fuel Sender Cover Plate

Locate an existing, blank fuel sender port in the vehicle fuel tank. Remove the cover plate, drill a 1" diameter hole and install the fuel pick-up as shown.

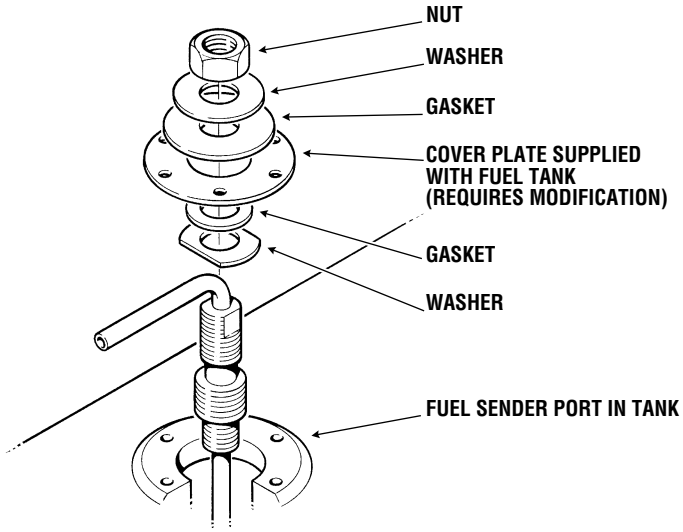


Figure 3-34 Blank Fuel Sender Port

3.6.4 OPTION C – Hole Drilled into Fuel Tank

This option requires a permanent modification to the fuel tank.

Select the location for the fuel pick-up in the vehicle fuel tank. Ensure sufficient clearance above the tank to get the fuel pick-up into the tank. Drill a 1" diameter hole in the tank.

⚠ CAUTION

To prevent fuel system contamination do not allow drill chips to fall into the fuel tank when drilling the hole.

⚠ WARNING

Drilling the fuel tank may not be acceptable in some jurisdictions. Do not drill the fuel tank on passenger carrying vehicles such as school buses.

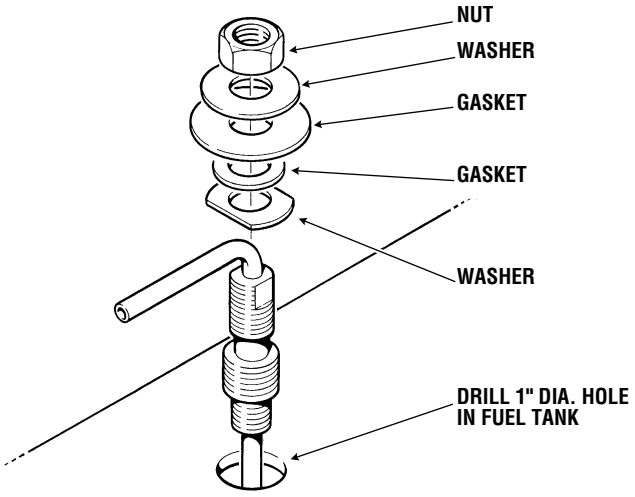


Figure 3-35 Drill Hole in Tank

3.6.5 INSTALLATION

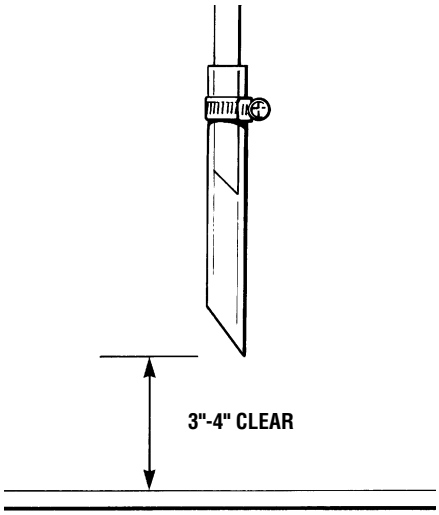


Figure 3-36 For some situations where the fuel pick-up is too far from the bottom of the tank, an extension from left over fuel line can be added.

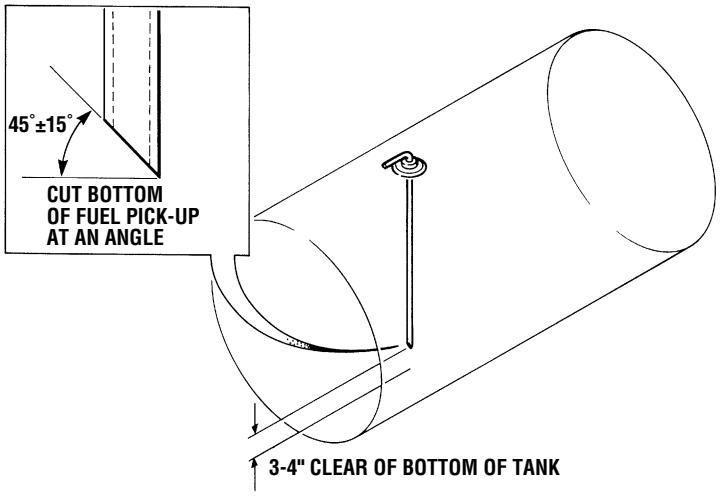


Figure 3-37 Fuel Pick-up Depth

1. Determine the depth of the fuel tank at the desired fuel pick-up location. Cut the fuel pick-up 3 to 4” shorter as shown in *Figure 3-37*.
2. Install the pick-up into the fuel tank as per selected option.
3. Route the fuel line from the heater to the fuel pick-up. Ensure the fuel line is well secured and will not abrade.
4. Attach the fuel line to the heater fuel pump fitting and the fuel pick-up with hose clamps. Lubricating the fittings with fuel may ease the installation effort.

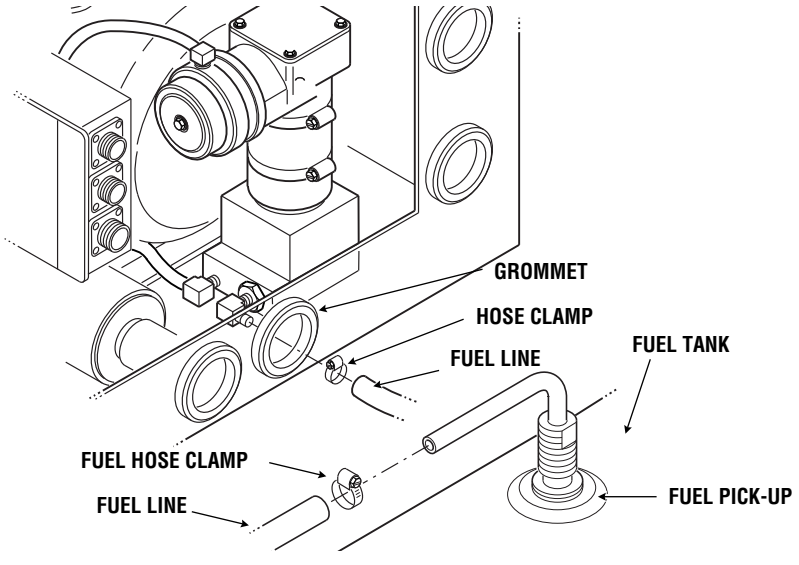


Figure 3-38 Fuel Line Connection Detail

3.7 FIRST TIME STARTUP

1. Inspect the entire installation for:

a) loose bolts,
b) loose hoses and hose clamps,
c) loose wires and wire connections,
d) kinked or pinched hoses or wires,
e) battery connection for correct polarity, and
f) coolant supply and return location on the engine.

2. Fill the vehicle cooling system with coolant as per owner's manual or engine manufacturer's recommendations.

3. Place dash heater control in the full "HOT" position. Turn air conditioning "OFF."

NOTE: If shut-off valves are installed make sure they are fully "OPEN."

4. Start the vehicle engine and run it at a fast idle for 5 to 10 minutes to purge air from the heater and coolant system. While the engine is running:

a) make sure the coolant is flowing freely,
b) inspect hoses and fittings for leaks,
c) check the coolant level in the radiator and add coolant as necessary.

5. Shut the engine "OFF."

6. Connect the power harness. All segments of the LED will flash on the PCM. This indicates that power has been supplied. See page 5-4 for more information.

7. Start the PROHEAT heater using the ON/OFF switch. The indicator lamp should be lit with a solid red light. Go to the heater and observe its operation. Test Preheat and Supplemental Mode operation if equipped. Refer to page 3-18 and page 4-5 for proper information.

Sequence of Events:

a) Coolant temperature must be less than 150˚ (65˚C).
b) "ON" light on PCM should be lit.
c) You should hear the coolant pump, blower and compressor start. Looking through the inspection port you should see a spark and a flame.
d) The spark will stop after 60 seconds and the heater will continue to run.

NOTE: If the indicator lamp in the ON/OFF Switch flashes upon initial startup – **WAIT**. The heater will attempt a restart in 3 minutes. In some cases it takes longer for the fuel pump to prime the empty fuel lines during the initial start. This is usually the case if the fuel lines are long (it may take a few restarts). If the light continues to flash after the restart, then there is a problem. The Troubleshooting & Repair section of this manual will assist you in correcting the problem.

8. Once the heater is started it will continue to run until the coolant temperature reaches 185˚F (85˚C) at heater outlet, then it will shut off.

NOTE: The vehicle dash temperature gauge may read significantly less depending on the location of the sender unit on the engine.

Sequence of Events for Shutdown

a) Fuel pump and compressor shut off.
b) The blower will run for 3 minutes on Cool Down (Purge) cycle then shut "OFF."
c) The water pump will continue to run.

9. The heater will restart when the coolant temperature falls below 150˚F (65˚C) at heater outlet, as long as the ON/OFF switch is left "ON."

10. If the vehicle has been equipped with the sleeper heat option then:
    a) Adjust the PROHEAT sleeper thermostat to highest heat position.
    b) The sleeper heat exchanger fan will start blowing warm air.

11. Switch the ON/OFF switch to "OFF." The red light will go out and the heater will Cool Down (Purge) for three minutes.

12. Inspect the installation again for leaks.

13. Install the enclosure cover.

14. **TO ENSURE FULL WARRANTY COVERAGE COMPLETE THE WARRANTY CARD AND MAIL TO PROHEAT.**

4.0 PRINCIPLE OF OPERATION

4.1 GENERAL DESCRIPTION

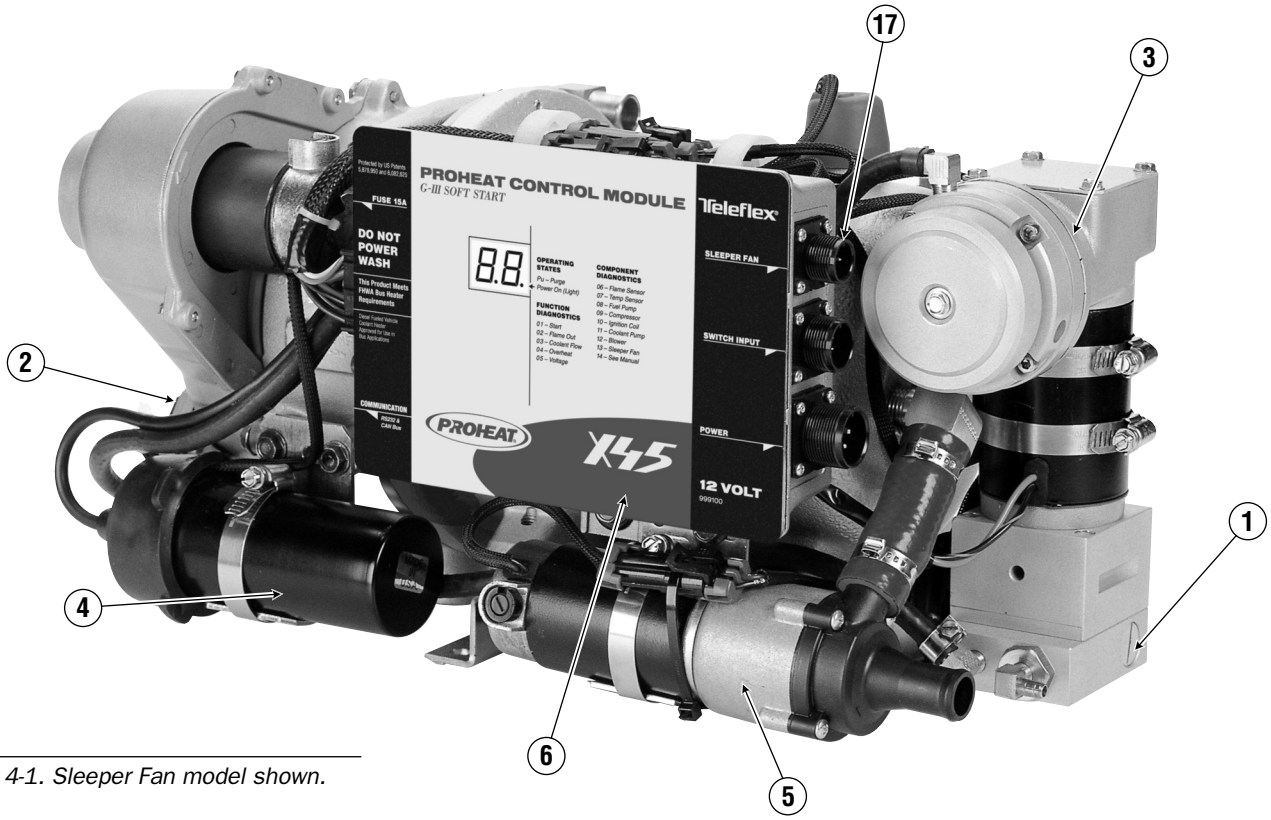


Figure 4-1. Sleeper Fan model shown.

1. Fuel Pump A gear pump driven from the same motor as the compressor pulls fuel from the tank. The fuel is filtered at the fuel pump inlet.

2. Fuel Regulator Reduces fuel to atmospheric pressure. Siphoning action from the nozzle draws fuel from the regulator. Without this siphoning there is no fuel flow.

3. Air Compressor A diaphragm type compressor supplies air to the fuel nozzle.

4. Ignition Coil An automotive type ignition coil supplies high voltage to the ignition electrode, sparking to the combustion tube.

5. Coolant Pump Circulates the engine coolant. An impeller style pump is used because of its low current draw and free flow during engine operation. **IT IS NOT SELF-PRIMING.** The pump must be flooded and the system must be purged of all air for it to operate. (DO NOT run dry.)

Utilizes a microprocessor to monitor operating conditions and control outputs

6. PROHEAT Control Module (PCM)

to the motors and sensors. It has powerful diagnostics to assist in troubleshooting. One of the key features is the diagnostic display on the front of the PCM which has a display LED to indicate function or component problems. The PCM comes in a "Sleeper Fan 12V" or "Aux Input 12V or 24V" model. The PCM model can be identified by looking at the lexan decal as shown in Figure 4-2.

- The "Sleeper Fan" model has an output with a special current limiting feature which, if used, limits the current draw of the sleeper heater fan to 3 Amps. This is done to control the total current draw on the vehicles batteries. This operation is typically used for truck installations.
- The "Aux Input" model uses two special input pins *(see Electrical Drawing on page 1-4)* that allow for a Preheat Mode and Supplemental Mode operation. This operation is typically used for transit and coach installation.

NOTE: See "Modes of Operation Section" for a description of the operating modes used for both the "Sleeper Fan" and "Aux Input" Models

NOTE: The PROHEAT PCM “Sleeper Fan” circuit has a one minute delay during ignition.

NOTE: The PROHEAT PCM is unique in that it uses “ground-side” switching for the blower, compressor, coolant pump and ignition coil. The positive wire to the motors and ignition coil will show voltage even when the heater is switched “OFF.”

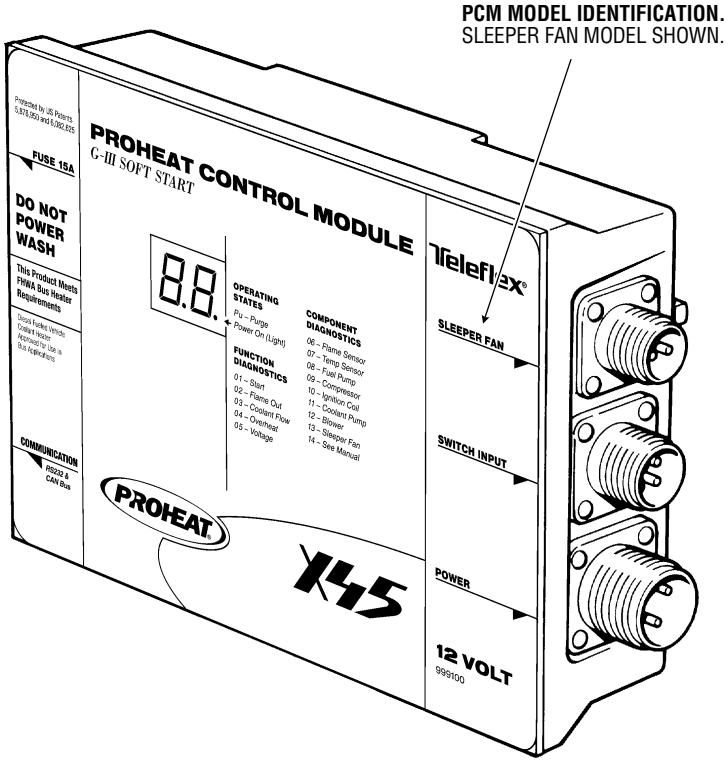


Figure 4-2 LED will light to indicate a problem. Switch or Timer indicator light will flash to indicate the diagnostic code (page 5-3).

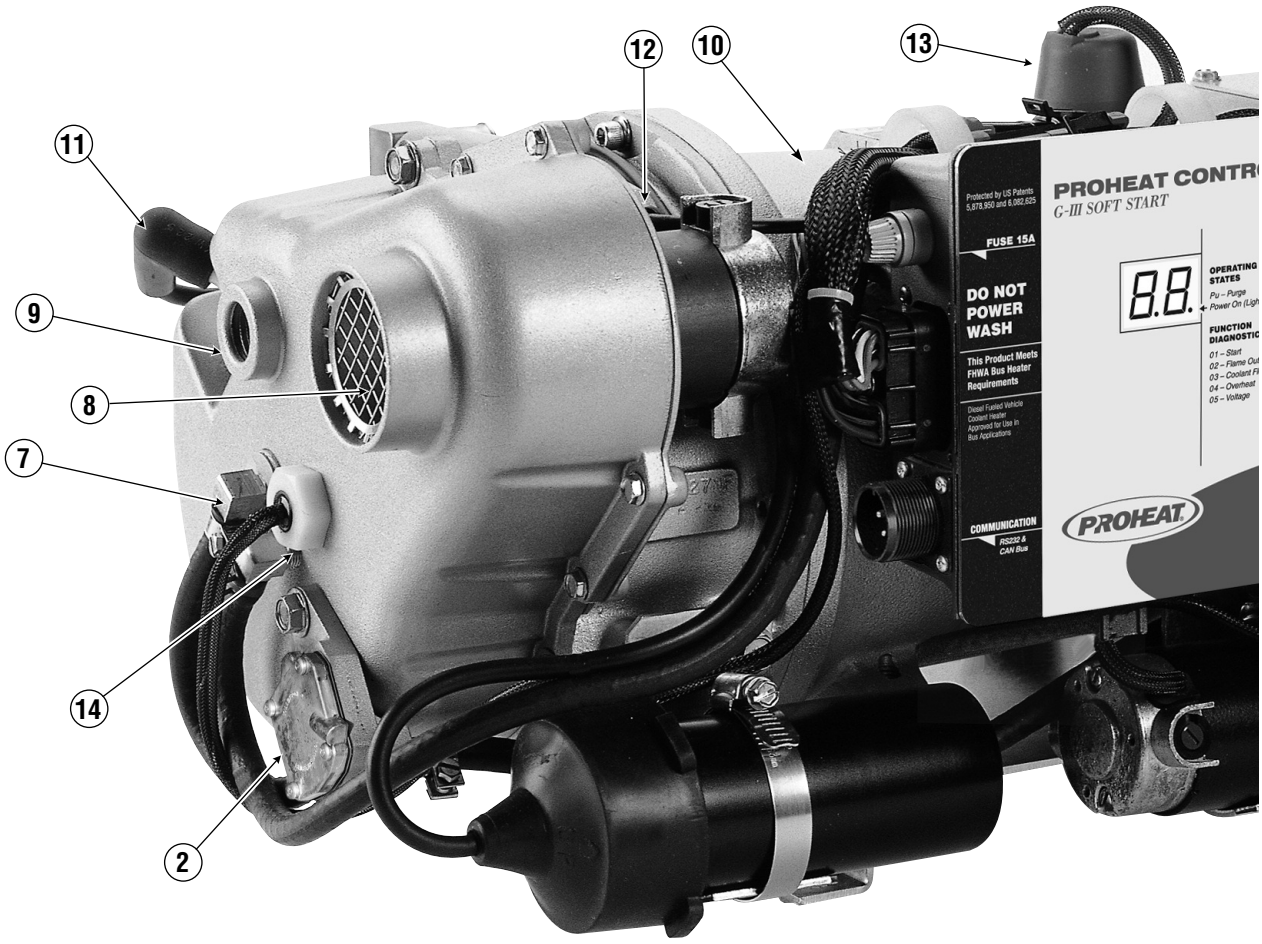


Figure 4-3

7. Nozzle An air/fuel aspirating type spray nozzle (located inside housing). The compressed air flows through the nozzle at high speed creating a venturi effect. This siphons fuel from the regulator and combines it with the air, creating an extremely fine mist which is sprayed out of the nozzle into the combustion chamber.

8. Blower Uses an impeller-type fan to supply the combustion air at low pressure. It is also used to cool and Cool Down (Purge) the combustion chamber during the 3 minute shut-down sequence.

9. Inspection Port Allows visual inspection of the combustion process and is invaluable for reducing time spent on troubleshooting and servicing the heater.

10. Heat Exchanger A two-part cast aluminum housing. Coolant will typically rise 10˚ to 15˚F (6˚ to 8˚C) in temperature as it passes through the heat exchanger, depending on the flow rate.

11. Ignition Electrode

The electrode is located near the nozzle just out of the air/fuel mixture path. During the ignition sequence the spark jumps the gap between the electrode and the combustion tube, igniting the air/fuel mixture. Spark duration is 60 seconds.

12. Coolant Temperature Sensor

Measures coolant temperature at the outlet port of the heat exchanger.

13. Overheat Breaker Sensor

Protects the heater from damage should it be operated without coolant. The overheat breaker monitors the surface temperature of the heat exchanger casting. When the temperature reaches 286˚F (141˚C) the breaker "trips out." This shuts off the power to the air compressor—extinguishing the flame. The breaker can be reset by pushing down on the red button (located under the rubber cap).

14. Flame Sensor

Photo-electrically measures the intensity of the flame. It is the flame sensor that signals to the PCM that the air/fuel mixture is burning properly.

15. On/Off Switch

Is used to switch the heater "ON" and "OFF." It has an indicator lamp that displays a red light when switched "ON." A flashing red light indicates a heater diagnostic code and one of the LEDs on the PCM diagnostic display will be lit. *(See page 5-3 for details.)*

16. 7 Day Timer

Is used to switch the heater "ON" and "OFF." This can be done manually or by a preset time and day. It has an indicator lamp that displays a red light when switched or timed "ON." A flashing red light indicates a heater diagnostic code and one of the LEDs on the PCM diagnostic display will be lit. *(See page 5-3 for details.)*

17. Sleeper Fan (only output connector shown)

On Sleeper Fan 12 V models *(see page 4-2)*, the Proheat Control Module is equipped with a 3 A limited output. It is used to drive fans or other equipment as determined by the installation *(see page 3-1)*. The output is ON 60 seconds after switch ON. In addition, it is also ON when there is a functional error *(see page 5-1 for details)*.

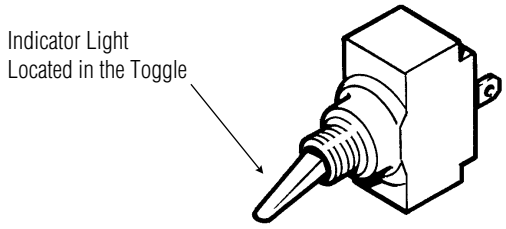


Figure 4-4 ON/OFF Switch

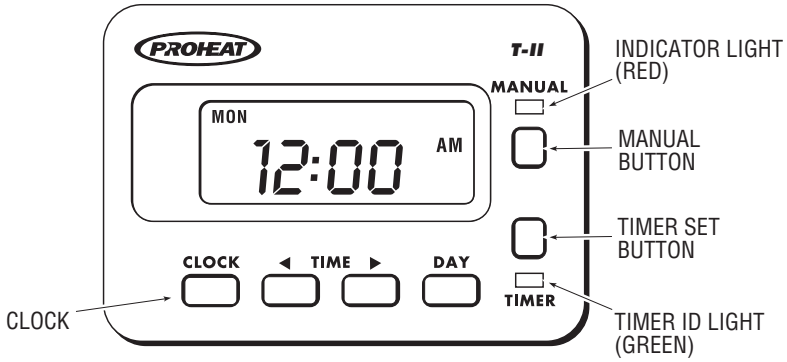


Figure 4-5 7 Day Timer

4.2 MODES OF OPERATION

The PCM comes in a "Sleeper Fan" or "Aux Input" model. The PCM model can be identified by looking at the decal as shown on page 4-2. Depending on the model and installation (refer to electrical drawing), the X45 has only the Standard Mode of Operation or combination of Standard, Preheat and Supplemental Modes of operation. The following table defines the applicability:

Operational Mode	Sleeper Fan Model	Aux Input Model
Standard	Yes	Yes
Preheat	no	Yes
Supplemental	no	Yes

Aux Input Operation Mode Summary

See page 3-18 for background information.

Standard Heat Mode
- normal operation of the Proheat
- over-rides and drops out *preheat mode*
- overrides *supplemental mode*

Supplemental Heat Mode
- similar to *standard mode* except: coolant pump does not run when Proheat is not firing
- overrides and drops out *preheat mode*
- 30 second signal required before mode enabled
- 30 second signal removal before mode shut off

Preheat Mode
- similar to standard mode Except: 90 minute time out
- activated via momentary contact push button switch with latching internal to the PCM

4.2.1 STANDARD MODE – All Models

1. Switch "ON" Standard Mode Signal

The ON/OFF switch (or Timer) lamp and the PCM "ON" LED will light. In addition, the Hour Meter (Auxiliary Output) will be powered. The PROHEAT goes to "Precheck".

2. Precheck

The PCM performs a short diagnostic cycle. This takes a few seconds to check components for proper ranges, checking for the presence of a flame, short-circuits and open circuits. If there are no errors indicated, the PROHEAT goes to "Ignition".

3. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor and fuel pump. The ignition electrode sparks for 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to "Full Output". At 60 seconds, the sleeper fan output turns on (if equipped. See page 4-2 for more information).

4. Full Output

The PROHEAT runs at Full Output until the coolant temperature reaches 185°F (85°C) at the heater outlet. The PROHEAT shuts the flame off and goes to "Cool Down (Purge)". Pu is displayed on the Proheat Control Module (PCM).

5. Purge

The air compressor and fuel pump shut off immediately. The blower and coolant pump continue to run. After 3 minutes, the blower stops and the PROHEAT goes to "Standby."

6. Standby

The coolant pump circulates the coolant through the system until the temperature drops to 150˚F (65˚C) at the heater outlet; then it will enter Precheck and repeat steps 2 to 6. The PROHEAT will continue to repeat steps 2 to 5 until it is switched “OFF.”

7. Switch “OFF”

If PROHEAT is in Full Output, it will Cool Down (Purge) first, then shut “OFF”.
If PROHEAT is in Standby, it will shut “OFF” immediately.
When switched OFF, the sleeper fan output turns off *(if equipped, see page 4-2)*.
When switched OFF, the Hour Meter (Auxiliary Output) will shut off.

NOTE: The PROHEAT will Cool Down (Purge) for 3 reasons:
- the coolant reaches 185˚F (85˚C)
- there is a function or component problem
  (See Troubleshooting & Repair on page 5-1)
- the PROHEAT is operating at Full Output when it is shut “OFF”

4.2.2 PREHEAT MODE – Aux Input Models Only

1. Activate Preheat Signal

Push the Preheat button and the PCM “ON” LED will light will turn on. In addition, the Hour Meter (Auxiliary Output) will be powered. The PROHEAT goes to “Pre-check.”

2. Precheck

The PCM performs a short diagnostic cycle. This takes a few seconds to check components for proper ranges, checking for the presence of a flame, short-circuits and open circuits. If there are no errors indicated, the PROHEAT goes to “Ignition.”

3. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor and fuel pump. The ignition electrode sparks for 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to “Full Output".

4. Full Output

The PROHEAT runs at Full Output until the coolant temperature reaches 185˚F (85˚C) at the heater outlet. The PROHEAT shuts the flame off and goes to “Cool Down (Purge).”

5. Purge

The air compressor and fuel pump shut off immediately. The blower and coolant pump continue to run. After 3 minutes, the blower stops and the PROHEAT goes to “Standby.”

6. Standby

The coolant pump circulates the coolant through the system until the temperature drops to 150˚F (65˚C) at the heater outlet. The Proheat returns to Precheck and repeats steps 2 to 6. The PROHEAT will continue to repeat this cycle until it is switched off, or will switch OFF automatically after 90 minutes.

7. After 90 minutes or Switched off

If PROHEAT is in “Full Output”, it will Cool Down (Purge) first, then shuts off.
If PROHEAT is in “Standby”, it shuts off immediately.
When switched OFF, the Hour Meter (Auxiliary Output) will shut off.

NOTE: The PROHEAT will Cool Down (Purge) for 3 reasons:
- the coolant reaches 185˚F (85˚C)
- there is a function or component problem
  (See Troubleshooting & Repair on page 5-1)
- the PROHEAT is operating at Full Output when it is shut "OFF".

4.2.3 SUPPLEMENTAL MODE – Aux Input Models Only

1. Activate Supplemental Signal for 30 Seconds

The 'ON" light and heater indicator will turn ON after 30 seconds of receiving the signal. In addition, the Hour Meter (Auxiliary Output) will be powered.

2. Supplemental Standby

The PROHEAT monitors coolant temperature until it drops below 150˚F (65°C). Once coolant temperature drops below 150˚F (65°C) the PROHEAT goes to "Pre-run".

3. Pre-run

The coolant pump operates for 3 minutes to circulate coolant through the system. If the coolant temperature rises above 150˚F (65°C), the pump shuts off and the PROHEAT returns to "Supplemental Standby". If the coolant temperature remains below 150˚F (65°C), the PROHEAT goes to Pre-check.

4. Pre-check

The PCM performs a short diagnostic cycle. This takes a few seconds to check components for proper ranges, checking for the presence of a flame, short-circuits, and open circuits. If there are no errors indicated, the PROHEAT goes to "Ignition".

5. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor and fuel pump. The ignition electrode sparks for 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to "Full Output".

6. Full Output

The PROHEAT runs at Full Output until the coolant temperature reaches 185˚F (85°C) at the heater outlet. The PROHEAT shuts the flame off and goes to "Cool Down (Purge)". Pu is displayed on the Proheat Control Module (PCM).

7. Purge

The Air Compressor and Fuel Pump shut off immediately. The Blower and Coolant Pump continue to run. After 3 minutes the Blower and Coolant Pump stop and the PROHEAT goes to "Supplemental Standby" and repeats steps 2 to 7.

8. Remove Supplemental Signal for 30 Seconds

The "ON" light and the Heater Indicator turn off after 30 seconds of the signal being removed. If the PROHEAT is in the "Supplemental Standby" or "Pre-run" sequence the PROHEAT will turn off immediately. If the PROHEAT is in any other function it will complete a "Cool Down (Purge)" function before turning off. When switched OFF, the Hour Meter (Auxiliary Output) will shut off.

NOTICE

There are special OEM versions for Supplemental Mode. For example, temperature thresholds may have a low threshold of 160°F (71°C) rather than 150°F (65°C) and a reduced coolant pump Pre-run time of 30 seconds rather than three minutes.

NOTE: The PROHEAT will Cool Down (Purge) for 3 reasons:

- the coolant reaches 185˚F (85˚C)
- there is a function or component problem *(See Troubleshooting & Repair on page 5-1)*
- the PROHEAT is operating at Full Output when it is shut off.

5.0 TROUBLESHOOTING AND REPAIR

NOTICE

Troubleshooting and repair is to be performed by Authorized Proheat Dealers.

Problems with the PROHEAT and its operation will be indicated in two ways:

1. PROHEAT Diagnostic Faults indicated by means of a flashing diagnostic code on an indicator light on the switch, Timer red manual light or OEM indicator light (installation options). See Example Proheat Behavior Error on page 5-2.
2. Operational problems may not be identified with a flashing diagnostic code (e.g. blown fuse, smoking exhaust, backfiring or low heat output. Go to page 5-34 to page 5-37.)

5.0.1 TROUBLESHOOTING A PROBLEM

STEP 1 Locate the PROHEAT, remove the enclosure lid if equipped and visually check for any problems with wiring harnesses, fuel leaks, coolant leaks, exhaust pipe damage and environmental conditions.

STEP 2 Inspect Proheat Control Module (PCM) display for error code. If PCM display is difficult to view, determine the blink code on the switch, Timer red manual light or OEM indicator light (installation options).

STEP 3 If no code is indicated, turn the PROHEAT off and then on again using the existing operational switches, timer or a PROHEAT remote start switch (PROHEAT P/N 952925K).

STEP 4 Let the PROHEAT attempt to start and/or operate. Observe the operation.

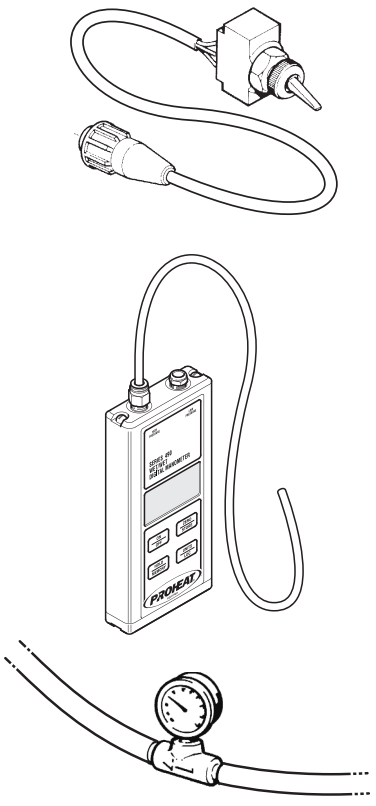


Figure 5-1 Troubleshooting Tools.

NOTE: The PROHEAT will always attempt to start twice, as long as the coolant temperature is below 150°F (65°C). If a fault is detected it will shut down, go through a **Cool Down (Purge)** and attempt a second start. After both attempts to start or operate, the PCM will display a code and the switch, Timer red manual light or OEM indicator (installation options) will blink the same code.

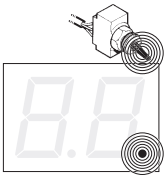
- After two consecutive start attempts, the PROHEAT will not attempt to start again and goes into a hold state. In the hold state the switch, Timer red manual light or OEM indicator light (installation options) will blink the error code(s) continuously. The PROHEAT will try again once the switch is turned "OFF" and then "ON" again.
- If the indicator light flashes, count the number of flashes and refer to the troubleshooting diagnostic code description for that number on the following pages.
- If the PROHEAT runs but is not performing or operating correctly, *consult the Operational Problems, Section 5.3 on page 5-37.*

Troubleshooting and Repair Tools Required

- **Remote Start Switch** (PROHEAT P/N 952925K)
  Allows the service technician to work at the PROHEAT. Isolates the PROHEAT from the existing vehicle system controls and comes with a built-in indicator light.
- **Digital Air Compressor Test Gauge** (PROHEAT P/N PK0037)
  Allows the service technician to check compressor pressure in order to ensure for correct fuel delivery. (Note The analog Air pressure gauge PK0060 can also be used.)

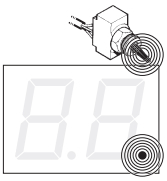
5.0.2 EXAMPLE PROHEAT BEHAVIOR ERROR – CODE 01

The following is an example of an X45 PROHEAT behavior during an error. The following example shows the sequence of events when the PROHEAT is switch “ON” in the Standard Mode (similar for Preheat and Supplemental Modes). This sequence of events occurs for Codes 01 through 12. Codes 13 and 14 do not put the heater into Cool Down (Purge) mode or shut down the PROHEAT; rather, the PROHEAT reports the error and continues to run.



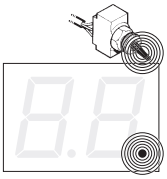
1. Switch “ON” Standard Mode Signal

The ON/OFF switch (or Timer) lamp and the PCM “ON” LED will light. In addition, the Hour Meter (Auxiliary Output) will be powered. The PROHEAT goes to “Precheck”.



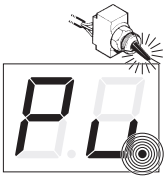
2. Pre-check

The PCM performs a short diagnostic cycle. This takes several seconds checking components for proper ranges, checking for the presence of a flame, short-circuits and open circuits. If there are no errors indicated, the PROHEAT goes to “Ignition”.



3. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor and fuel pump. The ignition electrode sparks for 60 seconds.



4. Error Detection – Purge

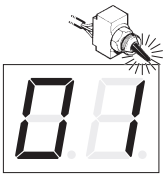
If the flame sensor did not “see” a flame in 60 seconds after entering ignition, the air compressor and fuel pump shut off immediately. The blower and coolant pump continue to run.

Code 01 will be displayed alternating with Pu. There will be one flash, pause and then one flash repeating on the switch, timer red manual light or OEM indicator light. After 3 minutes, the blower stops and the PROHEAT attempts to start again.

NOTE: Codes 13 and 14 will not cause the heater to shut down. The PROHEAT reports the error and continues to run.

5. Steps 1 to 4 are Repeated

The PROHEAT always restarts after one error detection (except for Codes 13 and 14). After the 3 minute Cool Down (Purge), the PROHEAT will go through Precheck, Ignition and the Error Detection – Cool Down (Purge) cycle one more time.



6. Hold State

After two consecutive Code 01 errors, the PROHEAT goes into a hold state. No further start attempts will be made. Code 01 will be displayed continuously and the PCM LED “ON” light will turn “OFF.” In addition, the Hour Meter (Auxiliary Output) will shut off.

The switch, timer red manual light or OEM indicator light will continue to flash once, pause, flash and repeat.

NOTE: In order to restart the heater turn the switch “OFF” and back “ON”.

5.1 OPERATION INDICATORS, FUNCTION AND COMPONENT DIAGNOSTICS

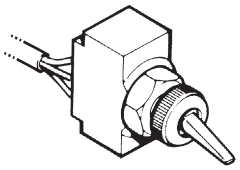


Figure 5-2 Remote On/Off Switch.

The microprocessor in the PCM continually monitors all the PROHEAT systems. If the internal diagnostics discover a problem, a diagnostic code will be displayed on the PCM function display. The remote ON/OFF Switch, Timer red manual light or OEM indicator light (installation options) will also flash the diagnostic code followed by a pause and then repeat. The number of flashes correspond to the numbered diagnostic code. For example, 5 flashes indicates a VOLTAGE ERROR. *(See diagram below for a complete list of operation states and error flash codes.)*

If multiple errors occur, multiple codes will be displayed. For example, if a 5 and 9 error occurs together, the PCM LED will flash 5 and then 9. Similarly, the remote ON/OFF Switch, Timer red manual light or OEM indicator light (installation options) will flash 5 times, pause and then 9 times.

NOTICE

The X45 fuel pump is a gear pump driven directly by the compressor motor. The fuel pump is NOT being monitored electrically. Should this component diagnostic code appear there will be a fault in the main wire harness connector *(See page 5-35, Figure 5-27)* or in the PCM. All mechanical problems with the fuel pump will be indicated as either a START (1) or a FLAME OUT (2) diagnostic code.

NOTICE

Code 13, Sleeper Fan, is only applicable to "Sleeper Fan" models. Should this diagnostic code appear on "Aux Input" models there will be a fault with the PCM.

CODE No.	Description of Operating State and Diagnostic Codes	No. of Flashes
Operation Indicators		
8.8.	Power Up	No Indicator
•	Switch On (Standard, Preheat or Supplemental Mode)	Solid Indicator
Pu	Cool Down (Purge)	Solid Indicator
Function Diagnostics		
01	Start	1
02	Flame Out	2
03	Coolant Flow	3
04	Overheat	4
05	Voltage	5
Component Diagnostics		
06	Flame Sensor	6
07	Temp Sensor	7
08	Fuel Pump *(See Note)*	8
09	Compressor	9
10	Ignition Coil	10
11	Coolant Pump	11
12	Blower	12
13	Sleeper Fan	13
14	Hour Meter (Auxiliary Output)	14

Figure 5-3 Function Display Panel Detail & Error Flash Codes

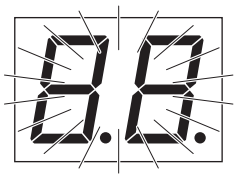
5.1.1 OPERATION INDICATORS

Operation States:

8.8. – Power Up
• – On
Pu – Cool Down (Purge)

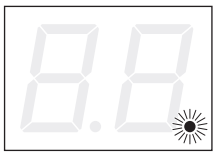
The operation indicators signal normal functioning of the PROHEAT. These two states do not indicate a fault.

Power Up



The Power Up indicator communicates that the PROHEAT power has been supplied. All segments of the LED momentarily flash and then turn off.

On



The ON indicator code communicates that the PROHEAT is operationally “ON” whenever the On LED is solid. This indicates a Mode of Operation *(see page 4-5)* is active.

⚠ WARNING

The "ON" LED indicates that the heater can start at any time. Refer to page 4-5 to page 4-7.

Purge

The PROHEAT will be in the Cool Down (Purge) state as defined in the Modes of Operation *(see page 4-5)* when “Pu” is displayed.

5.1.2 FUNCTION DIAGNOSTICS

Function Errors:

1 – Start
2 – Flame Out
3 – Coolant Flow
4 – Overheat
5 – Voltage

Errors displayed on the PCM diagnostic panel will cause the heater to shut down. These diagnostic codes are usually the result of a system problem.

It is possible to have two or more diagnostic codes displayed at the same time. A function diagnostic code may be displayed in conjunction with a component diagnostic code.

1 Start

A START diagnostic code. Indicates that the flame sensor did not see a flame during the FULL 60 second ignition period.

If the START diagnostic code is displayed, switch the heater “OFF” and then “ON” to restart. Observe the exhaust and the heater operation through the inspection window.

Troubleshoot the Flame Out diagnostic code based on:

1 Fuel System.
Go to page 5-6 to page 5-12, Steps 1 to 5.
- There is no fuel, fuel odor or atomized fuel coming from the exhaust pipe.
- There is no hot exhaust coming from the exhaust pipe.
- There is no flame visible through the inspection window.

2 Ignition System.
- There is raw fuel and/or atomized fuel and a raw fuel odor coming from the exhaust pipe. Go to page 5-13.
- There is no hot exhaust coming from the exhaust pipe.
- There is no flame visible through the inspection window.

3 Flame Sensor.
Go to page 5-14.
- There is a flame and the combustion sounds good, the PROHEAT appears to be operating normally.
- No smoke, raw fuel odor or atomized fuel is coming from the exhaust pipe.

Fuel System Schematic

The PROHEAT X45 fuel system operates on a venturi-style atomizing nozzle technology. It operates similarly to a compressed air paint sprayer.

As shown in Figure 5-3, when the compressor/fuel pump motor is on, fuel is drawn from the tank through the fuel pump and pressurizes the high pressure side of the fuel regulator. The fuel regulator reduces the fuel pressure supplied by the fuel pump to atmospheric pressure. Compressed air flowing through the nozzle creates a venturi or suction effect which siphons fuel from the regulator. If the compressed air flow through the nozzle stops, the regulator closes, shutting off the fuel flow.

Also shown in Figure 5-3 is the electrode and the flame sensor. The electrode provides the spark to ignite the fuel and the flame sensor is an optical device which “sees” the flame.

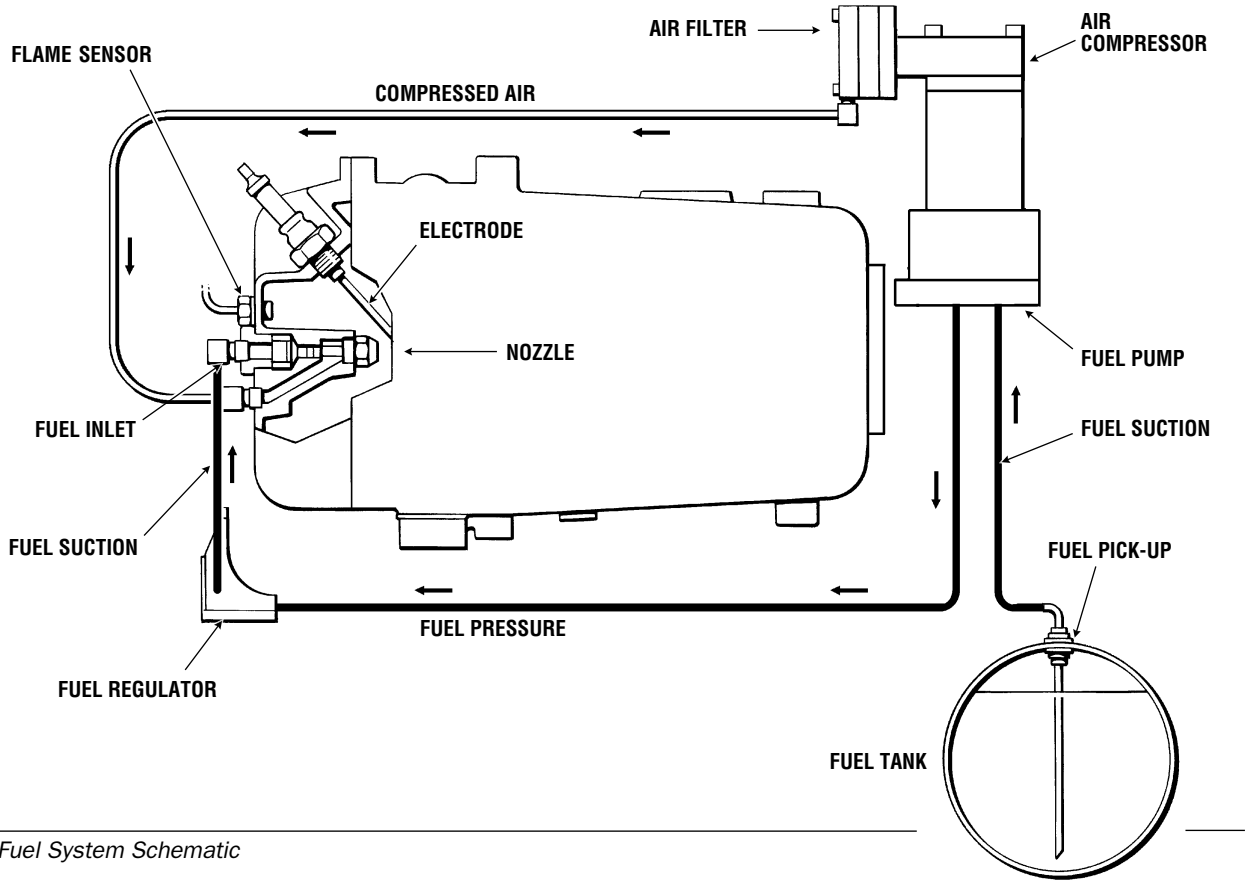


Figure 5-3 Fuel System Schematic

Fuel System – Step 1

Check: Fuel and fuel supply

a) The PROHEAT operation when supplying fuel from a direct source.

Test Procedure — Supplying fuel from a remote source:

a) Remove the fuel supply line from the outlet of the fuel regulator.

b) Put this end of fuel into a small container of CLEAN fuel that is about the same level as the regulator centre similarly to Figure 5-4. This will remove the vehicle fuel supply, fuel pump and regulator from the fuel delivery.

b) Switch the PROHEAT on and operate for at least 90 seconds. Observe the operation.

If the PROHEAT functions correctly, the fault is with the regulator, fuel supply or fuel pump. Check fuel lines, connections and routing back to fuel tank. Proceed to Step 2.

If a Start diagnostic code is indicated, the problem is with the nozzle or compressor fuel system. Proceed to Step 4.

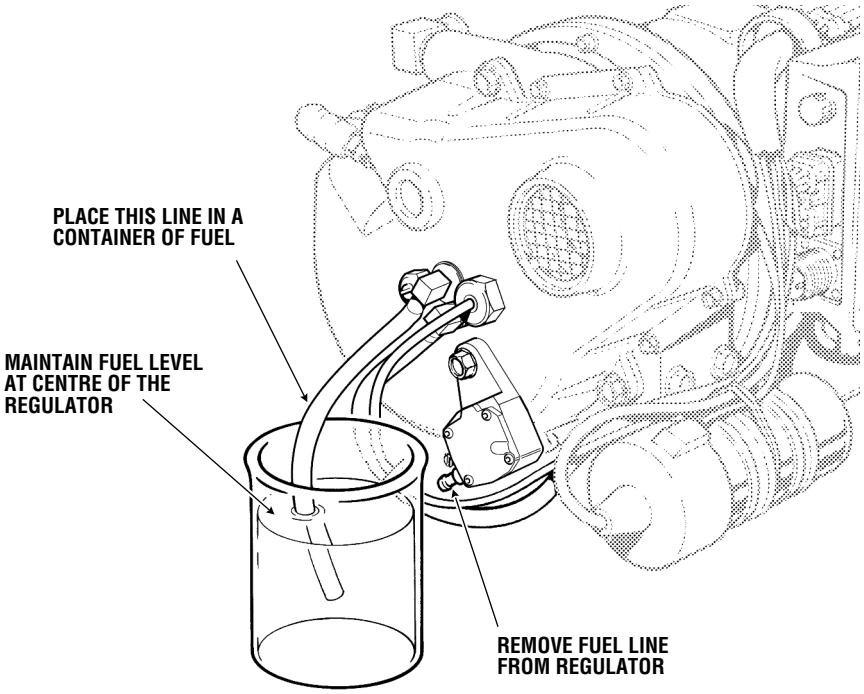


Figure 5-4 Eliminating Fuel Pump and Regulator from system.

Fuel System – Step 2

Check: Regulator

a) For damage, contamination and mechanical operation.

Test Procedure — Vent Hole Regulator Style:

a) Disconnect the fuel line at the nozzle fuel inlet fitting and place in a container.

b) Inspect vent hole to ensure that it is not plugged.

c) Start the heater. No fuel should be exiting the outlet of the regulator.

If fuel is leaking from the outlet, replace fuel regulator.

Test Procedure — Capped Style:

a) Remove fuel line that goes from the outlet of the regulator to the nozzle.

b) Start the heater. No fuel should be exiting the outlet of the regulator.

If fuel is leaking from the outlet, replace the fuel regulator.

c) Install clear plastic hose that replaces the hose removed.

d) Start the heater. Fuel should start to flow out of the regulator and up to the nozzle.

If the regulator does not operate as described in d), replace the regulator.

Fuel System – Step 3

Check: Vehicle Fuel Supply, Fuel Pump

a) Vehicle fuel level and/or for fuel gelling during cold weather.

b) Air leaks and/or restrictions in the fuel supply lines to the PROHEAT.

c) The PROHEAT operation when supplying fuel from a direct source.

Test Procedure — Fuel Supply Inspection:

a) Is there fuel in the tank?

b) Check fuel lines, connections and routing back to the fuel tank for kinks, loose fittings, stiff lines or cuts.

Replace any fuel lines that are cut, brittle or chaffed.

Test Procedure — Fuel Pump Inspection:

a) Disconnect the fuel line at the inlet to the regulator and place into a cup.

b) Start PROHEAT. Ensure that fuel flows out of the fuel line in a steady, uninterrupted and clear stream of fuel.

c) If fuel does not flow, check filter and relief valve for contamination as per Service Bulletin SB0062. (See appendices page 7-1.)

NOTICE

A
- Apply Loctite 242 to threads
- Torque bolts (2) to 25±3 in/lbs (2.8±0.3 Nm).

B
- Lubricate o-ring with diesel fuel
- Torque relief valve to 22±2 in/lbs (2.5±0.2 Nm).

C
- Apply Loctite 59241 sealant to threads.
- Torque elbow (1) to 55±5 in/lbs (6.2±0.5 Nm) minimum or until elbow is at correct orientation.

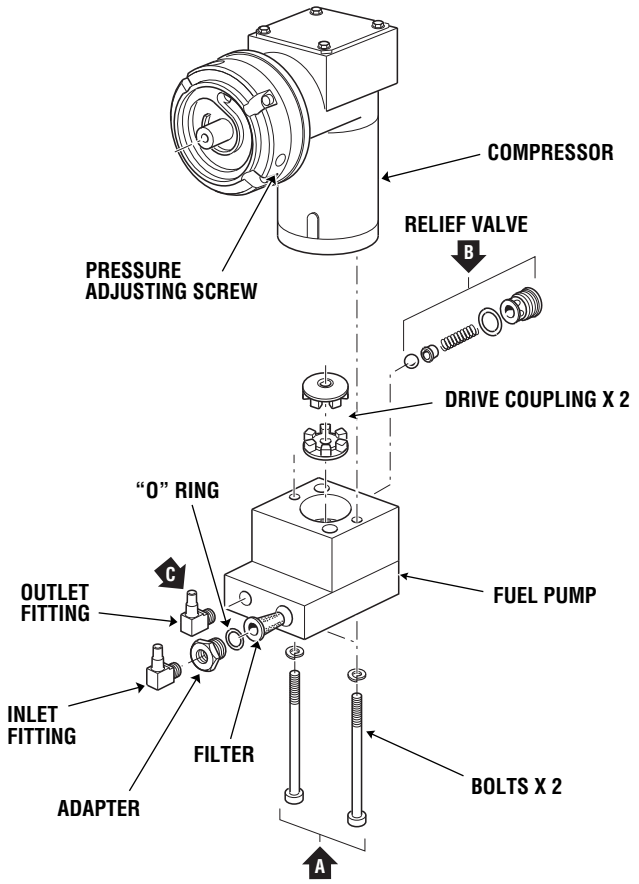


Figure 5-5 Compressor / Fuel Pump Assembly

Fuel System – Step 4

Check: Air Compressor

a) Air compressor pressure and operation

⚠ WARNING

Shock hazard due to high secondary coil voltage.

Test Procedure — Air Compressor pressure:

a) Run heater until warm to the touch. This ensures the heater components are up to normal operating temperature.

b) Switch heater off.

c) Install PK0037 Digital Manometer (or a calibrated PK0060 Analog Air pressure gauge) in-line as shown in Figure 5-6.

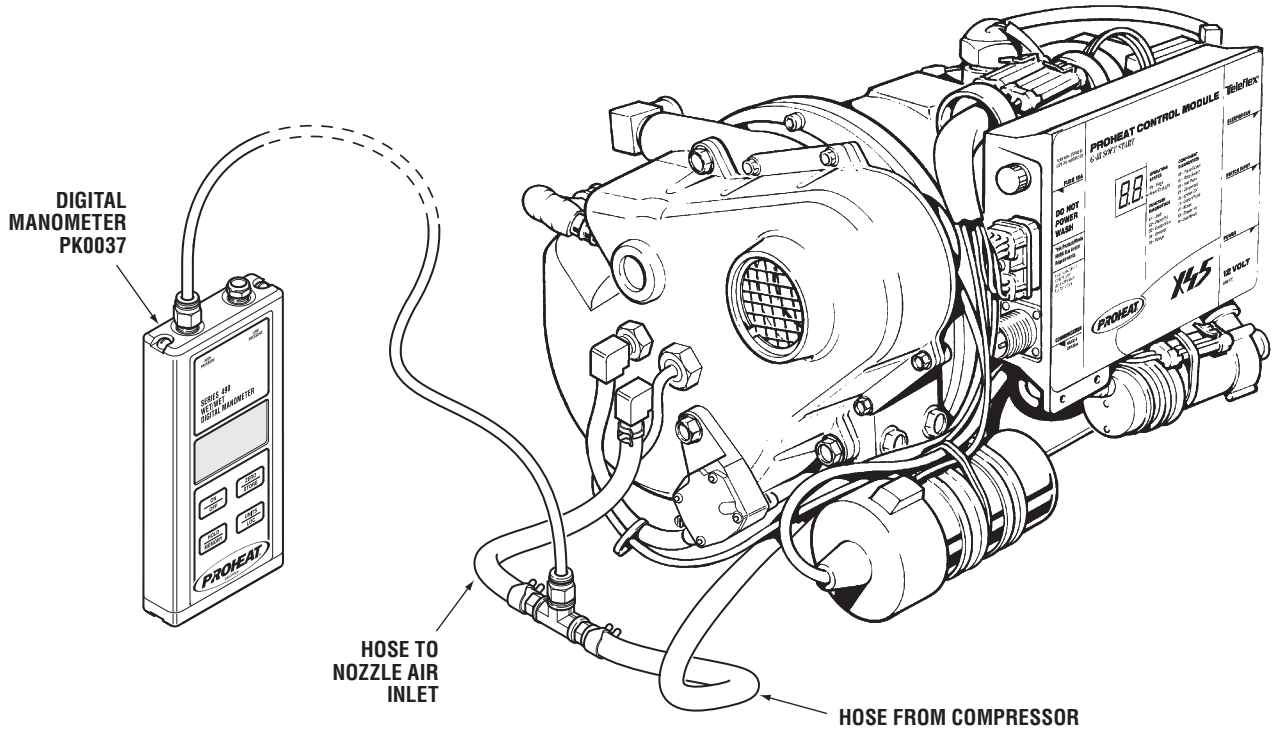


Figure 5-6

NOTICE

If using PK0060, Analog Air pressure gauge, calibrate gauge before each use refer to: www.proheat.com/PDFs/990614.pdf

NOTICE

Remove Pressure Gauge when finished with measuring & setting procedure.

NOTICE

Altitude Correction is needed above 3000 Feet (see inset on charts). DO NOT adjust air pressure when above 6000 Feet.

d) Locate the rubber boot on the positive end of the ignition coil and peel it back to expose the positive terminal.

e) Select the DC Volts range of a multimeter and connect as per Figure B. The positive lead of the multimeter should be attached to the positive coil lead. The negative lead of the multimeter should be attached to the heater chassis at the PROHEAT ground boss.

f) With the heater running in full output (flame on and ignition is off) read the voltage and refer to the 12 or 24 volt chart (Figure 5-8 and Figure 5-9) for the correct Air Pressure Reading.

g) The reading must be within the range of the shaded area as shown in Figure 5-8 and Figure 5-9.

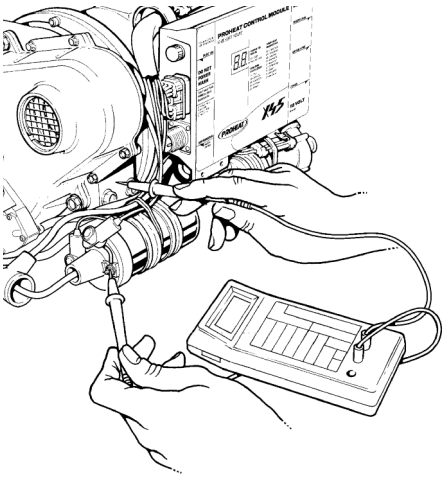


Figure 5-7

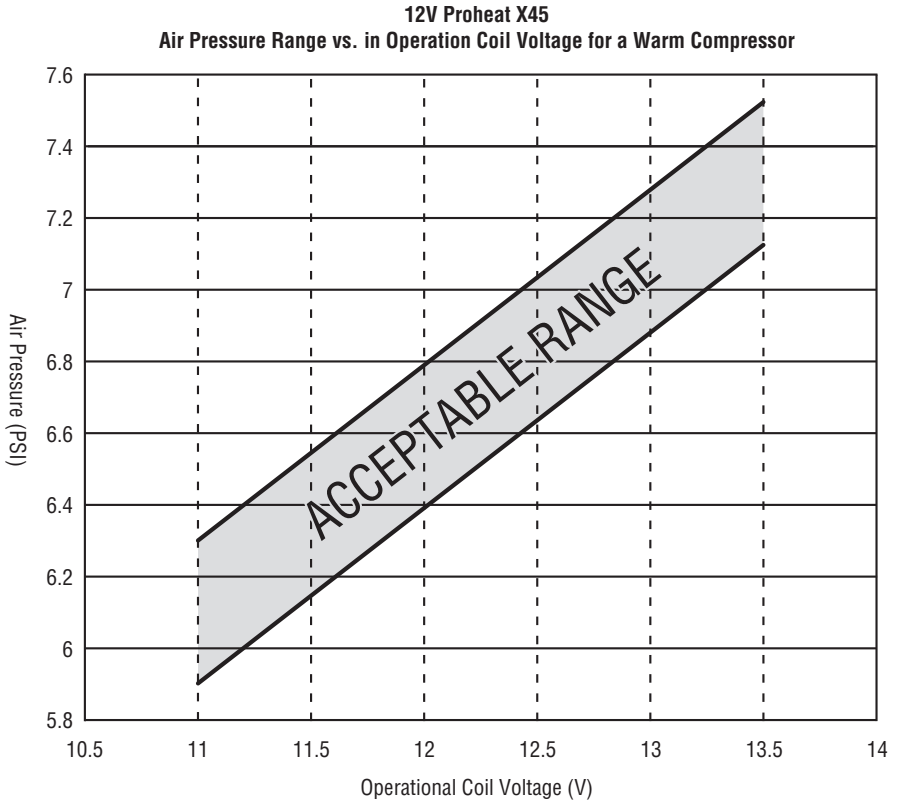


Figure 5-8 12V System Air Pressure Chart

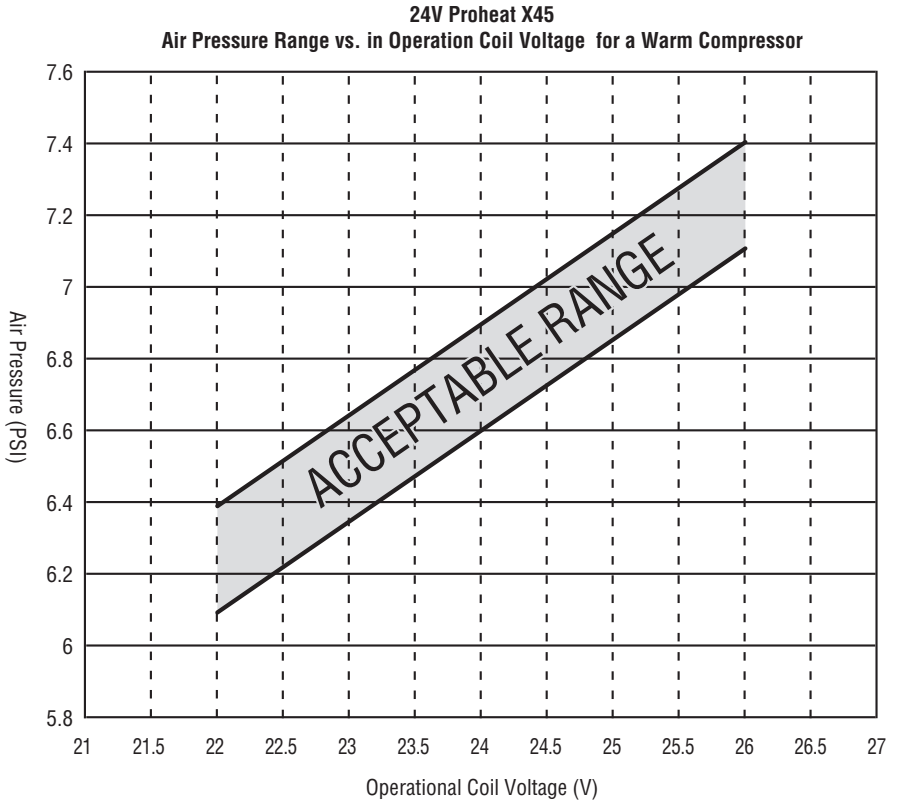


Figure 5-9 24V System Air Pressure Chart

Air Pressure Checks

If Air Pressure is outside the range for the measured voltage please perform the following checks before adjusting the compressor:

Low Pressure Reading – Check:

i) Inspect air line from compressor outlet to fan end inlet for leaks, kinks or other restrictions.

ii) Check condition of air compressor filter. Retest with the filter removed.

High Pressure Reading – Check:

i) Nozzle and cavity for blockage. Refer to Step 5 on page 5-12.

ii) Compressor is out of adjustment.

Compressor Adjustment

After performing the above checks and the Air Pressure is still outside the range for the measured voltage Adjust the air pressure by turning the screw as shown in Figure 5-10. Altitude Correction is needed above 3000 Feet (see inset on charts).

DO NOT adjust air pressure when above 6000 Feet.

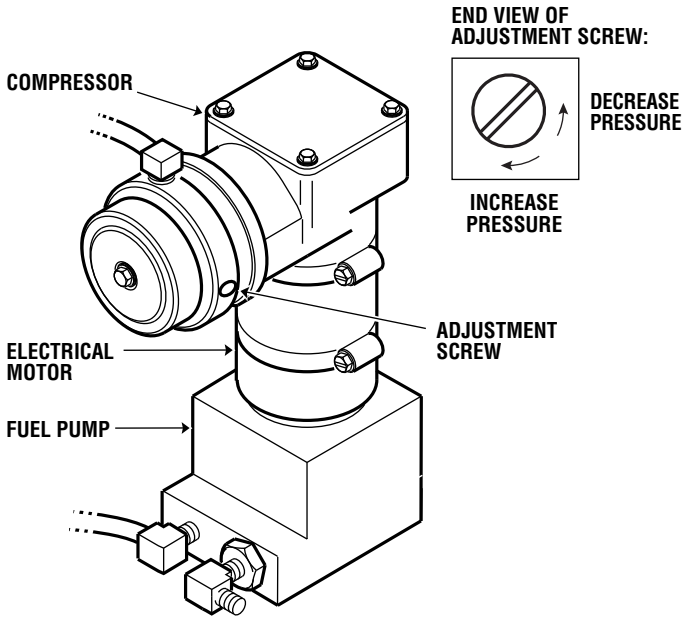


Figure 5-10 Compressor / Fuel Pump Assembly

If the air compressor pressure cannot be adjusted back into normal range, replace air compressor.

Fuel System – Step 5

Check: Nozzle

a) For fuel nozzle and o-ring damage and/or contamination.

Test Procedure — Fuel Nozzle Removal, Inspection & cleaning or replacement:

a) Remove three (3) bolts from the fan end and open up heater.

b) Remove nozzle from fan end.

c) Disassemble, inspect, clean and reassemble Fuel Nozzle (Figure 5-12).

Fuel Nozzle disassembly, inspection, cleaning & reassembly:

- Hold the Fuel Nozzle stem lightly but firmly in a vise using soft jaws, take care not to cause damage. Disassembles in three pieces.
- Inspect Fuel Nozzle stem and O-ring for contamination and/or damage. Inspect and clean distributor fuel orifice (a soft bristled brush may be used), air passages, head and stem with electrical contact cleaner or warm soapy water.
- Re-clamp the Fuel Nozzle stem lightly but firmly in a vise using soft jaws, take care not to cause damage. Reinstall the distributor and Fuel Nozzle head. Ensure that the distributor is seated correctly. The Fuel Nozzle assembly is self-aligning. Torque to 30±3 in/lbs (3.4±0.3 Nm).

d) Inspect the Fuel Nozzle cavity and clean as necessary using electrical contact cleaner or warm soapy water

e) Reinstall Fuel Nozzle into the fan end using diesel fuel to lubricate the o-ring. Torque to 150±10 in/lbs (17±1.1 Nm).

f) Reinstall fan end and torque three (3) bolts to 75±5 in/lbs (8.5±0.5 Nm)

NOTICE

Fuel Nozzle parts are a matched set and not interchangeable.

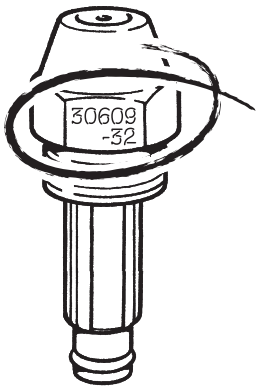


Figure 5-11. Nozzle Number Location

NOTICE

DO NOT use a tip cleaner in the fuel orifice

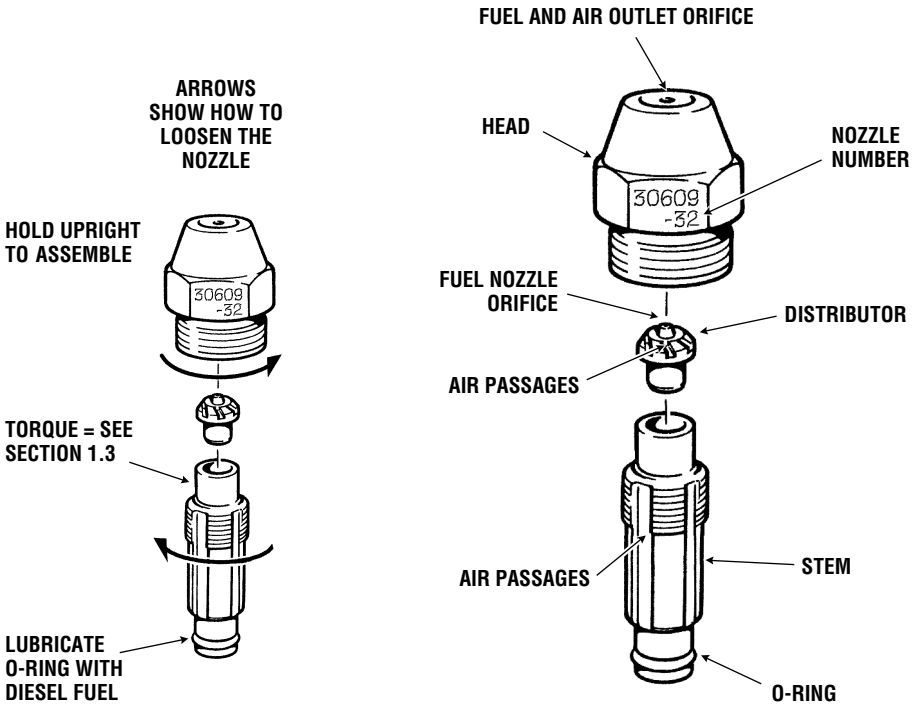


Figure 5-12 Fuel Nozzle Assembly

Ignition System

Check: Ignition Coil and Electrode Gap

a) Electrode cleanliness.

b) Electrode positioning for proper gap.

⚠ WARNING

The PROHEAT chassis is grounded to the PCM as shown in Figure 5-14. Ensure that the ground is securely connected. Failure to ensure a proper ground may result in electrical shock.

Test Procedure — Ignition System and Electrode Spark Inspection:

a) Inspect high tension lead between the coil and the electrode. Ensure that there is a proper connection at both the coil (positive and negative terminals) and at the electrode.

If the high tension lead is cut or damaged, replace.

b) Remove three (3) bolts from the fan end and open up heater.

c) Check the electrode for carbon buildup and clean as required.

d) Check electrode gap as per Figure 5-13.

e) Reinstall fan end and torque three (3) bolts to 75±5 in/lbs (8.5±0.5 Nm).

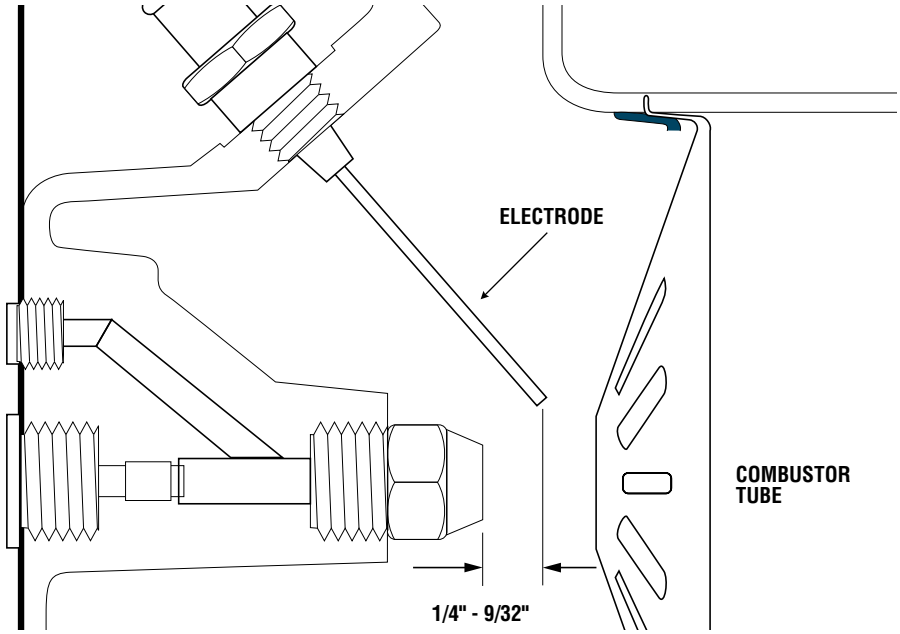


Figure 5-13 Electrode Gap Detail

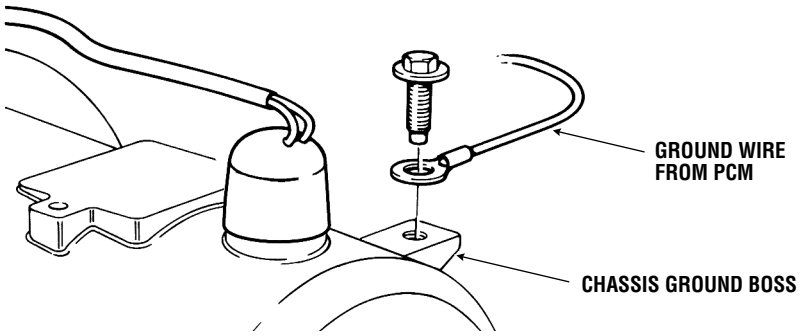


Figure 5-14 PROHEAT Ground Boss

Flame Sensor

Check: Flame Sensor

a) Flame sensor operation.

NOTICE

If the lens is dirty, the sensor does not properly “see” the flame.

Test Procedure — Flame Sensor Circuit:

a) Check cleanliness of the flame sensor.

b) To test flame sensor for operation:

Spare Flame Sensor Available – Check:

i) Ensure unit is powered off. Disconnect flame sensor.

ii) Connect known good Flame Sensor to harness.

iii) Hold up known good Flame Sensor to Inspection Port.

iv) Start heater with the known good flame sensor held to Inspection Port.

If heater runs for at least 90 seconds with the known good flame sensor, replace flame sensor as it is faulty.

NOTICE

DO NOT use an LED flashlight. Only an incandescent flashlight will check the sensor operation.

Spare Flame Sensor Not Available – Check:

i) Ensure unit is powered off. Disconnect flame sensor.

ii) Shine incandescent flashlight directly at sensor.

iii) Start heater with a flashlight shined directly at the sensor.

iv) Code 6 should be displayed immediately on start up.

If Code 6 does not display immediately on start up, replace flame sensor as it is faulty.

2 Flame Out

Indicates that a flame was detected (started successfully for at least 60 seconds) but is unable to maintain a steady flame before reaching the cycle off temperature of 185°F (85°C).

Flame Out sequence:

a) A flame is detected during the Ignition period and during Full Output.
b) The flame goes out or fails to be detected.
c) The ignition is switched on for a maximum of 10 seconds to try and reestablish the flame.
d) If the flame is not detected within 10 seconds, the Flame Out diagnostic code is displayed.
e) The PROHEAT goes into Cool Down (Purge) mode and attempts to restart after Cool Down (Purge) is complete.

A Flame Out diagnostic code distinguishes that:

a) A flame was detected therefore there was a spark and the Ignition system works.
b) The flame was detected therefore the Flame Sensor works.
c) The fault is in the fuel supply system.
d) The Flame Sensor could be dirty.

Troubleshoot the Flame Out diagnostic code based on:

1 Fuel supply to the PROHEAT.
Go to page 5-6 and perform Fuel Systems Steps 1 to 5.
- Fuel tank pick-up.
- Fuel fittings.
- Fuel lines.
- OEM supplied filters and check valves.

2 PROHEAT fuel and flame detection system.
Go to page 5-7 through page 5-14 and perform Fuel Systems Steps 2 to 5, Ignition System and Flame Sensor checks.
- Fuel Supply Pump
- Air Compressor – pressure
- Fuel Regulator – dirty or clogged
- Nozzle – dirty or clogged
- Flame Sensor – dirty

3 Operational symptoms that may occur in conjunction with a Flame Out code.
Go to page 5-37.
- Combustion hesitation or coughing.
- Backfiring.
- Smoke.
- Strong diesel fuel odor.

3 Coolant Flow

A COOLANT FLOW diagnostic code is displayed when the coolant temperature reaches 185˚F (85˚C) in less than one minute after ignition. This indicates that the coolant flow is severely restricted or blocked. This feature aids in detecting coolant flow problems that can degrade the PROHEAT performance.

An in-line flow indicator is a valuable troubleshooting tool used to: *(Figure 5-15)*

a) Check the coolant flow and direction.
b) Check for air in the system.
c) Check for restrictions caused by the truck systems ie. Shuttle valves, manual valves, air operated valves.

Check: Coolant Flow

a) **Coolant Lines:** For restrictions and blockages Are clamps tight?
b) **Shut-off Valves:** Ensure that shut-off valves are open and functioning properly.
c) **Fittings:** Fittings must be at least ½" NPT or larger. Avoid using 90˚ fittings where possible.
d) **Coolant Flow Direction:** The PROHEAT **must** be plumbed so that the coolant pump is pumping the coolant in the same direction as the engine coolant pump. The PROHEAT can be used when the engine is running.
e) **Coolant Pump:** Does the pump function properly? *(page 5-27)*
f) **Coolant System Capacity:** The coolant system must contain at least 3 gallons (11 litres) of coolant. If the system contains less the coolant may reach 185°F in less than 1 minute causing a COOLANT FLOW diagnostic code.
g) **Sleeper Heater:** Many OEM sleeper heaters are combined with an air conditioning system. The solenoid shut-off valve used to cut off coolant flow during the air conditioning mode, must be open when using the PROHEAT. *(Refer to page 3-9.)*

NOTICE

If the coolant system is contaminated with magnetic material, it may cause the impeller to stop turning.

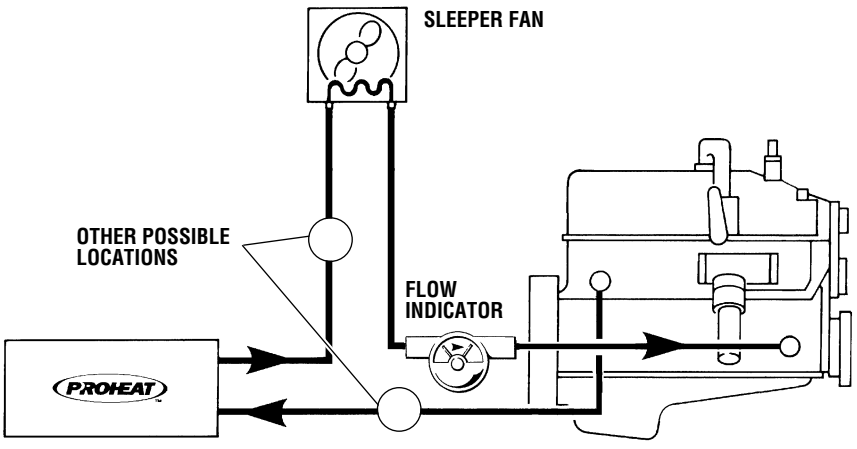


Figure 5-15 Flow Indicator – TK9002

4 Overheat

An OVERHEAT diagnostic code is displayed when the overheat breaker has tripped, shutting the heater down. This occurs if the heater has been started with little or no coolant in the heat exchanger.

Check: Coolant Flow

a) Is there coolant in the system?

b) Determine if there is a blockage or air in the plumbing.

The compressor motor is wired in series with the overheat breaker. The breaker contains a normally closed thermo switch. When the thermostat reaches the preset temperature of 286°F (141°C), the contacts OPEN shutting the compressor and fuel pump OFF, instantly shutting the heater down. It cannot be restarted until the breaker is manually reset.

To reset the breaker, remove the rubber cap covering the top of the overheat breaker and press the red reset button on top. If the breaker will not reset, allow the heater to cool.

Test Procedure:

a) Connect a multimeter (adjusted to measure resistance) to the overheat breaker connector. *(Figure 5-16.)*
The sensor should be normally closed. If the sensor has tripped the circuit should be open.

⚠ CAUTION

Do not reset the Overheat breaker until the cause of the overheat condition has been determined.

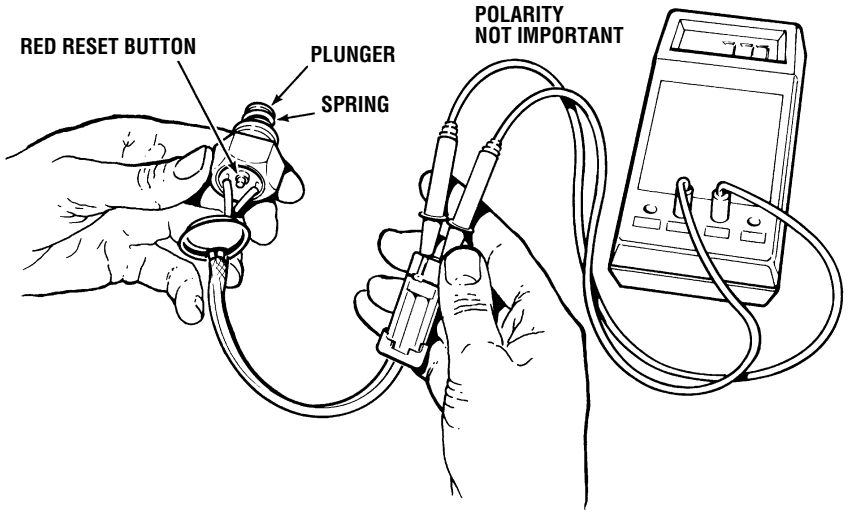


Figure 5-16 Overheat Sensor Test

5 Voltage

A VOLTAGE diagnostic code indicates that the supply voltage to the heater is out of the normal operating range.

Voltage ranges:

12 Volt heater – 10.0 to 15.0 Volts

24 Volt heater – 20.0 to 30.0 Volts

Check: **Vehicle Voltage**

a) Heater voltage must be within the specified range. See following page for procedure to measure heater voltage.

NOTE: Bad connections may show good voltage under no load conditions but not under full load. With the heater "OFF," measure the voltage. Then switch the heater "ON" and measure the voltage again. If the voltage drop is more than one Volt, check the vehicle battery connections, harness and the power connection at the PCM.

b) If the measured voltage is higher than the specified range then check the voltage regulator on the vehicle.

NOTE: If the vehicle batteries are marginal, starting the vehicle while the heater is running may:

a) Drop the voltage enough to cause a voltage error.

b) Cause random component errors (brown out).

To reset the PCM, switch the heater "OFF" and then back "ON" at the dash ON/OFF Switch. If the problem continues, load test the batteries to confirm their condition. Each battery should be independently tested.

Current: Checking current draw is done at the power harness connections on the batteries.

1) Check current draw on the red POSITIVE wire with the heater NOT running. Should read 50 to 100 mA.
2) Check current draw on the red POSITIVE wire with the heater running in full output, ignition "OFF." For 12 V models, the current should be 6.5 to 9.0 A (varies with input voltage). For 24 V models, the current should be 2.0 to 6.0 A (varies with input voltage).
3) Check current draw on the black NEGATIVE wire with the heater NOT running and the red POSITIVE wire disconnected. Should read 0 mA. This test is to confirm whether or not there is a power leakage from the vehicle through the heater.

Heater Voltage Measurement

The positive terminal of the ignition coil is always hot relative to the heater chassis ground as long as power is connected to the heater. This is the supply voltage to the heater.

Test Procedure:

a) Locate the rubber boot on the end of the ignition coil and peel it back to expose the positive and negative terminals.

b) Select the DC Volts range of a multimeter and connect as per *Figure 5-17.* The positive lead of the multimeter should be attached to the positive coil lead. The negative lead of the multimeter should be attached to the heater chassis at the PROHEAT ground boss. *(Figure 5-17)*

c) Read the voltage with the heater running or trying to run.

Normal Voltage Ranges

12 Volt heater – 10.0 to 15.0 Volts

24 Volt heater – 20.0 to 30.0 Volts

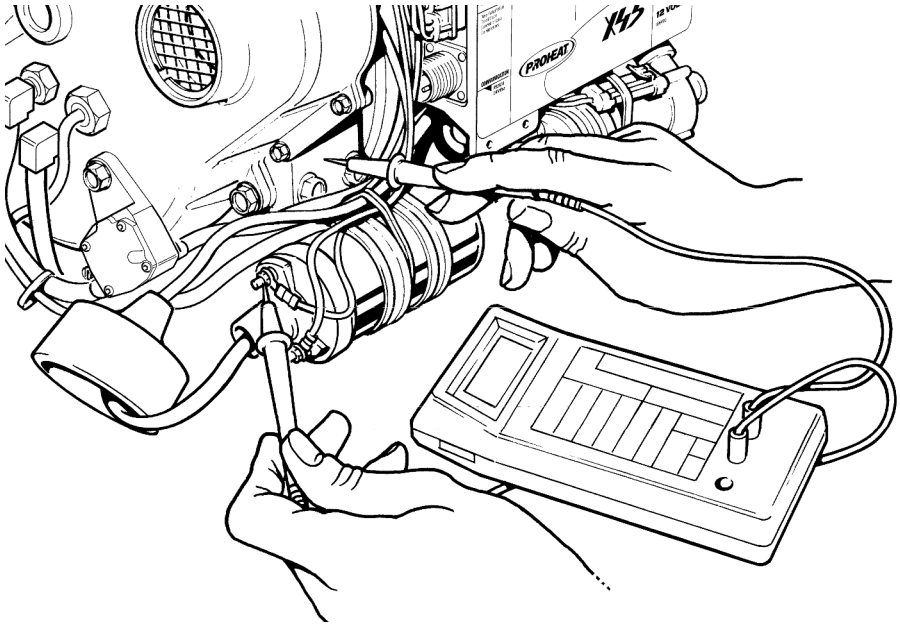


Figure 5-17 Heater Voltage Measurement

5.1.3 COMPONENT DIAGNOSTICS

NOTICE

A SLEEPER FAN error (13) and HOUR METER error (14) will not shut the PROHEAT down and heat to the engine will be maintained.

Component Faults:

6 – Flame Sensor	9 – Compressor	12 – Blower
7 – Temp Sensor	10 – Ignition Coil	13 – Sleeper Fan
8 – Fuel Pump	11 – Coolant Pump	14 – Hour Meter

This section covers the individual heater components. In many cases there is a corresponding indicator light on the PCM function display. The indicator light only indicates an electrical problem, NOT a mechanical failure. Component problems can also cause Function diagnostic codes.

6 Flame Sensor

A FLAME SENSOR diagnostic code indicates an electrical short circuit in the flame sensor wiring or a flame sensor failure. In addition, it can also indicate in rare cases the flame sensor detected a flame during pre-check *(see Modes of Operation Section)*. It will not indicate an open circuit. The flame sensor is an optical device which “sees” the flame. If the sensor lens is dirty or has an open circuit, it can not “see” the flame and results in either a START or a FLAME OUT diagnostic code to display.

Check: Flame Sensor

a) Inspect the flame sensor wiring for a short circuit.

b) Inspect the flame sensor lens for cleanliness.

c) Test the flame sensor. *(See following page for flowchart, Figure 5-18.)*

Flame Sensor Test Procedure

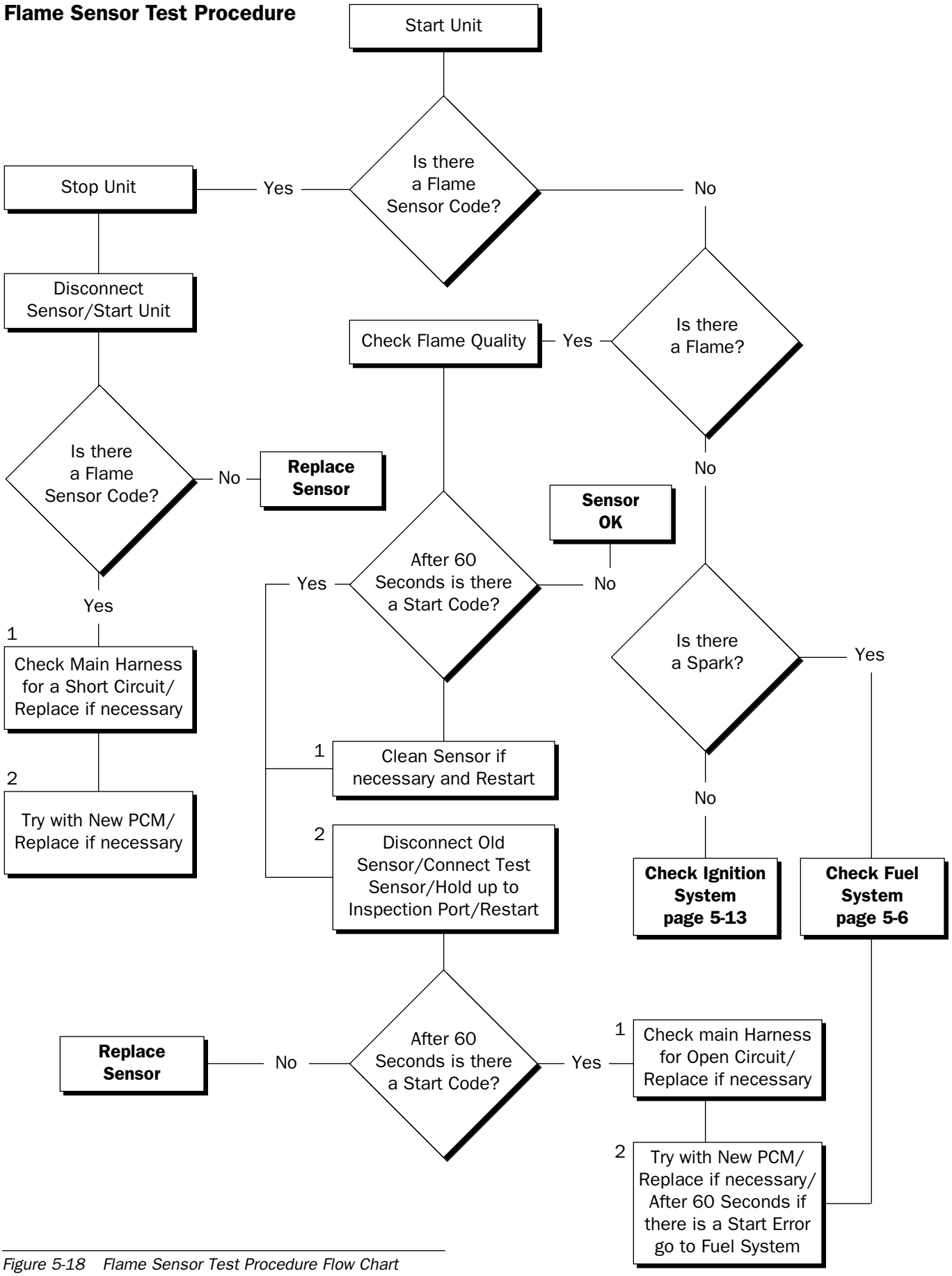


Figure 5-18 Flame Sensor Test Procedure Flow Chart

7 Temp Sensor

A TEMP SENSOR diagnostic code indicates a short or open circuit in the temperature sensor wiring or the coolant temperature is out of range—below -58˚F (-50˚C) or above 266˚F (130˚C). The resistance of the temperature sensor is proportional to temperature.

Check: Temperature Sensor (CODE indicated)

a) Inspect wiring for short or open circuits.

b) Check resistance of sensor. Is it within range as shown in Figure 5-20. If it is within valid range and the PCM still displays code on start up, replace PCM.

C) Test the sensor. *(See test procedure below.)*

Test Procedure:

a) Connect a multimeter (adjusted to measure resistance) to the temperature sensor as per *Figure 5-19*. The polarity of the sensor connections to the multimeter is not important.

b) Measure the sensor resistance versus temperature under the following conditions:
- at room temperature
- in a freezer
- in boiling water.

c) Compare the measured values against the graph (*Figure 5-20*). If values do not approximately match, then the sensor is defective and must be replaced.

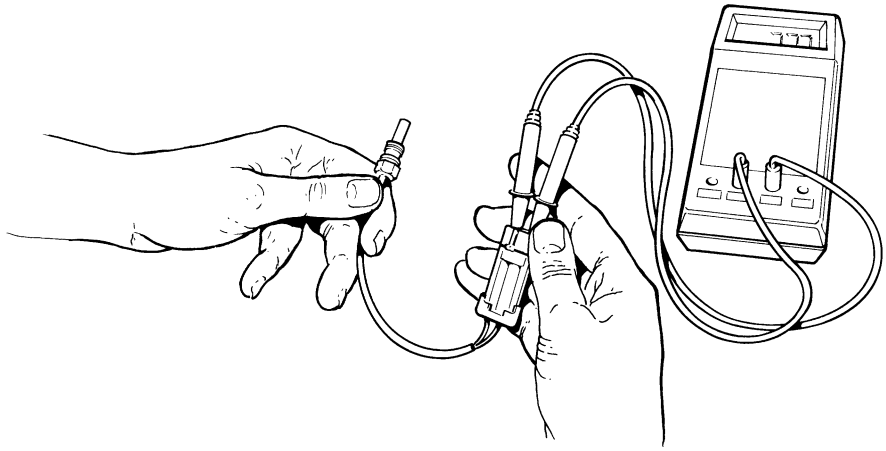


Figure 5-19 Temperature Sensor Test

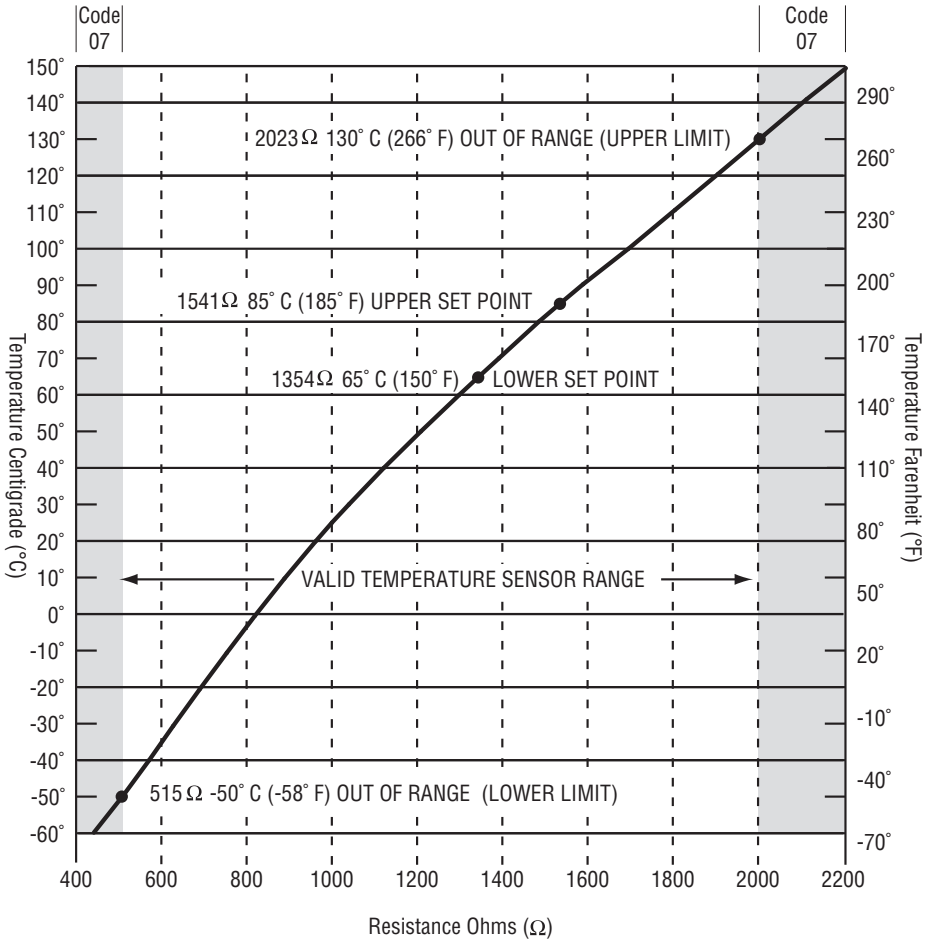


Figure 5-20 Coolant Temperature Sensor Graph

NOTE:	Room temperature	70˚F (20˚C)	Resistance 950Ω
	Boiling water	212˚F (100˚C)	Resistance 1700Ω

8 Fuel Pump

The X45 fuel gear pump is driven by the same motor as the compressor. Therefore, there is NO fuel pump electrical diagnostic code. A FUEL PUMP diagnostic code would indicate a fault in the PCM **only**.

A short or open circuit fault in the motor that drives the fuel pump will be indicated by a COMPRESSOR diagnostic code.

9 Compressor

A COMPRESSOR diagnostic code indicates an open circuit in the wire harness, a short in the wire harness between the positive and negative leads or an internal short in the motor. This component is ground side switched in the PCM.

Symptom: Air Compressor not running (code indicated)

Check: Air Compressor wiring & function

a) That compressor is connected to harness correctly. *(See PROHEAT Wiring Diagram page 1-4)*

b) The connector pins for damage or corrosion.

c) Harness for pinched or abraded wires.

d) Test compressor. If it tests OK replace PCM. *(See Figures 5-7 & 5-8 and Test Procedure)*

Test Procedure:

a) Connect air compressor directly to a power source of the rated voltage (12/24 Volts) and see if the motor runs. If not, replace the compressor.

b) Measure air compressor motor resistance. Use a multimeter to measure the resistance across the compressor connector pins. If resistance shows an open or short circuit, replace the compressor assembly.

c) Measure air compressor current. Use test lead part #967921K, as described on Service Bulletin #967329 in the Appendix.

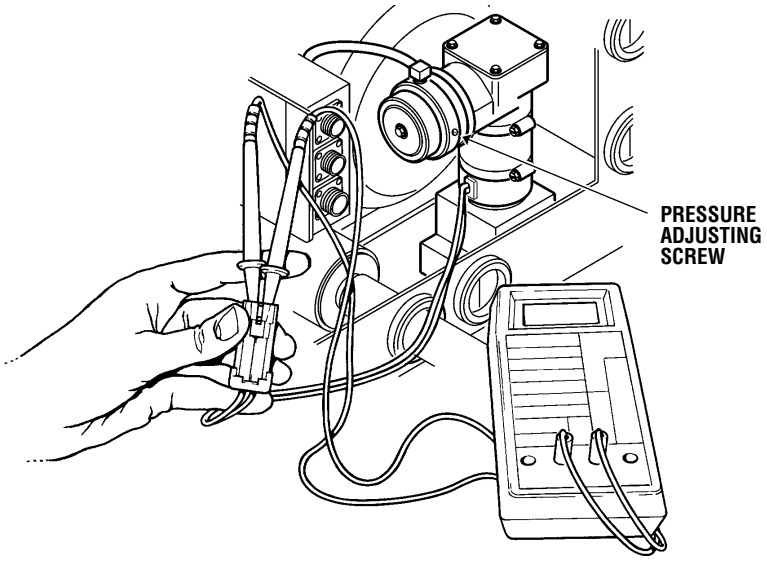


Figure 5-21 Compressor Test

MODEL	CURRENT DRAW (Amps)
X45-12	3.50 - 5.00 @ 12 Volts
X45-24	1.50 - 3.00 @ 24 Volts

Compressor Mechanical And Electrical Troubleshooting (No code Indicated)

The following material covers the air compressor mechanical or electrical problems that DO NOT indicate a Code 9. The compressor/fuel pump motor is ground side switched- there is always voltage at the positive terminal to the motor.

Symptom: Air Compressor runs as soon as power is applied (No code indicated)

Check: Internal Short in Motor

a) Disconnect compressor/fuel pump motor from internal harness.

b) To check motor condition:

Spare Compressor Motor is Available – Check:

i) Connect spare motor to internal harness and apply power to heater.

If spare motor does not run, replace the compressor/fuel pump motor. If the spare motor still runs:

ii) Inspect internal harness wires going to compressor. Ensure that there is no chaffing or cuts that would provide a compressor motor ground short.

If internal harness is in good condition, replace PCM.

Spare Compressor Motor is not Available – Check:

i) Plug connector that normally goes to compressor motor into the blower.

If the blower does not spin when power is applied, this indicates that there is a short in the compressor motor or short in the internal harness. Verify root cause by checking Steps (ii) and (iii).

If the blower spins, this indicates that there is a fault with the PCM or there is a short in the internal harness. Verify root cause by checking Step (iii).

ii) Measure resistance between either pin on the connector going to the motor and the body of the heater

If the resistance is not in the mega-ohm range, replace the compressor/fuel pump motor.

If the resistance is in the mega-ohm range, go to Step (iii).

iii) Inspect internal harness wires going to compressor. Ensure that there is no chaffing or cuts that would provide a motor ground short.

If internal harness is good condition, replace PCM.

Symptom: **Air Compressor running (No code indicated)**
Fuse blown in PCM

Check: **Air Compressor operation**

a) Harness for pinched or abraded wires. The positive wire must not short to ground.

b) Motor for internal short. *(See Figure 5-21 and Test Procedure)*

c) Check for seized motor or fuel pump. *(See Figure 5-5 and Figure 5-22)*

⚠ WARNING

Disconnect the PCM electrical power prior to trying to turn the compressor counterweight by hand.

REMOVE FOUR BOLTS AND COVER FOR ACCESS TO THE COMPRESSOR COUNTER WEIGHT BY HAND TO CHECK FOR SEIZED MOTOR OR FUEL PUMP.

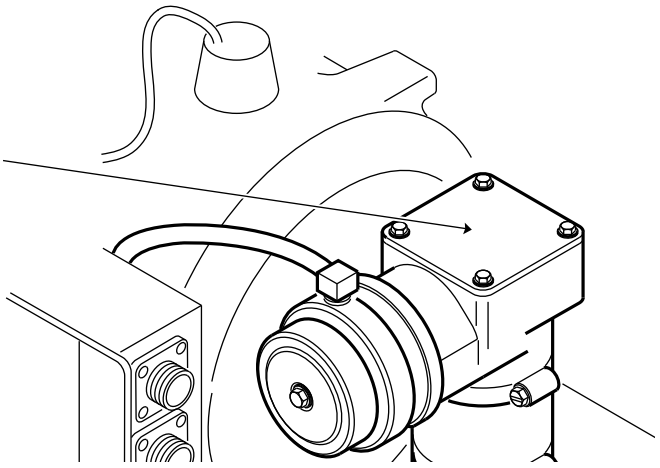


Figure 5-22 Compressor Access Cover

10 Ignition Coil

An IGNITION COIL diagnostic code indicates an open circuit in the wire harness, a short in the wire harness between the positive and negative leads or an internal short in the coil. The fuse will blow if there is a short to ground in the positive lead or the coil. The ignition coil is the easiest place to measure the voltage on the heater. This component is ground side switched in the PCM.

⚠ WARNING

The PROHEAT chassis is grounded from the PCM as shown in Figure 5-14. Ensure the ground is securely connected. Failure to ensure a proper ground may result in electrical shock.

Symptom: **No spark at the electrode (code indicated)**

Check: **Coil wiring**

a) Inspect the wiring harness to ensure the ring terminals are secured to the coil. Make sure the polarity is correct.

b) Inspect for broken or abraded wires in the wire harness.

b) Test coil. *(Figure 5-23.)*

c) If an IGNITION COIL diagnostic code occurs and no fault is found in the coil and wiring, then the PCM must be checked.

Ignition Coil Electrical Troubleshooting (No code Indicated)

The following material covers the ignition coil mechanical or electrical problems that do not indicate a Code 10. The ignition coil is ground side switched — there is always voltage at the positive terminal to the ignition coil.

Symptom: No spark at the electrode (No code indicated)

Check: High tension wires and electrode

a) Inspect the high tension lead between the coil and the electrode.

b) Inspect the ground lead between the second electrode and the heater chassis.

c) Is the electrode gap adjusted correctly? *(See page 5-13 for Electrode Gap Detail)*

Test Procedure:

a) Measure ignition coil resistance. Use a multimeter to measure the resistance across the positive and negative terminals. The resistance should be less than 1 ohm. If resistance is “open circuit” or 0 ohms (short circuit) then replace the ignition coil.

NOTE: Remove positive and negative wires from the coil when testing.

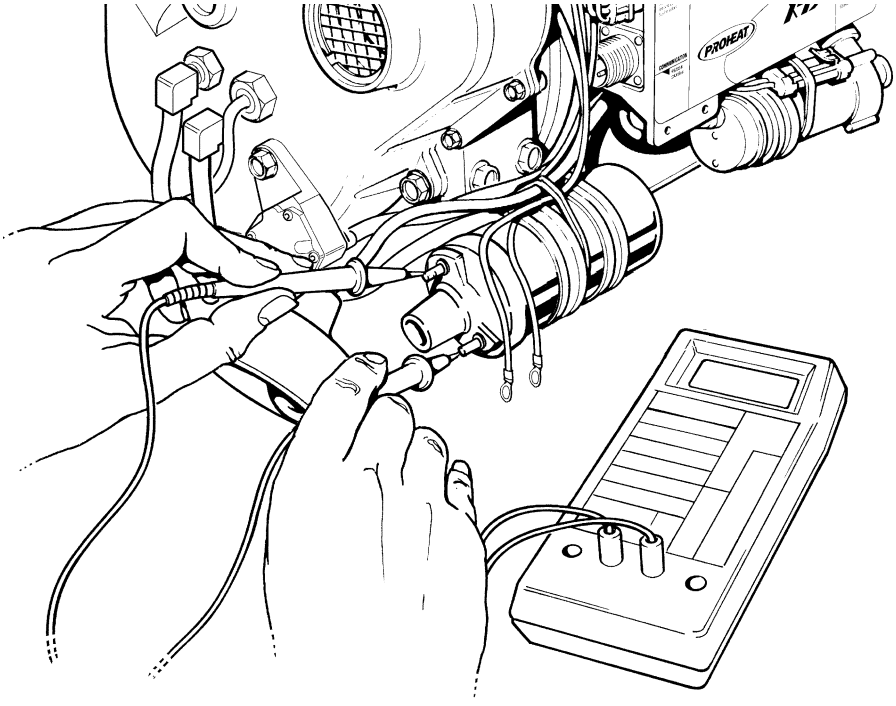
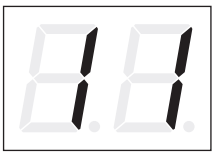


Figure 5-23 Ignition Coil Test

11 Coolant Pump



A COOLANT PUMP diagnostic code indicates an open circuit in the wire harness, a short in the wire harness between the positive and negative leads or an internal short in the motor. This component is ground side switched in the PCM.

The coolant pump is not self-priming. Ensure that the coolant system has been purged of air by running the vehicle engine for at least ten minutes following installation or service. (DO NOT run dry.)

Symptom: Pump not running (code indicated)

Check: Pump Motor

a) Connect coolant pump directly to the rated voltage (12/24 Volts) and see if it runs. If not, replace the pump.

b) Measure coolant pump motor resistance. Using a multimeter, measure the resistance across the coolant pump connector pins. If resistance shows an open circuit or an internal short circuit, replace the coolant pump.

c) Measure coolant pump current. Use test lead part #967921K as described on Service Bulletin #967329 in Appendix.

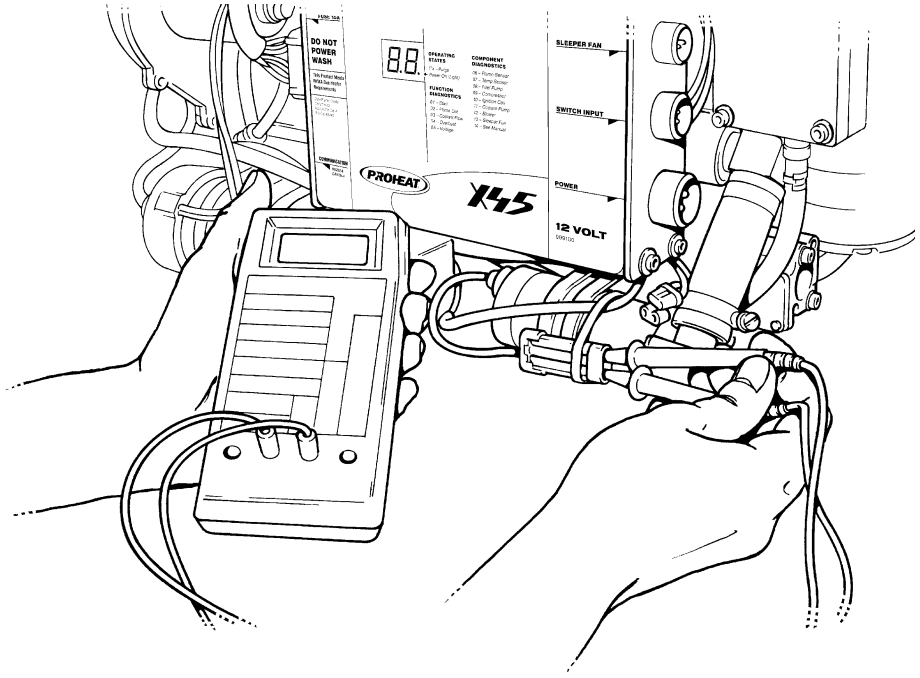


Figure 5-24 Coolant Pump Test

MODEL	CURRENT DRAW (Amps)
X45-12	1.50 - 4.00 @ 12 Volts
X45-24	0.75 - 2.00 @ 24 Volts

Symptom: Coolant pump not running (code indicated)

Check: Coolant Pump wiring & function

a) That coolant pump is connected to harness correctly. *(See PROHEAT Wiring Diagram page 1-4)*

b) The connector pins for damage or corrosion.

c) Harness for pinched or abraded wires.

d) Test pump. If it tests OK replace PCM. *(See Figure 5-24 and Test Procedure.)*

Coolant Pump Mechanical & Electrical Troubleshooting (No code Indicated)

The following material covers the coolant pump mechanical or electrical problems that do not indicate a Code 11. The coolant pump motor is ground side switched — there is always voltage at the positive terminal to the motor.

Symptom: Coolant pump runs as soon as power is applied (No code indicated)

Check: Internal Short in Motor

a) Disconnect coolant pump motor from internal harness.

b) To check motor condition:

Spare Coolant Pump is Available – Check:

i) Connect spare coolant pump motor to internal harness and apply power to heater.

If spare coolant pump does not run, replace the coolant pump. If the spare coolant pump still runs:

ii) Inspect internal harness wires going to coolant pump. Ensure that there is no chaffing or cuts that would provide a coolant pump motor ground short.

If internal harness is in good condition, replace PCM.

Spare Coolant Pump is not Available – Check:

i) Plug connector that normally goes to coolant pump motor into the blower.

If the blower does not spin when power is applied, this indicates that there is a short in the coolant pump motor or short in the internal harness. Verify root cause by checking Steps (ii) and (iii).

If the blower spins, this indicates that there is a fault with the PCM or there is a short in the internal harness. Verify root cause by checking Step (iii).

ii) Measure resistance between either pin on the connector going to the coolant pump motor and the body of the heater.

If the resistance is not in the mega-ohm range, replace the coolant pump.

If the resistance is in the mega-ohm range, go to Step (iii).

iii) Inspect internal harness wires going to coolant pump. Ensure that there is no chaffing or cuts that would provide a motor ground short.

If internal harness is good condition, replace PCM.

Symptom: Coolant pump not running (no code indicated)
Fuse blown in PCM

Check: Coolant Pump function

a) Harness for pinched or abraded wires. Positive lead must not short to ground.

b) Check motor for internal short.
(See Figure 5-24 and Test Procedure.)

Symptom: Coolant pump not pumping (no code indicated)

Check: Coolant Pump function

a) If the impeller is turning freely. If not, replace pump.

Symptom: Coolant pump leaking

Check: Leak location

a) Hose clamps. Tighten if necessary.

b) Pump housing seal. Replace pump if required.

12 Blower

A BLOWER diagnostic code indicates an open circuit in the wire harness, a short in the wire harness between the positive and negative leads or an internal short in the motor. This component is ground side switched in the PCM.

The PCM measures the RPM of the blower. This feature will give an error should it fall below the necessary RPM to maintain sufficient combustion air.

⚠ CAUTION

When a blower fails, the combustion chamber must be checked for carbon build up and cleaned as necessary.

Symptom: Blower not running (code indicated)

Check: Blower wiring & function

a) That blower is connected to harness correctly. *(See PROHEAT Wiring Diagram page 1-4)*

b) The connector pins for damage or corrosion.

c) Harness for pinched or abraded wires.

d) Test blower. If it tests OK replace PCM. *(See Figure 5-25 and Test Procedure)*

Blower Mechanical and Electrical Troubleshooting (No code Indicated)

This section covers the blower mechanical or electrical problems that do not indicate a Code 12. The blower motor is ground side switched — there is always voltage at the positive terminal to the motor.

Symptom: Blower runs as soon as power is applied (No code indicated)

Check: Internal Short in Motor

a) Disconnect blower motor from internal harness.

b) To check motor condition:

Spare Blower is Available – Check:

i) Connect spare blower to internal harness and apply power to heater.

If spare blower does not run, replace the blower pump. If the spare blower still runs:

ii) Inspect internal harness wires. Ensure that there is no chaffing or cuts that would provide a blower motor ground short.

If internal harness is in good condition, replace PCM.

Spare Blower is not Available – Check:

i) Plug connector that normally goes to blower motor into the coolant pump.

If the coolant pump does not spin when power is applied, this indicates that there is a short in the blower motor or short in the internal harness. Verify root cause by checking Steps (ii) and (iii).

If the coolant pump spins, this indicates that there is a fault with the PCM or there is a short in the internal harness. Verify root cause by checking Step (iii).

ii) Measure resistance between either pin on the connector going to the blower motor and the body of the heater

If the resistance is not in the mega-ohm range, replace the blower.

If the resistance is in the mega-ohm range, go to Step (iii).

iii) Inspect internal harness wires going to blower. Ensure that there is no chaffing or cuts that would provide a blower motor ground short.

If internal harness is good condition, replace PCM

Symptom: Blower not running (no code indicated)
Fuse blown in PCM

Check: Blower function

a) Harness for pinched or abraded wires. Positive lead must not short to ground.

b) Check motor for internal short. *(See Figure 5-25 and Test Procedure)*

Symptom: Blower turning slowly (no code indicated)

Check: Blower function

a) For fan blade rubbing on housing.

b) For fan blade slipping on motor shaft.

Test Procedure:

a) Connect the blower to a power supply of the rated voltage. Does it turn? If not, replace the blower.

b) Measure the blower motor resistance. Using a multimeter, measure the resistance across the blower connector pins. If resistance shows an open circuit or an internal short circuit, then replace the blower assembly.

c) Measure blower current. Use test lead part #967921K as described on Service Bulletin #967329 in Appendix.

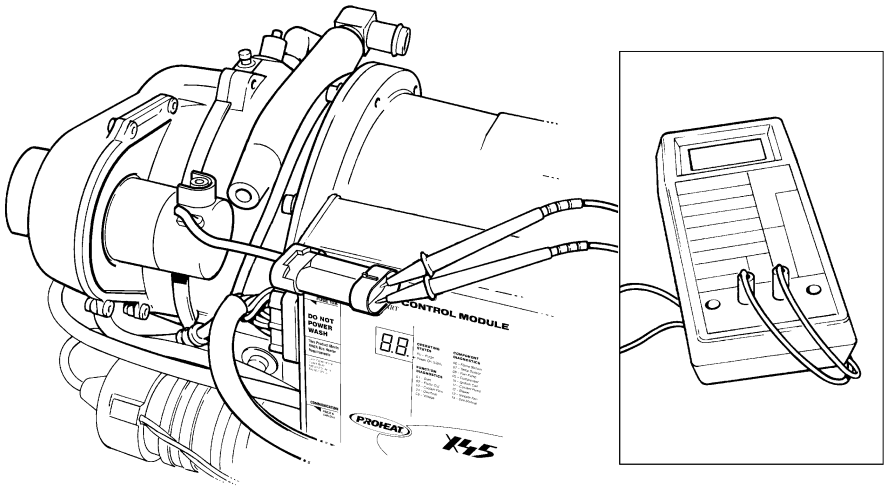


Figure 5-25 Blower Test

MODEL	CURRENT DRAW (Amps)
X45-12	.75 - 1.5 @ 12 Volts
X45-24	.5 - 1.0 @ 24 Volts

13 Sleeper Fan

A SLEEPER FAN diagnostic code indicates an electrical short in the sleeper fan wiring harness, electrical connections or fan motor. This error will not shut the heater down and heat to the engine will be maintained. An open circuit will not display a diagnostic code.

NOTE: This error is only applicable to "Sleeper Fan" models. See page 4-2 for model identification. If the PCM model is an "Aux Input" model and this error is displayed, there is a fault with the PCM. Replace the PCM.

Symptom: Sleeper Heater fan not turning (code indicated)

Check: Sleeper Heater system

a) The wiring connections and polarity.

b) For an electrical short from the positive wire to the negative wire. For an electrical short from the positive wire to the chassis. Test sleeper heater fan. *(See Test Procedure)*

Sleeper Fan Troubleshooting (No code Indicated)

The following material covers the sleeper fan mechanical or electrical problems that do not indicate a Code 13. Note that the sleeper fan is high side switched.

Symptom: Sleeper Heater fan not turning (no code indicated)

Check: Sleeper Heater system

a) The wiring connections and polarity.

b) Test sleeper heater fan. *(See Test Procedure)*

Symptom: Sleeper Heater system has low air flow (no code indicated)

Check: Sleeper Heater system

a) Air ducting.

b) Use Test Procedure items (*e)* and (*f)* to determine if PROHEAT is supplying enough power to drive the sleeper fan.

Test Procedure:

a) Disconnect sleeper fan harness.

b) Restart the PROHEAT, If there is still an error, replace the PCM.

c) Check for correct voltage at the sleeper fan output on the PCM. *(See wiring diagram on page 1-4 and page 1-5.)*

d) Reconnect sleeper fan harness. Start the PROHEAT.

e) Check for voltage at the thermostat, isolator (if used) and the sleeper fan motor. The power to the sleeper heater fan is regulated by voltage in the PCM. It will read low when trying to drive the sleeper fan.

f) Connect sleeper heater fan motor directly to a remote power source of the rated voltage (12/24 Volts). Does the motor run?

NOTICE

The PROHEAT PCM sleeper fan circuit has a one minute delay during ignition. Power to open a sleeper fan coolant valve must be taken from another source such as the wire for the Hour Meter (Auxiliary Output). *(See PROHEAT Wiring Diagram page 1-4.)*

14 Hour Meter (Auxiliary Output)

An HOUR METER (AUXILIARY OUTPUT) diagnostic code indicates an electrical short in the hour meter (auxiliary output) wiring harness, electrical connections or connected electrical load. The electrical load could be an hour meter, relay or any other low load (< 1 A) connection that depends on the installation. This error will not shut the heater down and heat to the engine will be maintained. An open circuit will not display a diagnostic code.

Symptom: Hour Meter (Auxiliary Output) Electrical Load not Operating (code indicated)

Check: Hour Meter (Auxiliary Output) Electrical Load

a) The wiring connections and polarity.

b) For an electrical short from the positive wire to the negative wire. For an electrical short from the positive wire to the chassis. Test electrical load. *(See Test Procedure)*

Hour Meter Troubleshooting (No code Indicated)

The following material covers the Hour Meter (Auxiliary Output) electrical problems that do not indicate a Code 14. Note that the Hour Meter (Auxiliary Output) is high side switched.

Symptom: Hour Meter (Auxiliary Output) Electrical Load not Operating (no code indicated)

Check: Hour Meter (Auxiliary Output) Electrical Load

a) The wiring connections and polarity.

b) Test electrical load. *(See Test Procedure)*

Test Procedure:

a) Disconnect load/circuit to hour meter (auxiliary output) harness and start heater. If error goes away, check for short circuits in the load/circuit.

b) Restart the PROHEAT. If there is still an error, disconnect the 18-pin internal harness and restart the PROHEAT again. If code 14 is still present, replace PCM.

c) Check for correct voltage (12 V: 9 – 14 V, 24 V: 19– 30 V) at the hour meter (auxiliary output) harness.

d) Reconnect hour meter (auxiliary output) harness. Start the PROHEAT.

e) Connect electrical load directly to a remote power source of the rated voltage (12/24 Volts). Does the electrical load run?

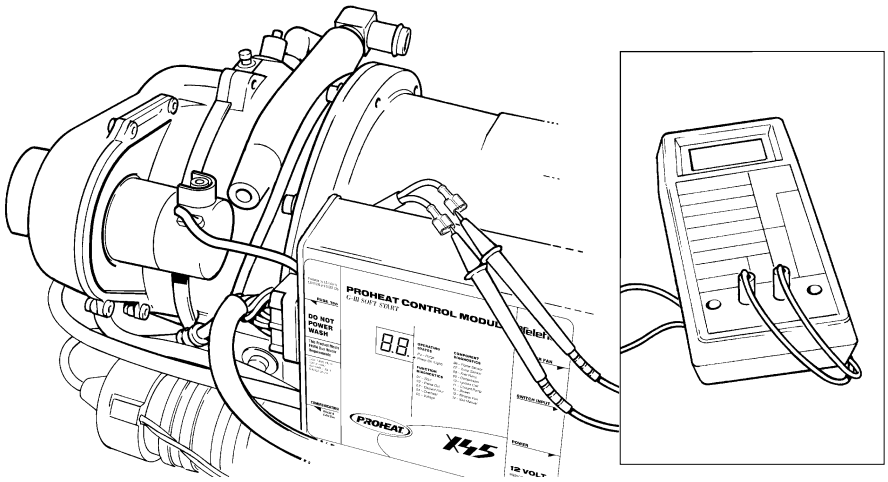


Figure 5-26 Hour Meter (Auxiliary Output) Test

5.2 COMPONENT MECHANICAL OR ELECTRICAL PROBLEMS

5.2.1 FUEL NOZZLE

Go to page 5-12.

5.2.2 FUEL REGULATOR

Go to page 5-7.

5.2.3 AIR COMPRESSOR

Go to page 5-9 and page 5-23.

5.2.4 FUEL PUMP

Go to page 5-8.

5.2.5 IGNITION ELECTRODE

Go to page 5-13.

5.2.6 COOLANT PUMP

Go to page 5-27.

5.2.7 BLOWER

Go to page 5-30.

5.2.8 FUSE

If, when the heater is switched “ON,” the heater does not run and the “ON” light does not light, check the fuse in the PCM. The fuse will blow if there is a short to ground in a positive lead or internally for the following components:

- ON/OFF Switch
- Air Compressor/Fuel Pump
- Ignition Coil
- Coolant Pump
- Blower
- Internal Wire Harness

Reversing polarity at the battery will also cause the fuse to blow. This will not harm the PCM.

Check: Heater wiring. See flow chart Figure 5-28 on next page.

⚠ CAUTION

Repeated replacement of the fuse or using incorrectly rated fuses without correcting the problem, can damage the PCM.

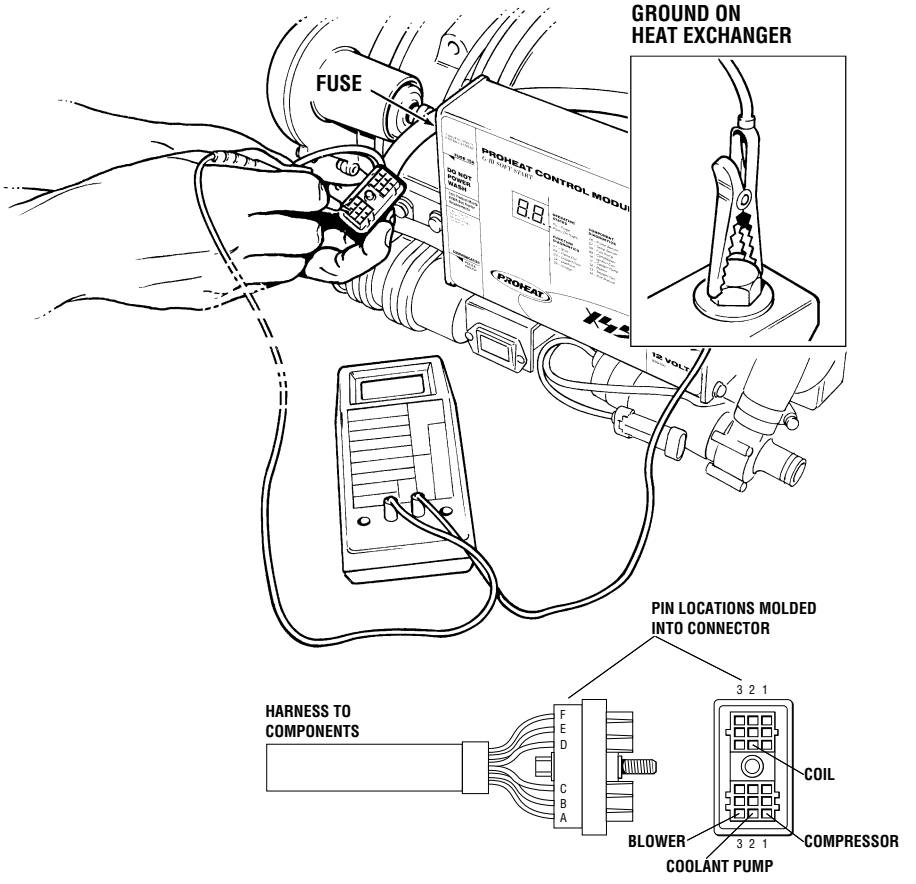
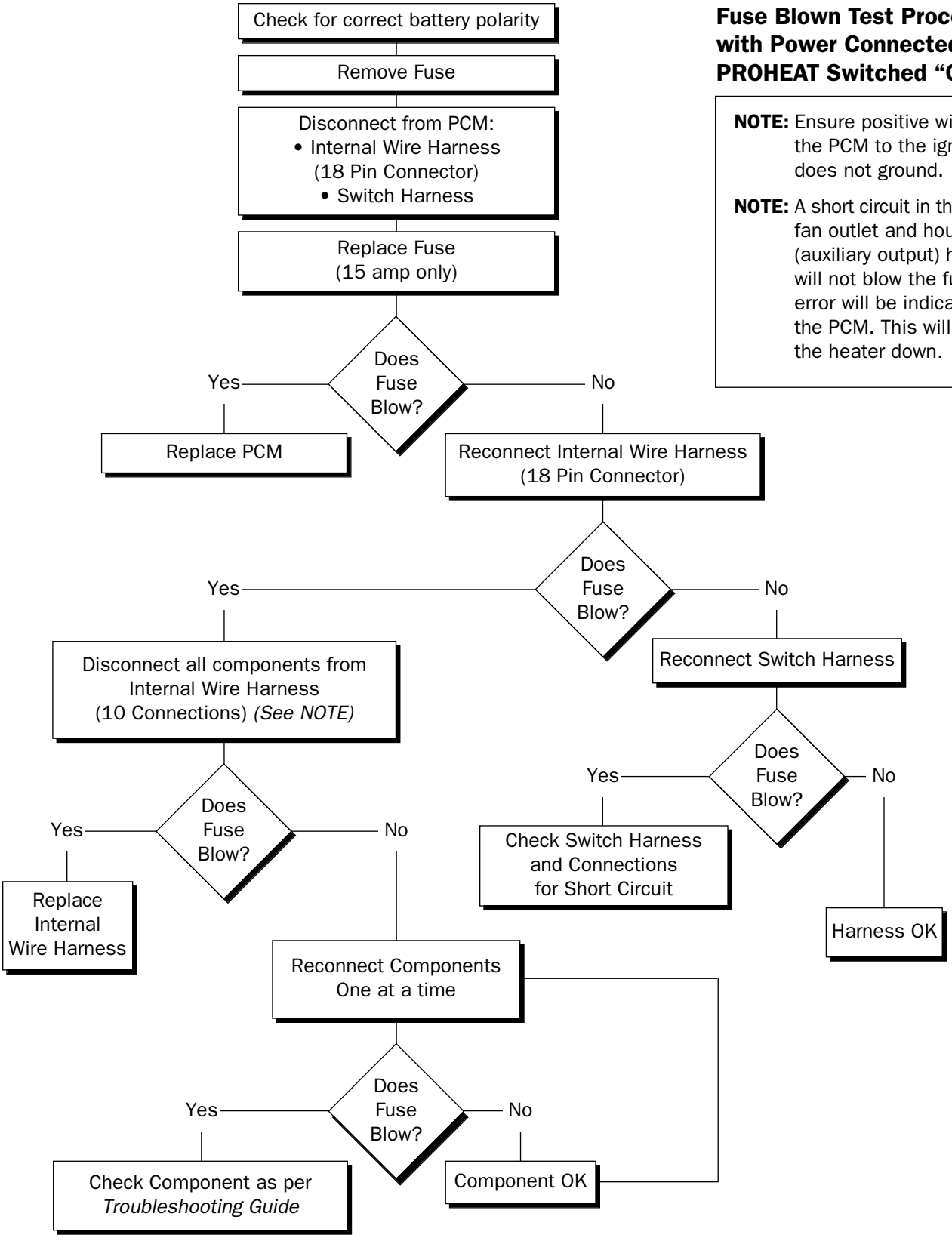


Figure 5-27 Internal Wire Harness Test



Fuse Blown Test Procedure with Power Connected and PROHEAT Switched "OFF"

NOTE: Ensure positive wire from the PCM to the ignition coil does not ground.

NOTE: A short circuit in the sleeper fan outlet and hour meter (auxiliary output) harness will not blow the fuse. An error will be indicated on the PCM. This will not shut the heater down.

Figure 5-28 Blown Fuse Test Procedure Flow Chart

5.3 OPERATIONAL PROBLEMS

Heater Operational Problems that are not specifically described in the function or component diagnostic section.

5.3.1 COMPLAINT: Smoking exhaust/Smelly exhaust fumes

These symptoms are usually an indication of an extremely rich air/fuel mixture.

Check

a) Is the PROHEAT connected to the correct voltage? *(page 5-18)*

b) Is the blower functioning? Is the air inlet restricted?

c) Is the compressor functioning? *(page 5-23)*

d) Is the exhaust restricted?

e) Is it a new heater? New heaters may smoke for 15 minutes as oil is burned off the exhaust pipe.
This is normal.

5.3.2 COMPLAINT: Low heat output

If the heater appears to be functioning properly but the driver complains of low heat this is often indicative of a coolant flow restriction. *(See section on Coolant Flow page 5-16).*

5.3.3 COMPLAINT: Engine temperature gauge reads low

Depending on its location, the engine temperature sensor may not be directly in the path of coolant flow from the heater. In these cases the gauge may read significantly lower than actual coolant temperature.

5.3.4 COMPLAINT: Backfiring

Backfiring occurs when there is air in the fuel supply lines.

Check

a) Fuel level in tank – is the pick-up submerged?

b) Air leaks – are all the fuel line clamps tight?

c) For severely restricted combustion air blockage at the blower inlet, in the combustion chamber, or in the exhaust system.

6.0 MAINTENANCE

6.1 WEEKLY MAINTENANCE

Run the heater a minimum once a week to keep new fuel in the heater's critical components.

6.2 ANNUAL MAINTENANCE

Your **PROHEAT** has been designed to operate with a minimum of maintenance. To ensure the efficient operation of your heater an **ANNUAL MAINTENANCE TUNE-UP** is strongly recommended to be performed each year.

NOTICE

A higher duty cycle may require a more frequent maintenance schedule. i.e. 2 or 3 times per year.

Proper maintenance will result in the following benefits:

- Maximum heat transfer to the coolant
- Minimum battery power draw
- Long term cost savings
- Increased reliability

Check the system annually before each heating season. There are several maintenance procedures you can perform to keep your heater in service. Read this section of the manual carefully.

Always return to your Authorized PROHEAT Dealer for major maintenance. Your PROHEAT Dealer has the specialized equipment necessary to keep your PROHEAT in new condition.

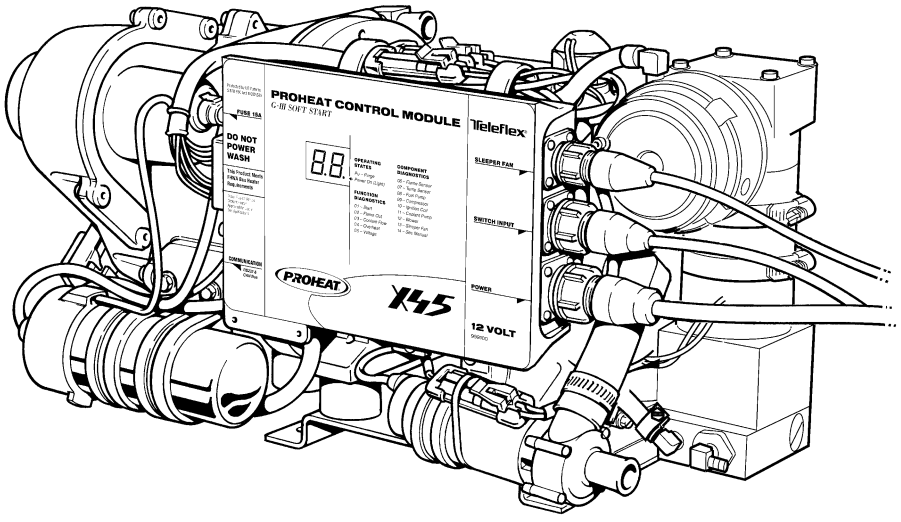


Figure 6-1 PROHEAT X45 Heater

6.2.1 CLEAN HEATER, ENCLOSURE AND AIR INTAKE

⚠ WARNING

DO NOT pressure wash or steam clean.

- Remove the heater enclosure cover.
- Clean any accumulated debris or dust from the components.
- Blow out the compartment with compressed air.
- Check the combustion air inlet screen for restrictions. Clean as required.
- Make sure the opening around the exhaust pipe is clear.
- Visually inspect all the components for wear or damage.
- Clean the X45 Heater using the following procedure.
  1 Protect yourself from burns and only touch a heater after it has cooled to room temperature.
  2 Clean the X45 Heater by hand with dry or damp cloth, or with compressed air. DO NOT use chemical agents as this may damage surfaces, gaskets, boots, cabling and/or hoses.
  3 DO NOT use a pressure washer or hose down the heater. This may result in damage to the PCM or damage to the electrical system.
  4 Water should not come into contact with any part of the heater when it is hot. Water can cause rapid cooling which may damage components.
  5 Ensure that the rubber boots on the ignition lead are clean and free from debris. Remove debris with compressed air or by wiping with a clean towel. DO NOT use chemical agents on the rubber boots.

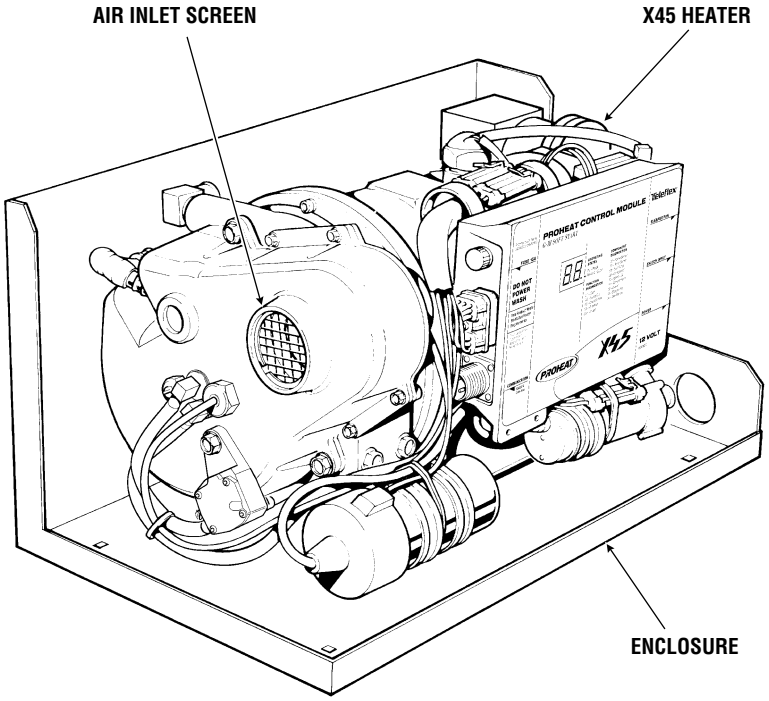


Figure 6-2 X45 Heater and Enclosure

6.2.2 CHECK EXHAUST SYSTEM

- Make sure the exhaust pipe is vented safely away from the vehicle cab.
- Check the pipe for dents, restrictions or severely corroded areas.
- Replace the exhaust pipe and clamps if necessary.
- Ensure the exhaust pipe clamp is tight.
- Clean exhaust pipe if there is a significant accumulation of carbon build up.

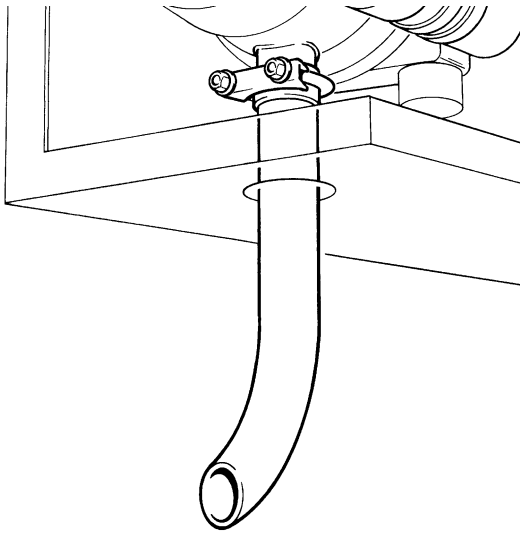


Figure 6-3 Exhaust Pipe

6.2.3 CHECK HEAT EXCHANGER

- To maintain optimum heat output, clean any combustion deposits that may have accumulated on the heat exchanger fins.
- Remove the fan end assembly and combustion tube to access the inside of the heat exchanger.
- Ensure exhaust pipe is clean and free from restriction.
- Use a wire brush to loosen the deposits and a vacuum to suck them out.
- Torque securing screws to 25±3 in/lbs (2.8±0.3 Nm).

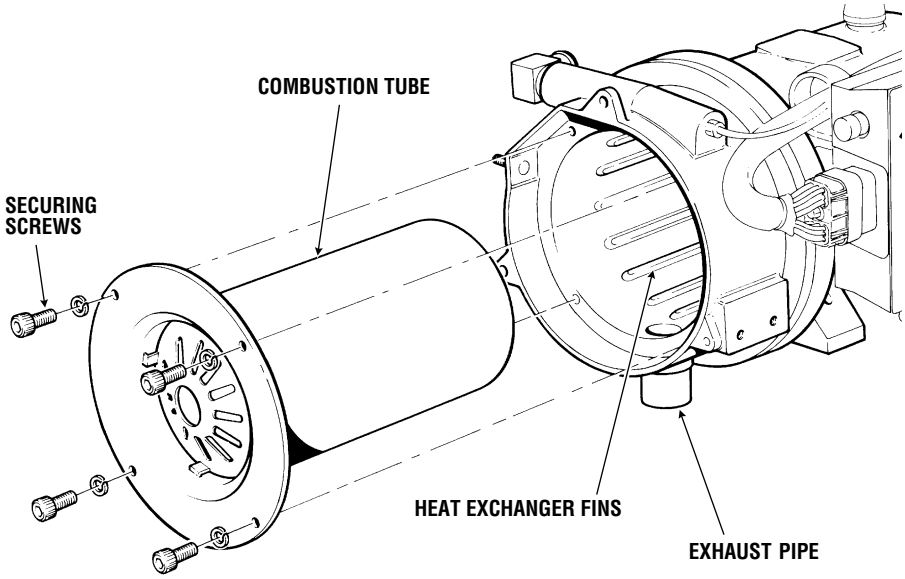


Figure 6-4 Heat Exchanger

6.2.4 CLEAN FLAME SENSOR

- To maintain proper sensor readings, the flame sensor glass should be wiped clean.
- With the fan end removed, clean the sensor glass with water and a rag. Glass should be clear.

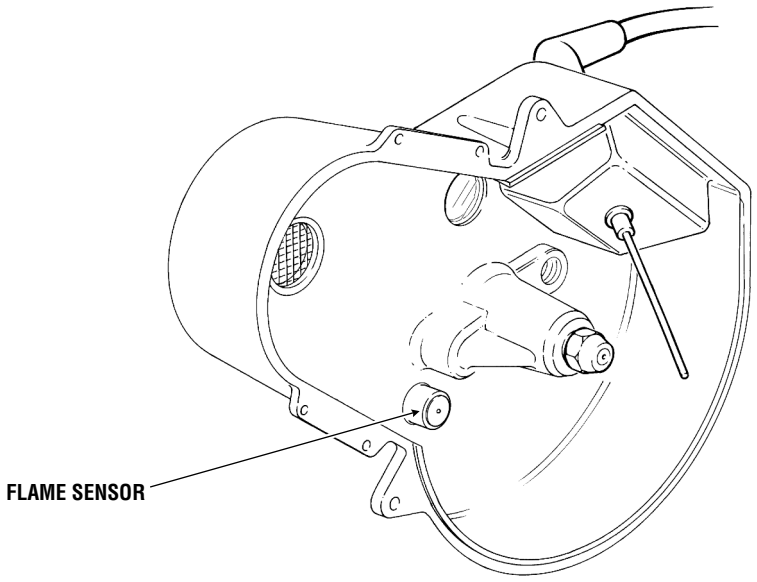


Figure 6-5 Flame sensor

6.2.5 CHECK COOLING SYSTEM

- Check all heater hoses and connections for signs of leakage or damage.
- Repair or replace as required.
- **NOTE:** The coolant mix must be 50% Ethylene Glycol.

6.2.6 CHECK BATTERIES

- Check the condition of batteries and the power connections.
  The heater will not function properly with weak batteries or corroded connections.

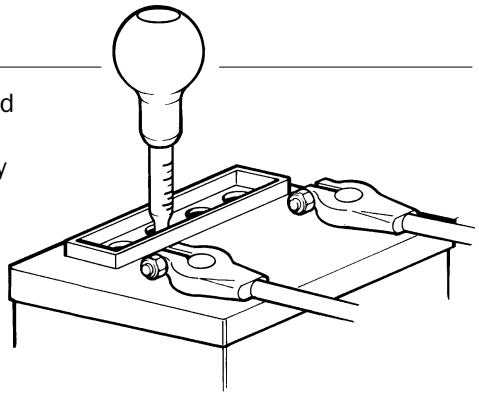


Figure 6-6 Test Battery

6.2.7 CHECK FUEL SYSTEM

- Check the fuel system for damaged fuel lines or leakage.
- Make sure the clamps on the fuel lines are secure.
- Ensure fuel lines are flexible.

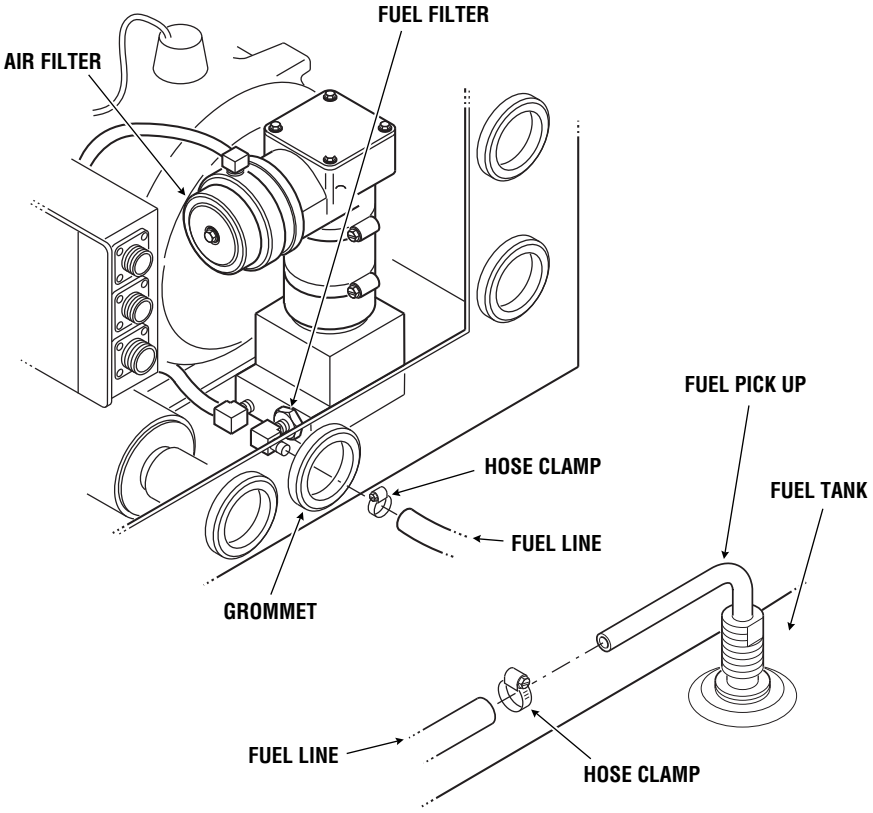


Figure 6-7 Fuel Line Clamp

6.2.8 CHECK FUEL FILTER

- Remove and inspect filter. Clean or replace as necessary.

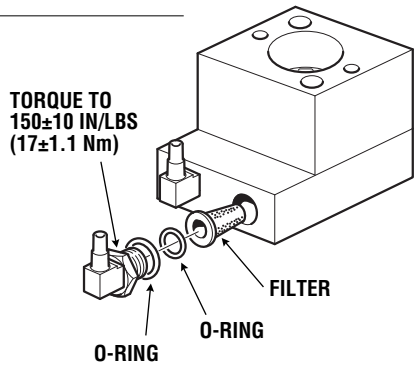


Figure 6-8 Fuel Filter Components

6.2.9 CLEAN NOZZLE

- Remove and install Nozzle as shown on page 5-12. Torque to 150±10 in/lbs (17±1.1 Nm).
- To properly clean the nozzle use electrical contact cleaner or warm soapy water. This will wash any dirt out and leave no residue. When using compressed air, blow into the nozzle orifice from the head end.

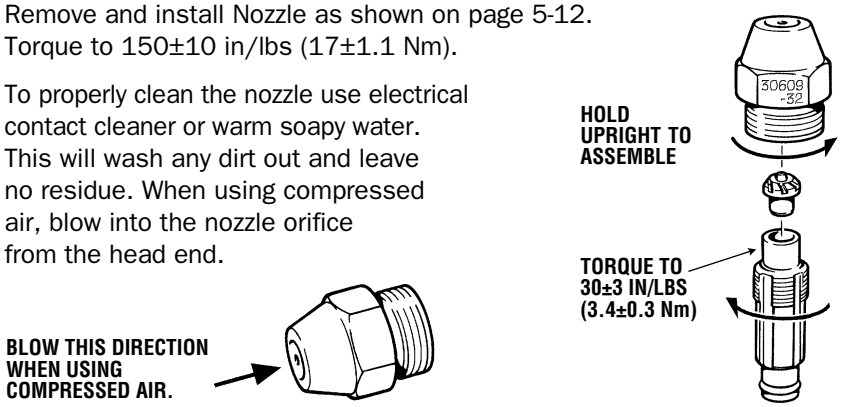


Figure 6-9 Nozzle Components

6.2.10 REPLACE COMPRESSOR AIR FILTER

- Replace inlet air filter annually or more often if dusty conditions are encountered.

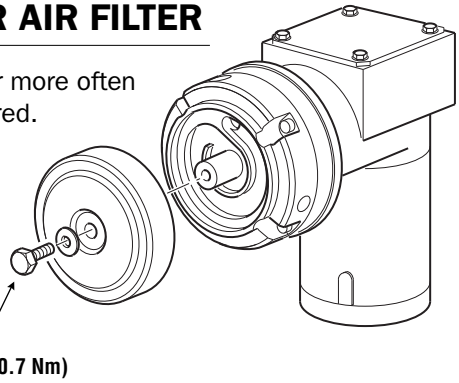


Figure 6-10 Compressor Air Filter

6.2.11 CHECK ELECTRICAL SYSTEM

⚠ CAUTION

Ensure that power is disconnected to the X-45 prior to servicing the Ignition Lead.

- Check the internal and the external wire harnesses for damage. Replace if required.
- Service the X45 Ignition Lead and Ignition Coil by following the steps listed below.
  1 Annually or better, inspect the ignition lead and the boots on both ends. Replace the entire lead with new lead (p/n 930523K) if the lead itself or boots are coated with oil, torn, cracked or brittle.
  2 Ensure that the electrical connections are clean and tight.
  3 Ensure that all boots are clean and free from debris. Remove debris by wiping with a clean towel. Do not use water or chemical agents.
  4 Ensure that all boots are properly reseated.
- It is recommended that the ignition lead is replaced every five years or better with a new lead (p/n 930523K).

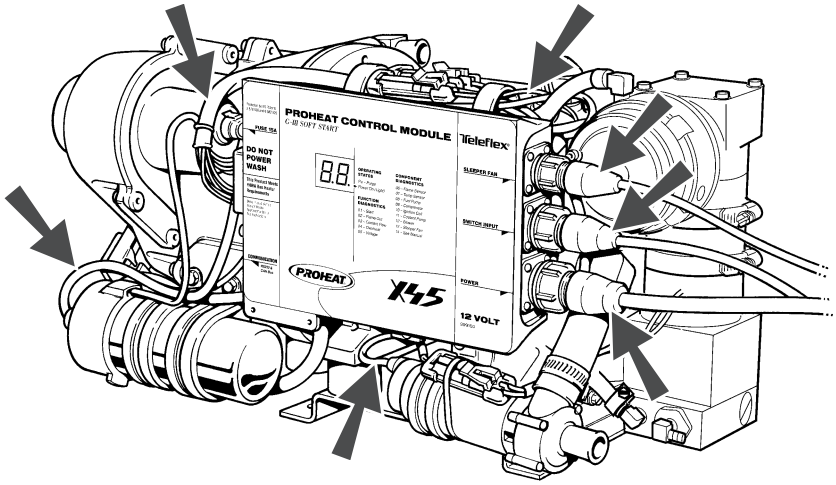


Figure 6-11 Wire Harnesses

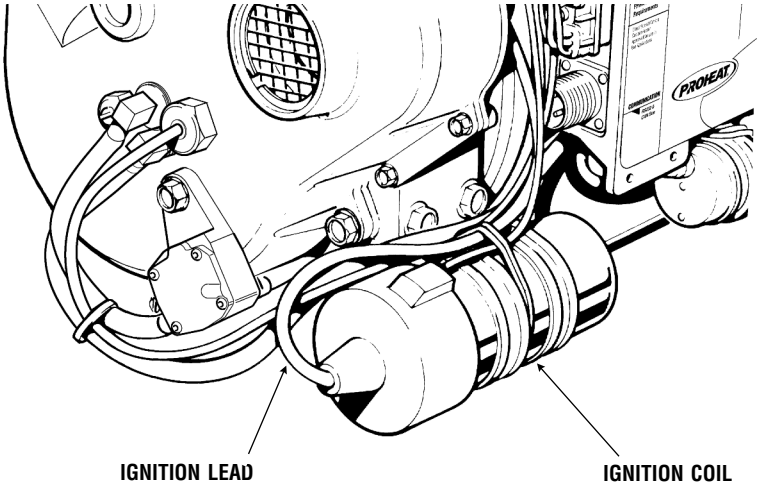


Figure 6-12 Ignition Coil

6.2.12 CHECK AIR PRESSURE

- Refer to Air Compressor pressure test procedure on page 5-9.

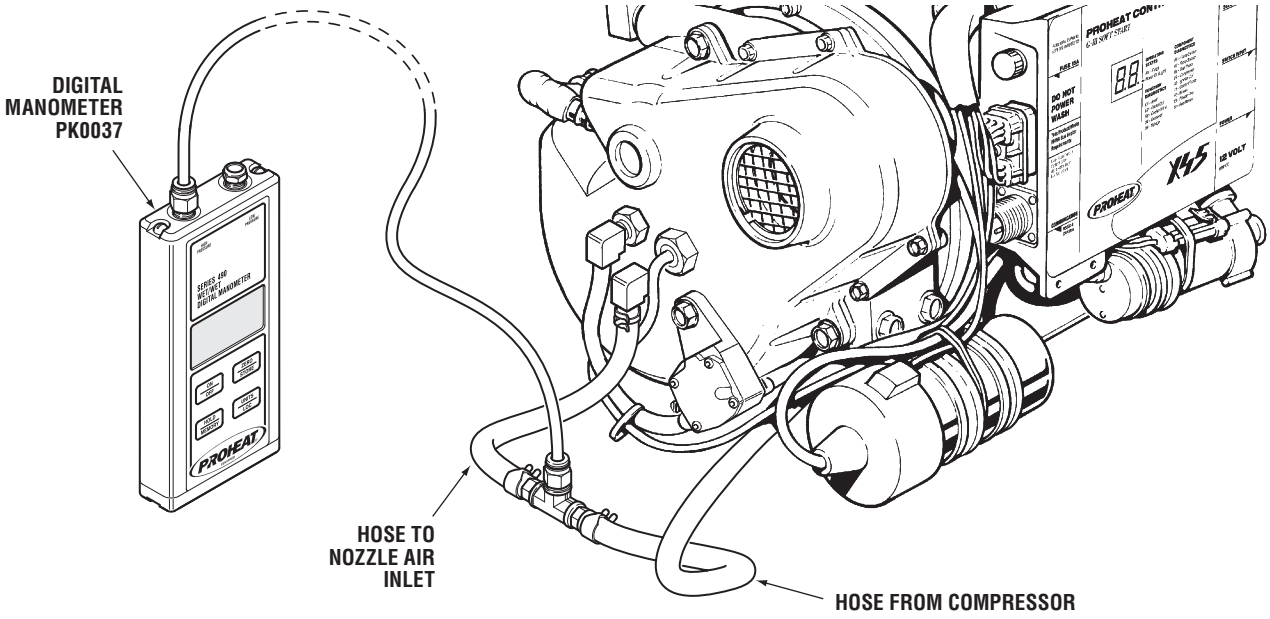


Figure 6-13 Air Compressor pressure test procedure

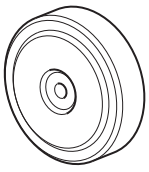
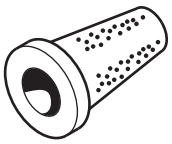
6.2.13 CHECK MODES OF OPERATION – SWITCH, TIMER OR OEM SIGNALS

- Check to see that the modes operate as described on page 4-5 to page 4-7.

Operation Test

- Run the system for at least 15 minutes or until the heater cycles “OFF” and then “ON” again.
- Alternate the thermostat for the sleeper heater (if connected) between the lowest and highest settings to ensure that the sleeper heater fan cycles “ON”and “OFF”.

Replacement Parts

PART #	QTY	DESCRIPTION
825730K	1	Air Filter, X45. 
880035K	1	Fuel Filter, X45. 

PART #	QTY	DESCRIPTION
PK0094	1	X45 Fall Service Kit includes: 1 x Air Filter 1 x Fuel Filter 2 x O-Ring
PK0069	1	X45 Major Service Kit 1 x Electrode 1 x Nozzle 1 x Regulator 1 x Flame Sensor 1 x Ignition Lead 1 x Air Filter 1 x Fuel Filter 2 x O-Ring

7.0 APPENDICES

CONTENTS

Description:
Coolant Flow Indicator

Part:

TK9002

Purpose:

The Coolant Flow Indicator is a service tool used to troubleshoot and test for possible flow and air problems in the coolant flow path. Flow direction during heater operation or during engine operation can then be observed.

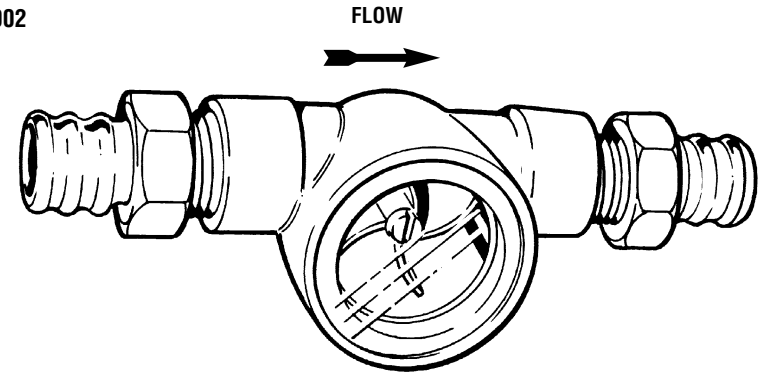


FIGURE 1

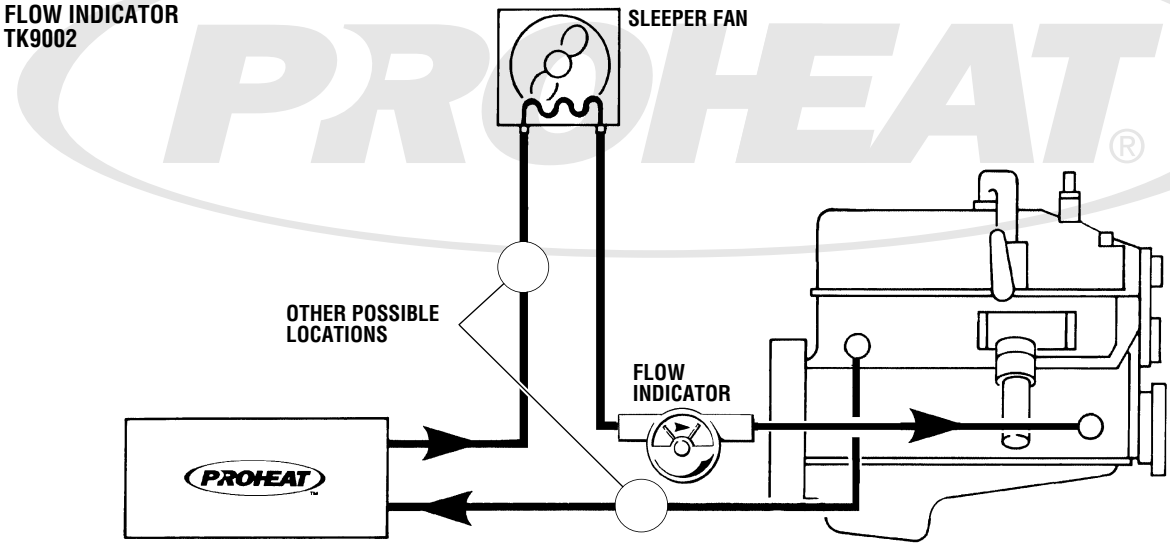


FIGURE 2

Description:

The PROHEAT wiring system uses sealed connectors for resistance to corrosion and greater reliability. The following test leads are required for troubleshooting.

Parts:

967921K Test Lead

952925K Remote On/Off switch

Instructions:

1. Test Lead #967921K is used for measuring voltage, resistance, continuity or amperage and can be used on all components except for the blower. Direct voltage can be applied to the compressor and water pump by wiring from a remote power source to the spade connections.
2. The #952925K Remote On/Off switch allows the service technician to plug into the heater at the switch input of the PCM. This allows the heater to be turned On/Off at the unit.

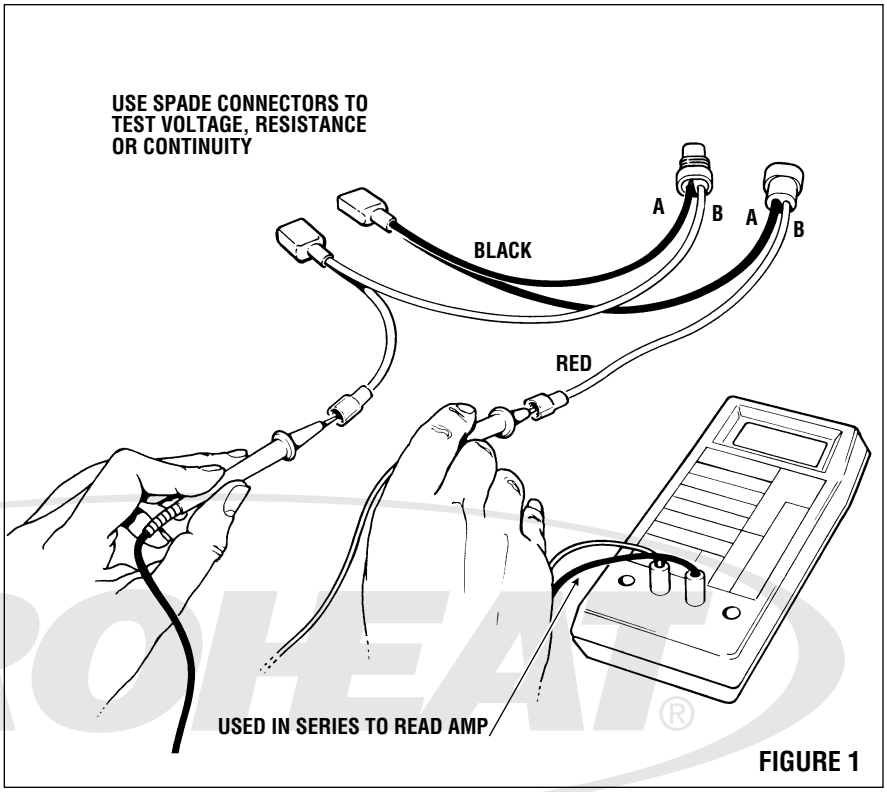


FIGURE 1

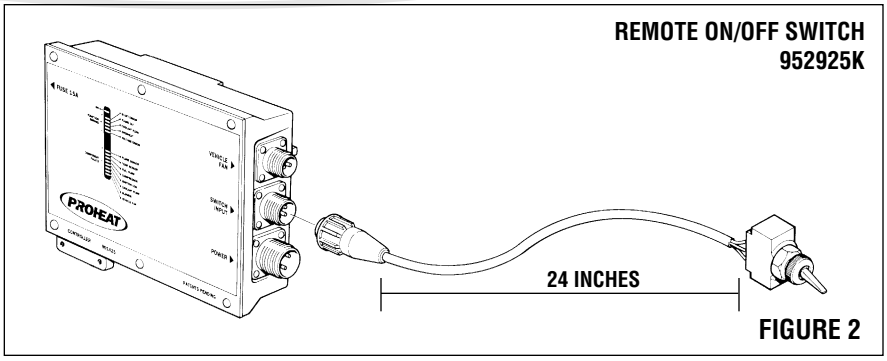


FIGURE 2

Description:

Ground Side Battery Disconnect

Purpose:

This service bulletin includes troubleshooting steps and protection recommendations from damage, that may occur when attempting an engine start while the ground side battery disconnect switch is in the "open" position. A Proheat is typically connected directly to the batteries so that it can be used to preheat the coolant when the ground side battery disconnect switch is "open". If the operator (driver) attempts to start the engine with this switch "open" the entire electrical current from the starter motor attempts to pass through the proheat internal wiring harness. Without adequate fuse protection the Proheat ground circuit in the internal harness and/or controller will be damaged.

Test Procedure:

The symptoms may include a START error or FLAME OUT error. The fuel pump will not operate if the Proheat ground circuit has been damaged, resulting in intermittent operation of the Proheat.

1. Start the Proheat. Check that the fuel pump is running. Approximately 20 to 40 pulses per minute can be felt or heard. Check for voltage at the fuel pump power terminal.
2. If the fuel pump does not operate, ground the body of the fuel pump directly to the battery negative post using a wire. Restart the Proheat. If the fuel pump runs and the Proheat starts then the problem is in the ground wire.

   Note: It is possible to get a partial ground for the fuel pump if the exhaust pipe is contacting the machine frame and the ground side battery disconnect switch is closed.
3. To locate the fault in the ground circuit, first check the internal harness. The ground wire is black with a green stripe. Remove the 18 pin connector from the controller and check for continuity between the ground pin (Pin C3) and the ring terminal. See Figure 1 (over). If a fault is found replace the harness. Next, check the controller by measuring for continuity between pin C3 on the controller 18 pin connector and pin B at the power harness connector. See Figure 2.
4. If the fuel pump did not run in step 2 refer to Fuel Pump, Start error and Flame Out error in the troubleshooting section of the Service Manual.

Recommended Method of Protection:

1. Install a 10 amp in-line fuse on the ground wire (black with green stripe) of the Proheat harness. Proheat Part# PK0310.
2. Ensure that the Proheat exhaust pipe does not contact vehicle chassis.
3. If possible rewire the disconnect switch to the positive side of the battery.

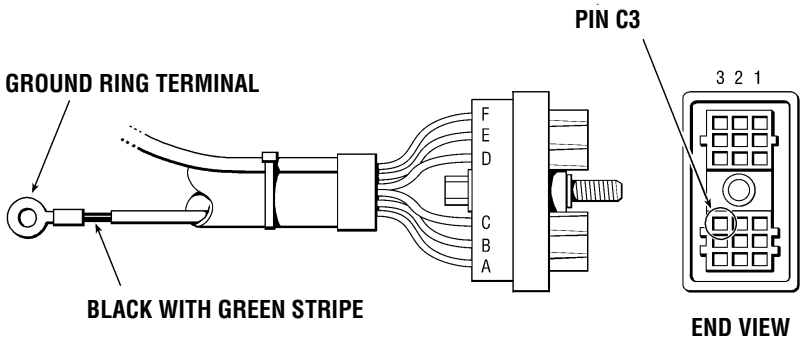
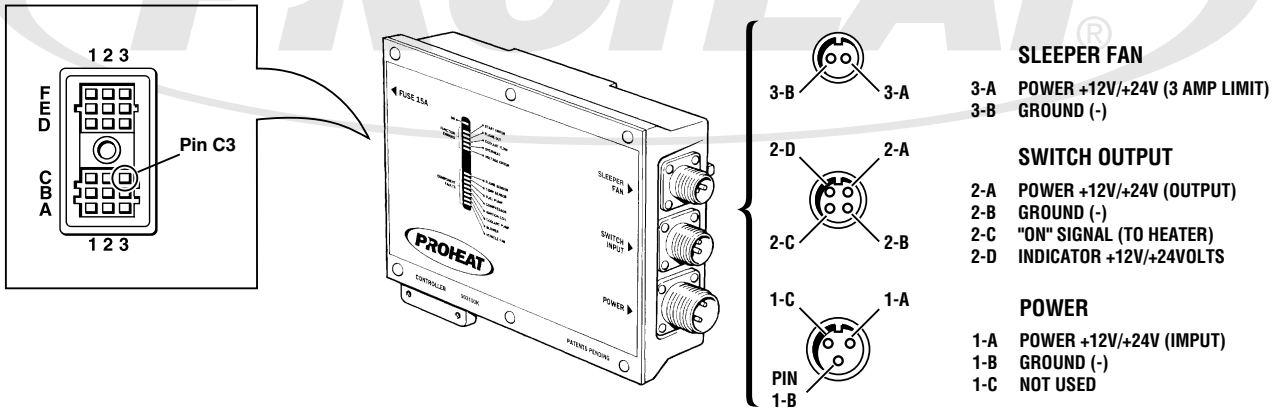


FIGURE 1



SLEEPER FAN

3-A	POWER +12V/+24V (3 AMP LIMIT)
3-B	GROUND (-)

SWITCH OUTPUT

2-A	POWER +12V/+24V (OUTPUT)
2-B	GROUND (-)
2-C	"ON" SIGNAL (TO HEATER)
2-D	INDICATOR +12V/+24VOLTS

POWER

1-A	POWER +12V/+24V (IMPUT)
1-B	GROUND (-)
1-C	NOT USED

FIGURE 2

Introducing: G-III Proheat Control Module (PCM) for X45 and XL series Heaters.

Part Numbers:

Application	Discontinued PCM PID	Replacement PCM PID
X45-12 V Trucks with or without Sleeper Kit and on Heavy Equipment	903100K	999100K
X45-12 V Transit or Coach	904200K	999200K
X45-12 V School Bus	904300K	999300K
X45-24 V Transit or Coach, Heavy Equipment and School Bus	905300K	999400K
XL Bravo 24 V External Compressor Transit or Coach	817526-1K	999600K
XL Bravo 24 V Internal Compressor Transit or Coach	906300K	999700K
X45-24 V Coach MCI Custom	906400K	999800K

Updates:

1. 100% backward compatible - no adapter required
2. CANbus communication and new serial port location
3. New 2x7 Segment LED
4. Vent with filter

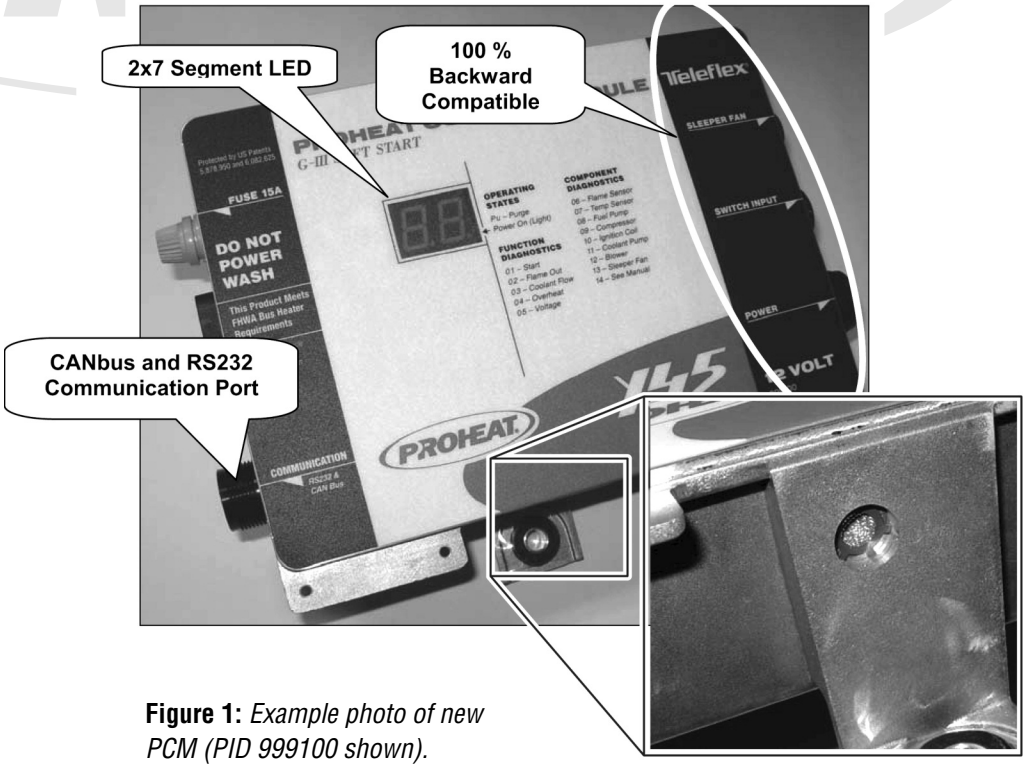


Figure 1: *Example photo of new PCM (PID 999100 shown).*

1 **100 % Backward Compatible**

- G-III PCM works with existing heaters and wiring harnesses.

2 **CANbus Communication and new Serial Port Location**

- The new communication port provides CANbus SAE J-1939 communication.
- Relocated serial port allows Datalink connection without disconnecting the switch input.
- New communication port requires the G-III controller Proheat Data Link Kit PK0053-3. The G-II download cable kit PK0053-2 (download cable and software) will not work with the G-III controller.

3 **New 2x7 Segment LED**

- The 2x7 segment LED provides improved communication of operational states and error messages.
- Figure 2: Original G-II PCM display with single LED lamps and new G-III PCM display with 2x7 segment LEDs.

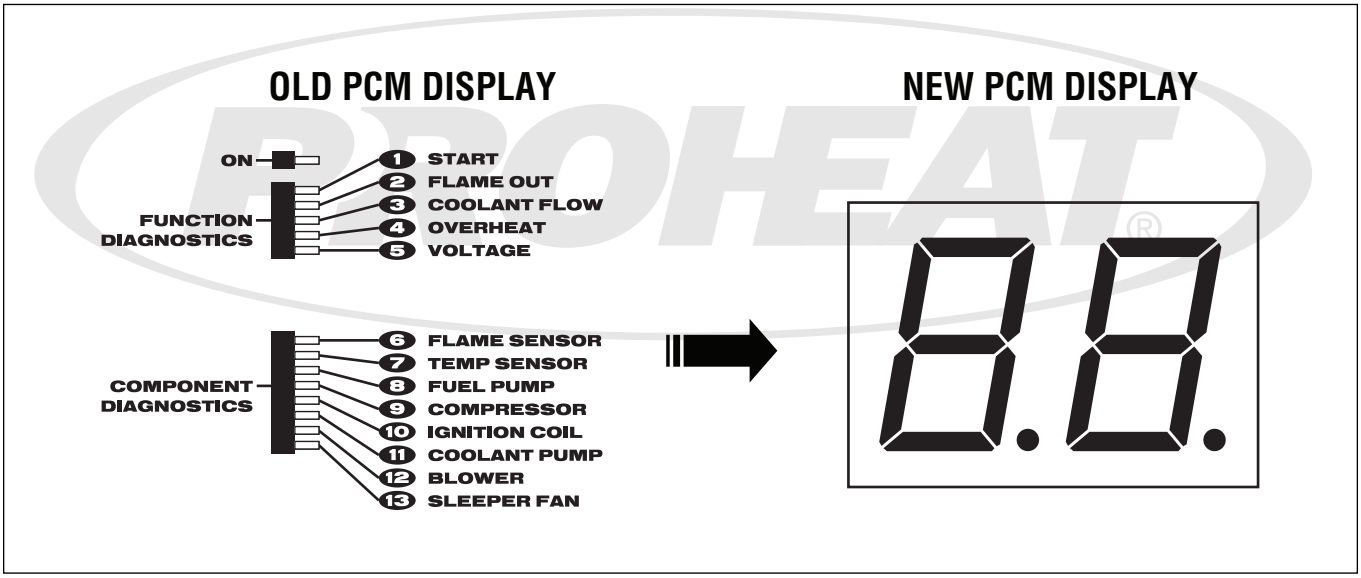


Figure 2: *Comparison of the original G-II PCM to the new G-III PCM display.*

- **Figure 3:** Original G-II PCM code numbers still apply. For example, Diagnostic Code LED associated with 12 Blower on the original PCM display will light up as the number 12 on the new display. In addition, the G-III controller indicator switch lamp will blink 12 times like the G-II controller does.
- **Figure 3:** Also illustrated is the “ON” indicator meaning the heater is powered in the normal or standby state and “Pu” indicator showing the heater is in the Cool Down (Purge) state.
- **X45 ONLY:** A new error code, 14, has been added to indicate a short circuit on the hour meter (auxiliary output) harness. For this error code, the indicator switch lamp will blink 14 times as well.

4 **Breather with Filter**

- A breather hole has been added to prevent moisture buildup inside the PCM by maintaining equal pressure inside the PCM enclosure. A wire mesh filter has been added to prevent any debris or excessive moisture from entering through the breather hole.

NEW PCM DISPLAY – SAMPLE CODES

ON **PURGE STATE** **ERROR CODE 12**

Figure3: *New PCM display sample codes.*

X45 FUEL PUMP PRESSURE CHECK AND SERVICE

Installation Instructions

⚠ WARNING

To avoid the risk of shock, ensure to disconnect power to heater unit during disassembly/reassembly.

⚠ WARNING

Fire Hazard. Do not place any flammable items around the heater and exhaust pipe.

1. Disconnect power to heater.
2. Remove air compressor hose to ensure heater will not run in full output during test.
3. Remove fuel outlet hose from fuel pump.

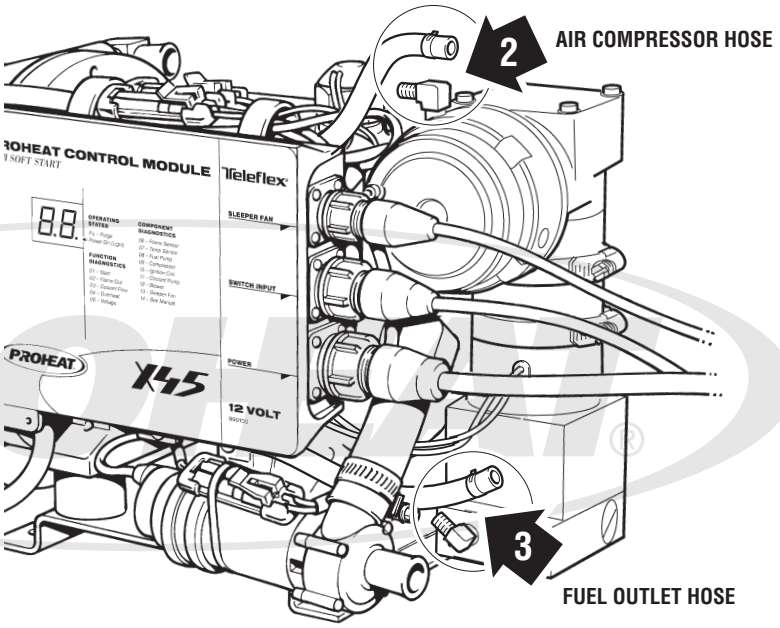


Figure A.

4. Remove 'T' fitting from test gauge PK0060.

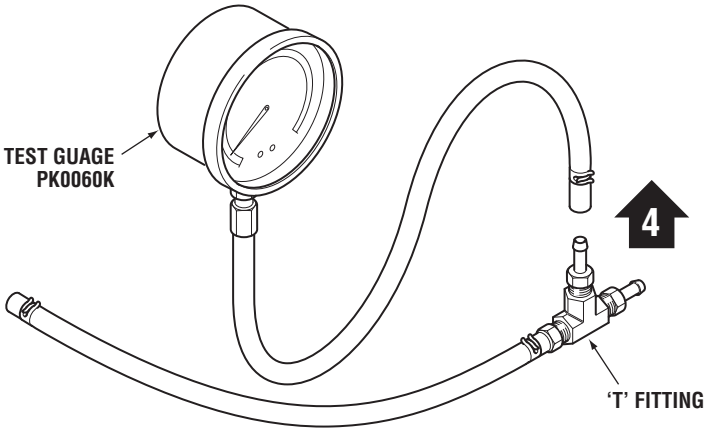


Figure B.

NOTICE

Calibrate gauge before each use see www.proheat.com/PDFs/990614.pdf for more information.

5. Install test gauge PK0060 on fuel pump outlet.

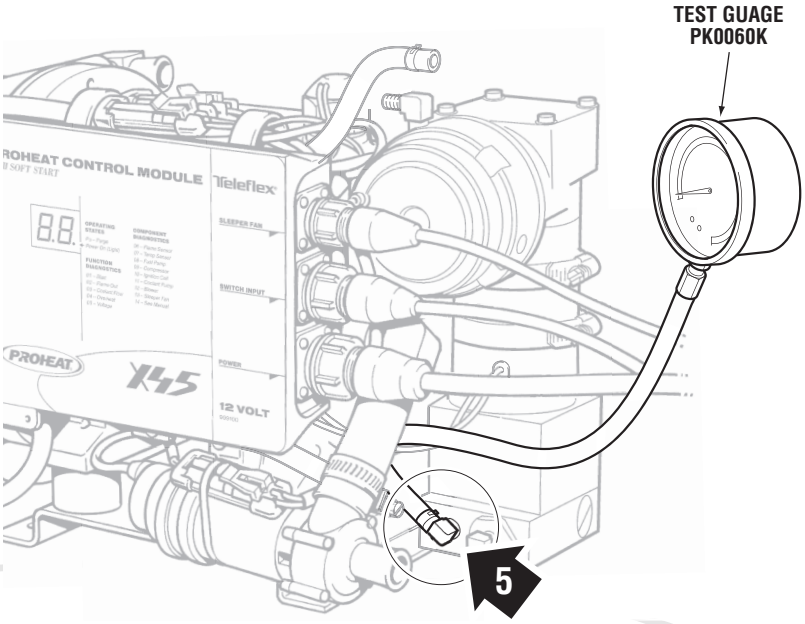


Figure C.

6. Switch the PROHEAT on and read the fuel pressure on test gauge. A reading of 5 – 10 PSI is normal and no further action is required.

If reading is <u>ABOVE 10 PSI</u>

1. Locate the pressure relief valve cap and remove with a slot screwdriver. Be careful not to lose any of the internal components that may fall out.

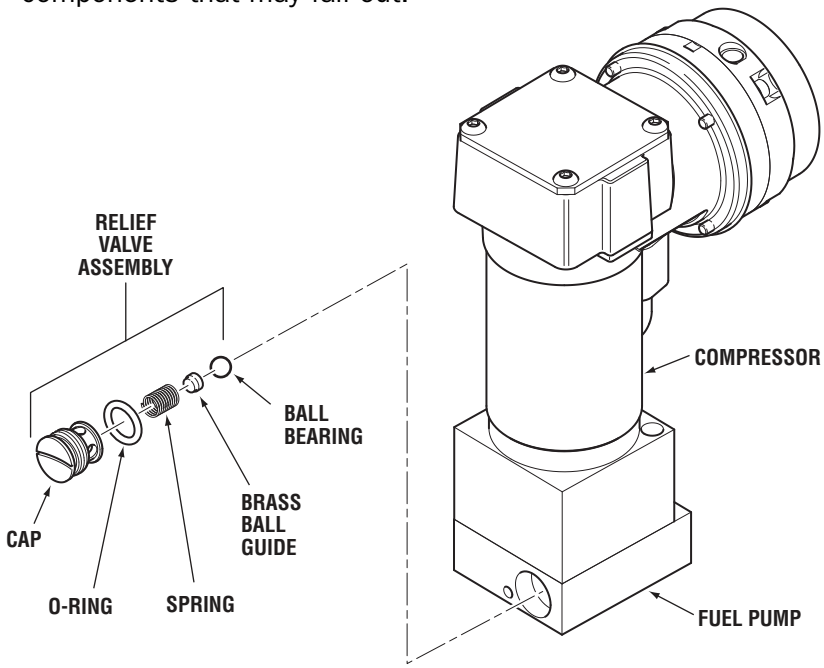


Figure D.

2. Remove the spring and brass ball guide from the cavity.
3. Carefully separate and discard the brass ball guide from the pressure relief valve spring. DO NOT stretch or damage the spring.
4. Remove the ball bearing from the cavity.
5. Inspect and clean all components.
6. Inspect and clean the cavity. Pay close attention to the center hole in the cavity for any debris or a damaged edge. The edge of the hole should be smooth with no nicks, do not use any tool that may damage the edge as this will cause loss of fuel pressure.
7. Place ball bearing back in cavity on the center hole.
8. Place spring back in hole on top of ball bearing.
9. Lubricate O-ring with diesel fuel.
10. Install pressure relief valve cap and torque relief valve to 22 ±2 in-lbs (2.5 ±0.2 Nm)
11. Re-test the fuel pressure.
12. If fuel pressure is still above 10 PSI replace relief valve assembly or fuel pump assembly.

If reading is <u>BELOW 5 PSI</u>

1. Check that there is fuel in the fuel tank.
2. Check the fuel filter for contamination.

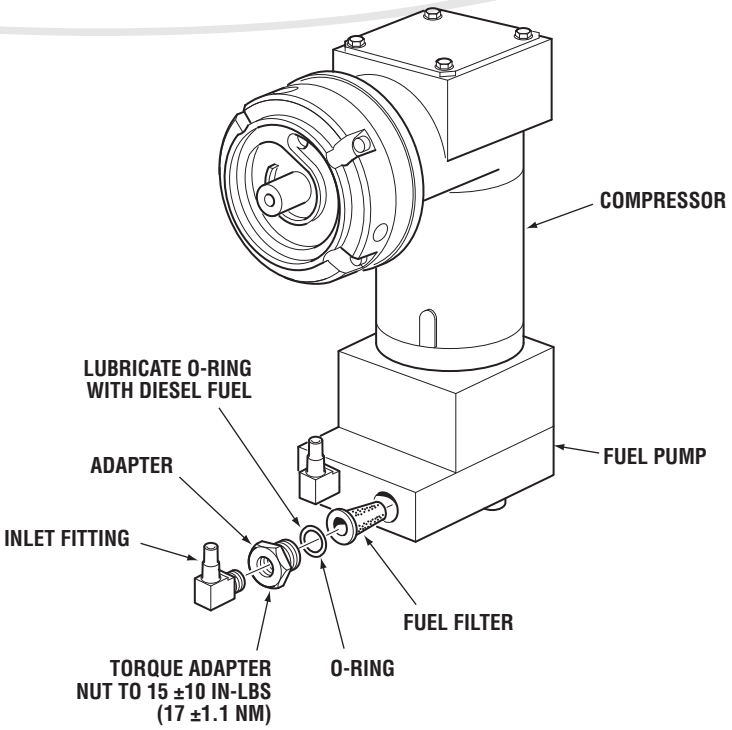


Figure E.

3. Check fuel lines, connections and routing back to the fuel tank for kinks, loose fittings, stiff lines or cuts.

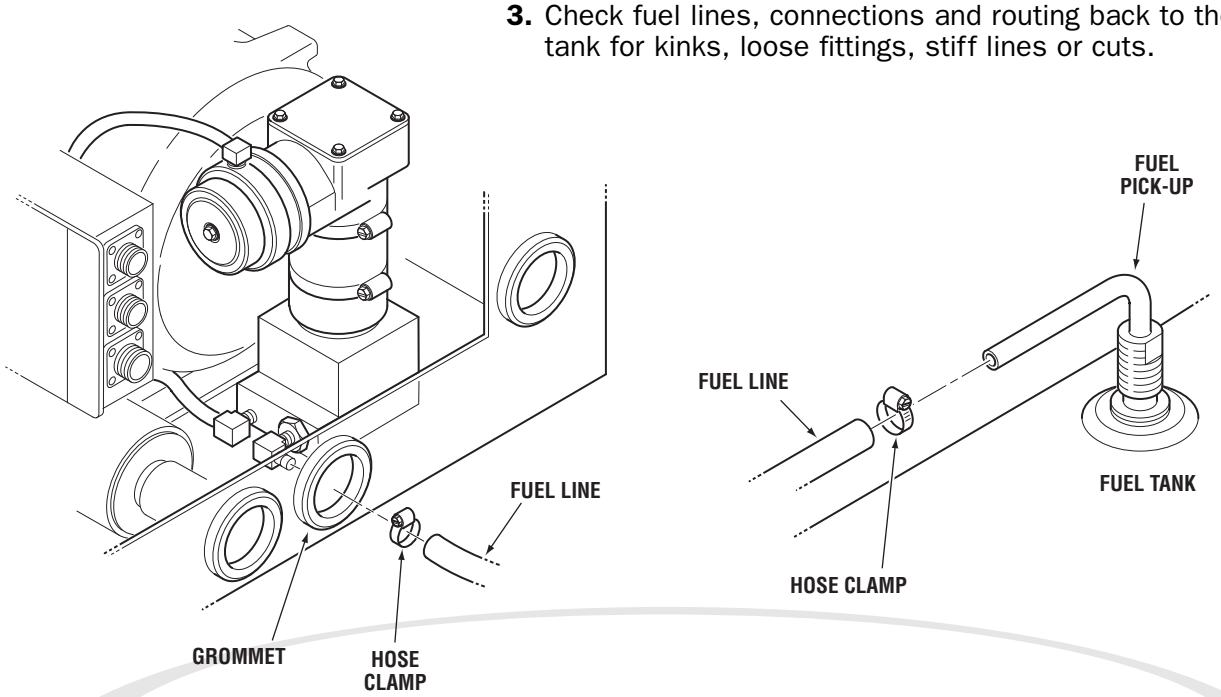


Figure F.

4. Check pressure relief valve. Locate the pressure relief valve cap and remove with a slot screwdriver. Be careful not to lose any of the internal components that may fall out.

5. Remove the spring and brass ball guide from the cavity.

6. Remove the ball bearing from the cavity.

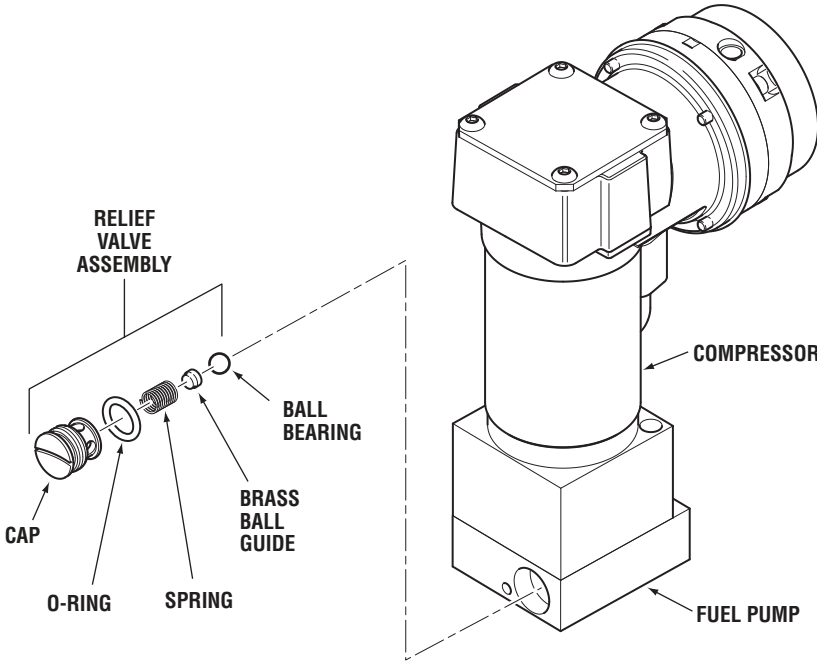


Figure G.

2. Inspect and clean all components.
8. Inspect and clean the cavity. Pay close attention to the center hole in the cavity for any debris or a damaged edge. The edge of the hole should be smooth with no nicks, do not use any tool that may damage the edge as this will cause loss of fuel pressure.
9. Place ball bearing back in cavity on the center hole.
10. Place spring back in hole with brass ball guide on top of ball bearing.
11. Lubricate O-ring with diesel fuel.
12. Install pressure relief valve cap and torque relief valve to 22 ±2 in-lbs (2.5 ±0.2 Nm)
13. Re-test the fuel pressure.
14. If fuel pressure is still below 5 PSI replace relief valve or fuel pump assembly.

Reassembly

1. Remove test gauge PK0060K.

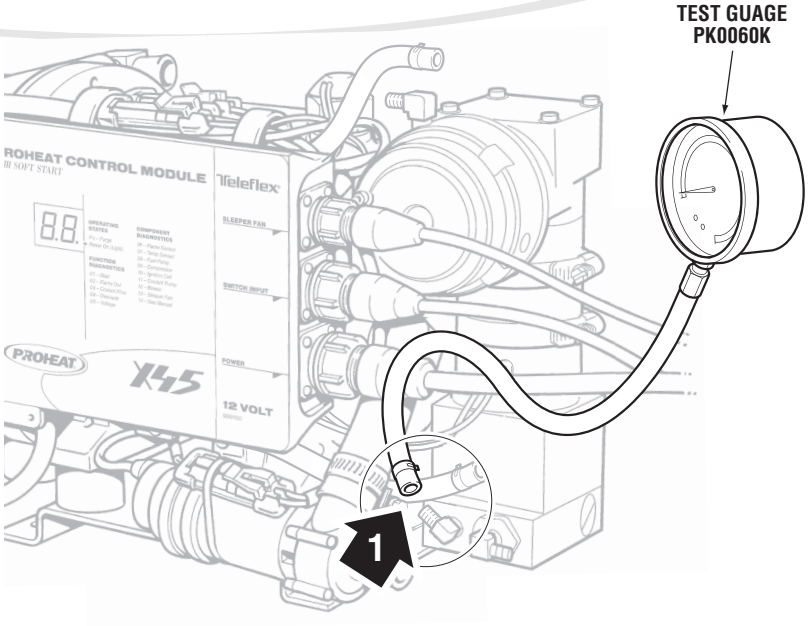


Figure H.

2. Reconnect fuel line to fuel pump outlet.

3. Reconnect air hose at compressor.

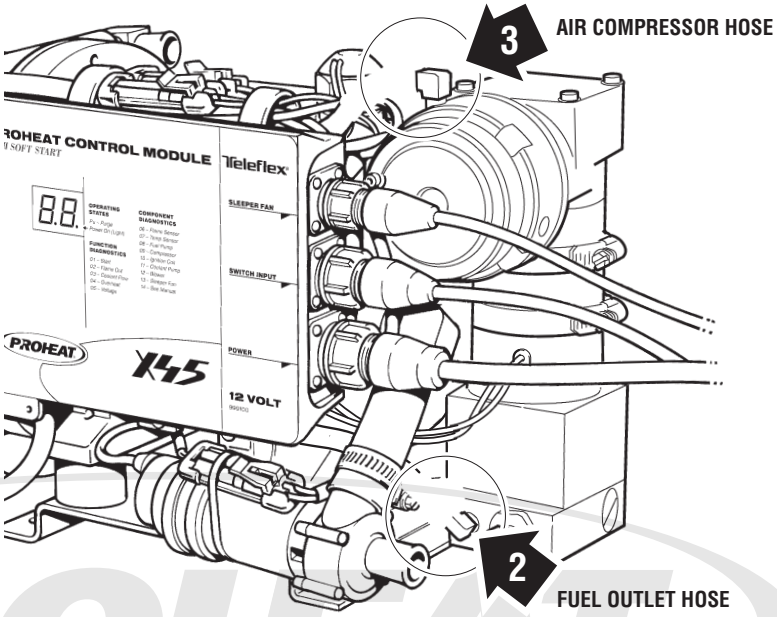


Figure I.

4. Run heater for a full cycle and inspect for proper operation.

PROHEAT WARRANTY

NOTICE

This is a warranty summary. For the complete warranty manual, please go to www.proheat.com

Proheat warrants the PROHEAT Heater to be free of defects in material and workmanship under design usage and service conditions for two (2) years on parts and labour from the date of first installation. Replacement parts are covered for the remainder of the heater's warranty or ninety (90) days, which ever is greater.

This warranty does not apply to damage or failure of the PROHEAT Heater or the vehicle into which it was installed due to improper installation, assembly, maintenance, abuse, neglect, accident, or the use of parts not supplied by Proheat. Accessories supplied, but not manufactured by Proheat, shall be covered by the manufacturer's warranty only and not subject to this warranty.

Non-standard installations, that is, those requiring a departure from published installation instructions, should not be undertaken without first having consulted Proheat.

Coverage for warrantable parts, at the discretion of Proheat will be made to the claimant in the form of repair, replacement or credit. Warranty labour payments will be made only to Registered PROHEAT Service Centres in accordance with the Standard Repair Times (SRT's) as published by Proheat.

Marine Installations

The purchaser and installer are advised that specific rules and regulations are in effect with respect to the installation of heaters in marine applications. These rules and regulations are enforced by regional and federal agencies and/or other agencies having jurisdiction. It is the installer's responsibility to review and comply with all such rules and regulations.

In addition each marine installation must be inspected and approved by an Authorized PROHEAT Dealer. Only those installations which are approved, and so registered, will be eligible for warranty coverage of one (1) year on parts and labour.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY PROHEAT IN REGARD TO THE PROHEAT HEATER SYSTEM. PROHEAT MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

OWNER RESPONSIBILITIES

Before the expiration of the warranty, Owner must give notice to a Registered PROHEAT Dealer of failures, if any, considered to be warrantable and deliver the defective heater system to such dealer. Owner is responsible for the cost of all repairs made to the engine or equipment in which it is installed, other than the PROHEAT Heater system. Owner is responsible for lodging, meals and incidental costs incurred by the Owner as a result of a warrantable failure. Owner is responsible for "down-time" expenses, and all business costs and losses resulting from a warrantable failure. **Proheat is not responsible for incidental or consequential damages.**

Items Covered Under This Warranty

1. Basic Heater including combustion chamber components, fuel system components, air compressor, ignition components, coolant pump, air blower.
2. Electrical controls provided by PROHEAT including cab mounted controls and PCM.
3. PROHEAT supplied accessories and mounting hardware.

Items Not Covered Under This Warranty

1. Proheats no longer within the warranty period.
2. Normal wear and maintenance parts, including fuel filter, air filter, nozzle, and clamps.
3. Parts which malfunction due to improper installation, causing inadequacies in: air, fuel or coolant flow; voltage due to wiring; shock or vibration protection.
4. Any progressive damage to the engine or vehicle arising out of failure of the PROHEAT.
5. Proheats which have been modified or use of non-standard parts not approved by Proheat.
6. Proheats that have been abused or damaged.
7. Travel time by a PROHEAT Dealer.
8. Diagnosis or repairs when caused by problems not directly related to the heater or due to empty fuel tanks or poor fuel quality.

If you have any questions or concerns about the PROHEAT Warranty, contact your nearest PROHEAT Distributor or Proheat at (604) 270-6899.

Proheat Serial Number:

Installation Date:

Dealer:

SeaStar Solutions
3831 No.6 Road
Richmond, B.C.
Canada V6V 1P6

Tel: 604-270-6899
Fax: 604-270-7172

www.proheat.com

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