INSTALLATION AND SERVICE MANUAL
PROHEAT X45 PLUS

Rev. A

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

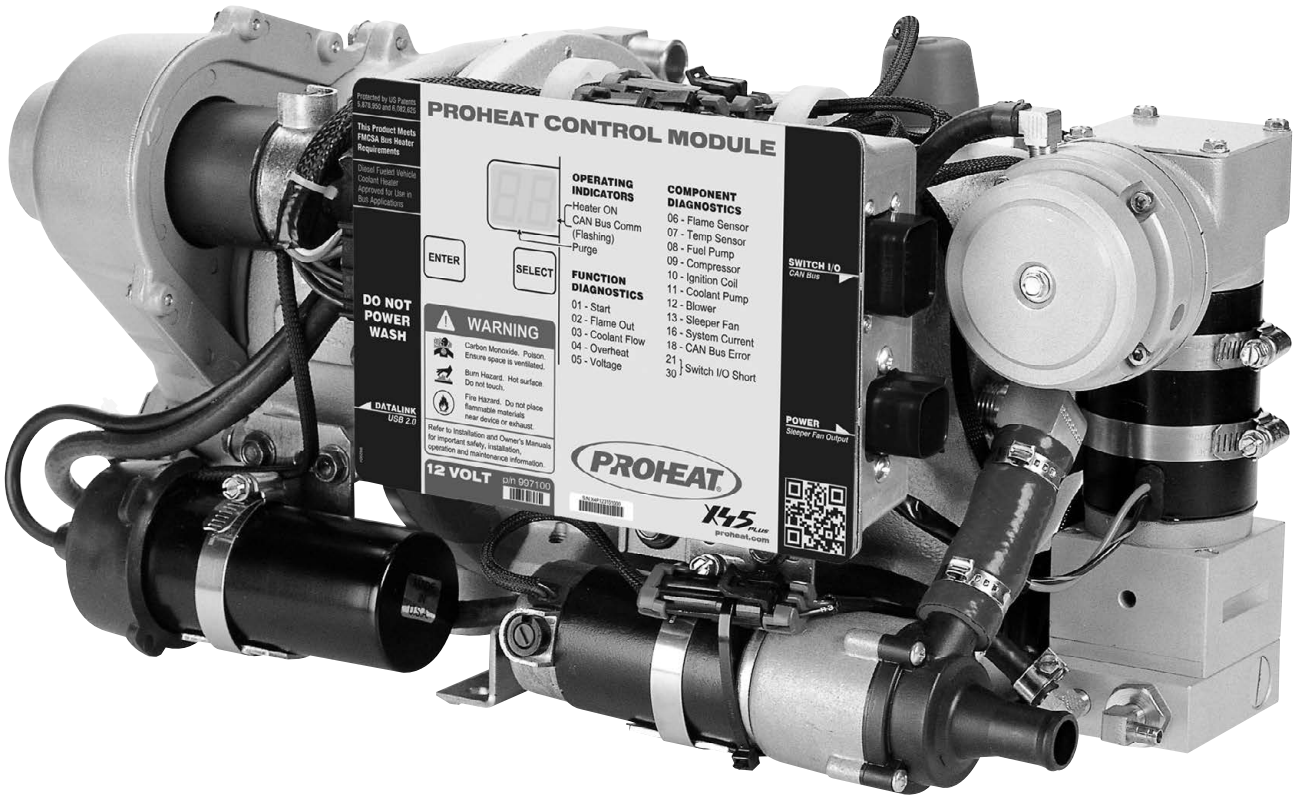
Do not operate heater in garages or in other closed or unventilated areas.

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 Plus



This manual is provided to assist authorized PROHEAT dealers install and service PROHEAT X45 Plus heaters. The X45 Plus features a new PROHEAT Control Module (PCM) and other significant improvements and replaces all earlier versions of the X45 heater. The X45 Plus can be configured for a variety of applications and for either 12V or 24V power supply.

Please refer to the X45 Plus Parts Book at www.proheat.com for detailed part descriptions and part numbers. The parts book also provides information on optional equipment, such as timers, sleeper fan control kit, impact switch (for school bus applications), and associated installation and maintenance tools.

B.1 HEATER APPLICATIONS

Although trucks have been used in the examples, 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 carriers.

PROHEAT heaters can be used in a variety of applications including:

Engine block heat – PROHEAT will preheat an engine block to ensure reliable starting in cold weather. When used throughout the year, it helps to reduce the wear associated with cold starts.

Cab or sleeper heat (with the engine off) – PROHEAT will supply heat to a vehicle cab or sleeper so drivers can sleep in comfort during cold weather without idling the engine, which reduces fuel consumption.

Supplemental heat (with the engine running) – as the efficiency of modern diesel engines improves, there is less reject heat available to heat the vehicle's interior, particularly for buses. PROHEAT can be used while the vehicle is operating to provide supplemental heat for the vehicle interior.

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

Marine applications – Marine applications typically involve the engineering and installation of a complete hot-water heating system of which PROHEAT is one component. PROHEAT recommends that only an expert in marine hot-water heating systems install a PROHEAT on a boat. The installer is responsible for ensuring that the installation complies with all applicable regulations.

1.0 TECHNICAL SPECIFICATIONS

	X45 Plus 12V	X45 Plus 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	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
AUTOSTART	Same as system voltage Maximum 1 Amp draw (over-load shut-off protection) High-side switched

SYSTEM INPUTS	
SWITCH	10 – 15 VDC (12V X45 Plus) | 20 – 30 VDC (24V X45 Plus) Standard mode Preheat mode (momentary) Supplemental mode Anti-freeze mode Supplemental Priority, Supplemental Max Heat, Global Low Temperature
POWER	12 VDC or 24 VDC
CANBus	Meets SAE J1939-11

1.1 PHYSICAL – X45 PLUS

1.1.1 X45 PLUS HEATER

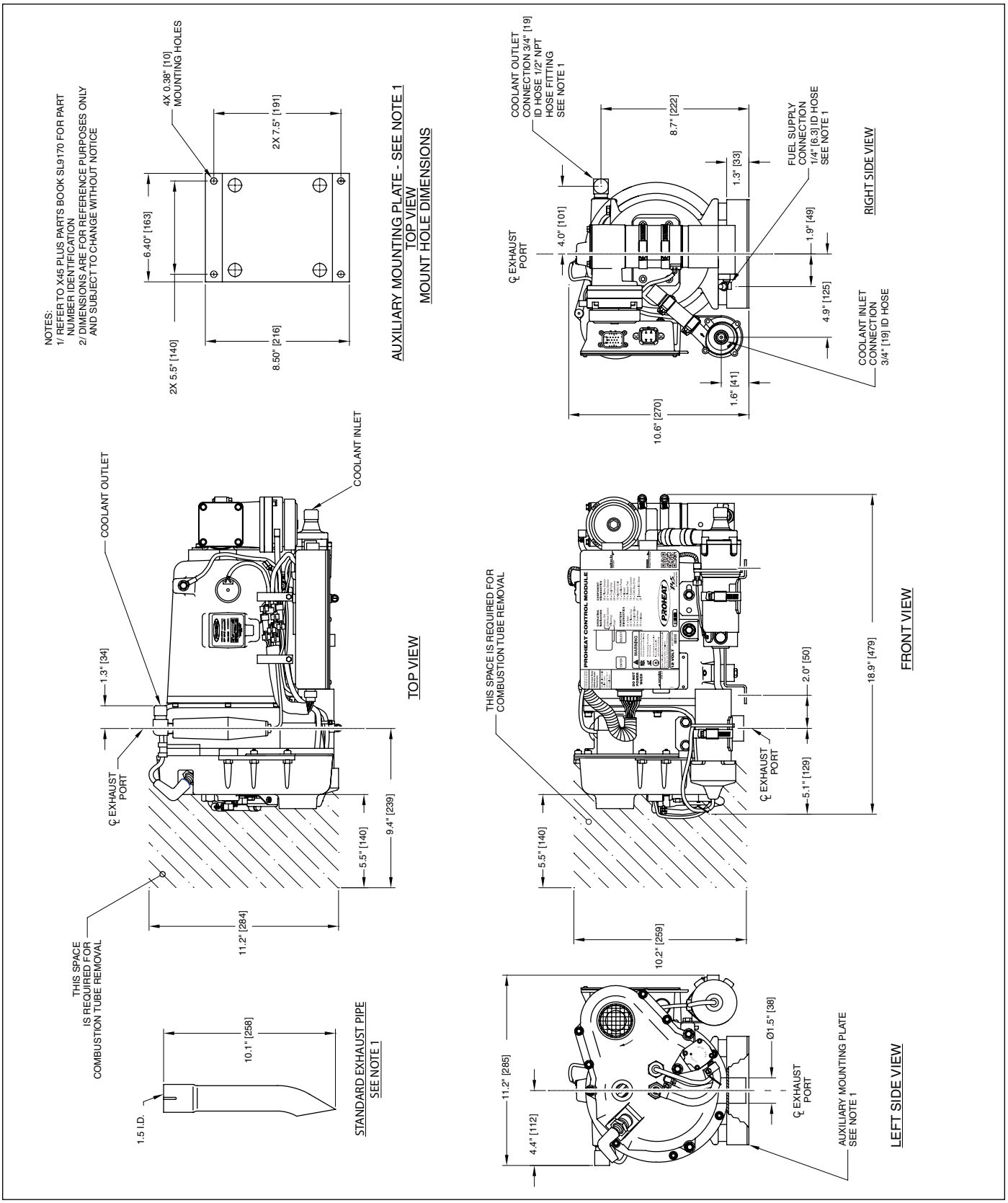


Figure 1-1. Heater Dimensions – X45 Plus

1.1.2 X45 PLUS WITH ENCLOSURE

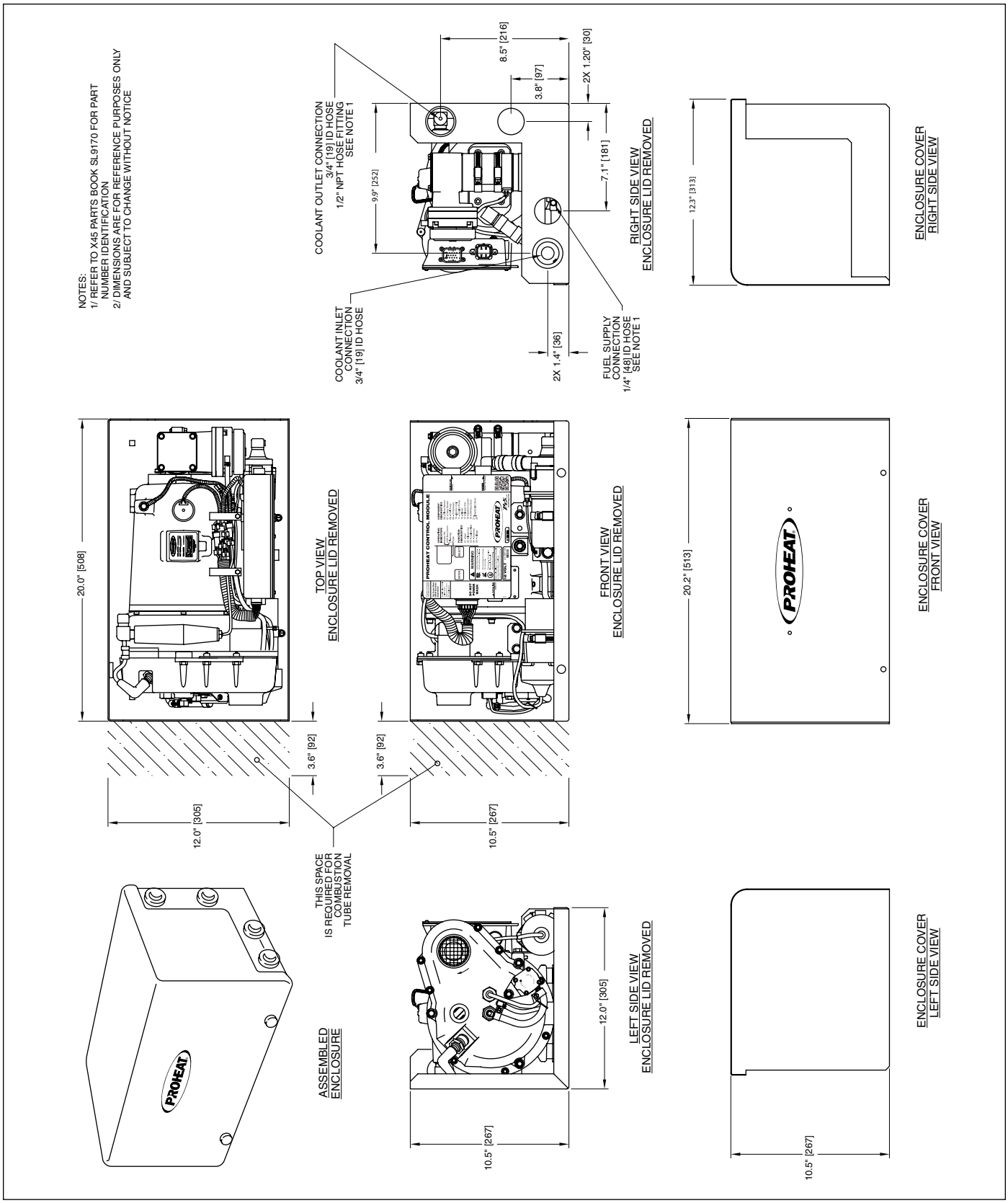


Figure 1-2. Heater Dimensions including Enclosure – X45 Plus

1.2 ELECTRICAL – X45 PLUS

NOTICE

All control signal input voltages must match heater supply voltage.
All heater output signals will match heater supply voltage.

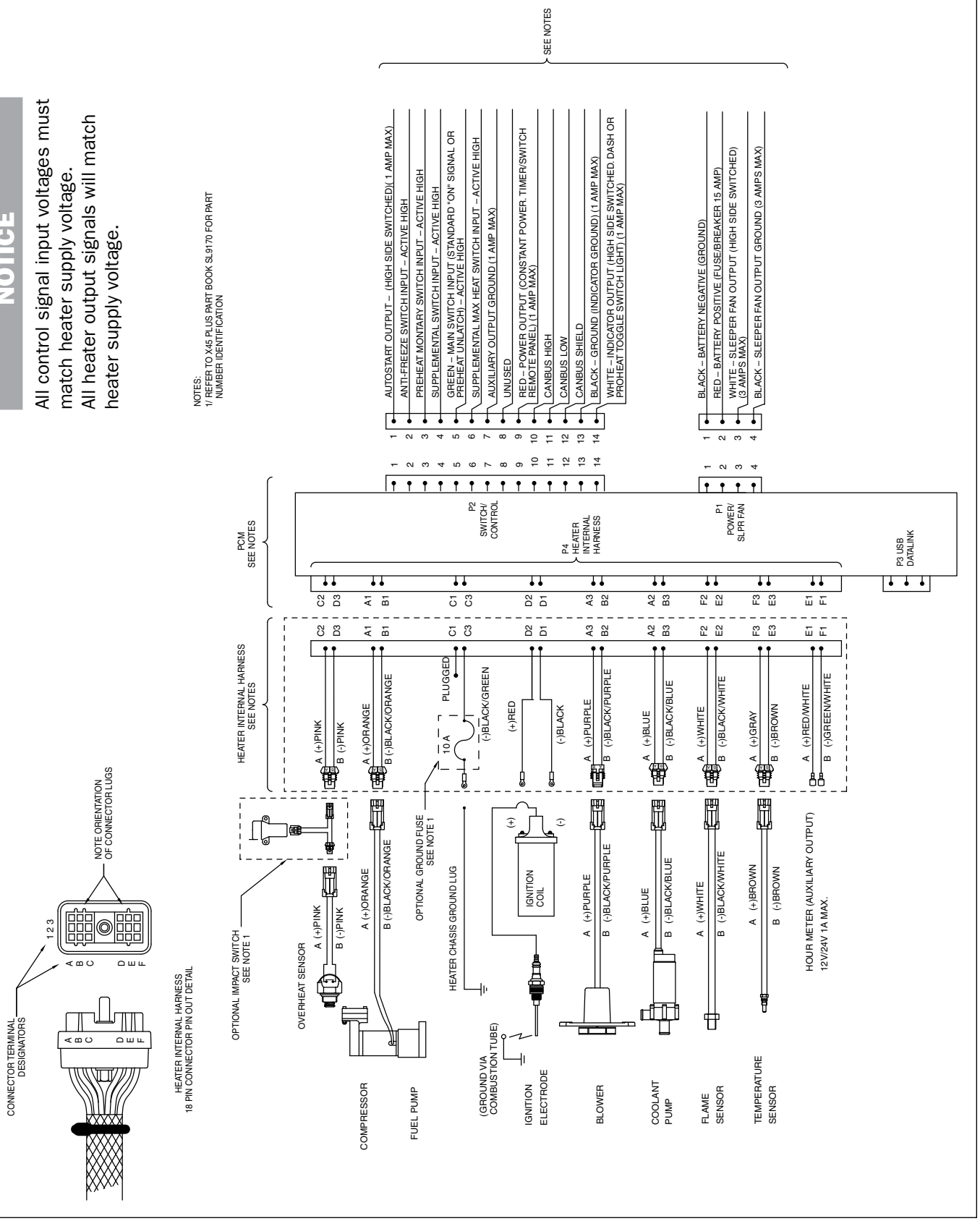


Figure 1-3. Wiring Diagram – X45 Plus

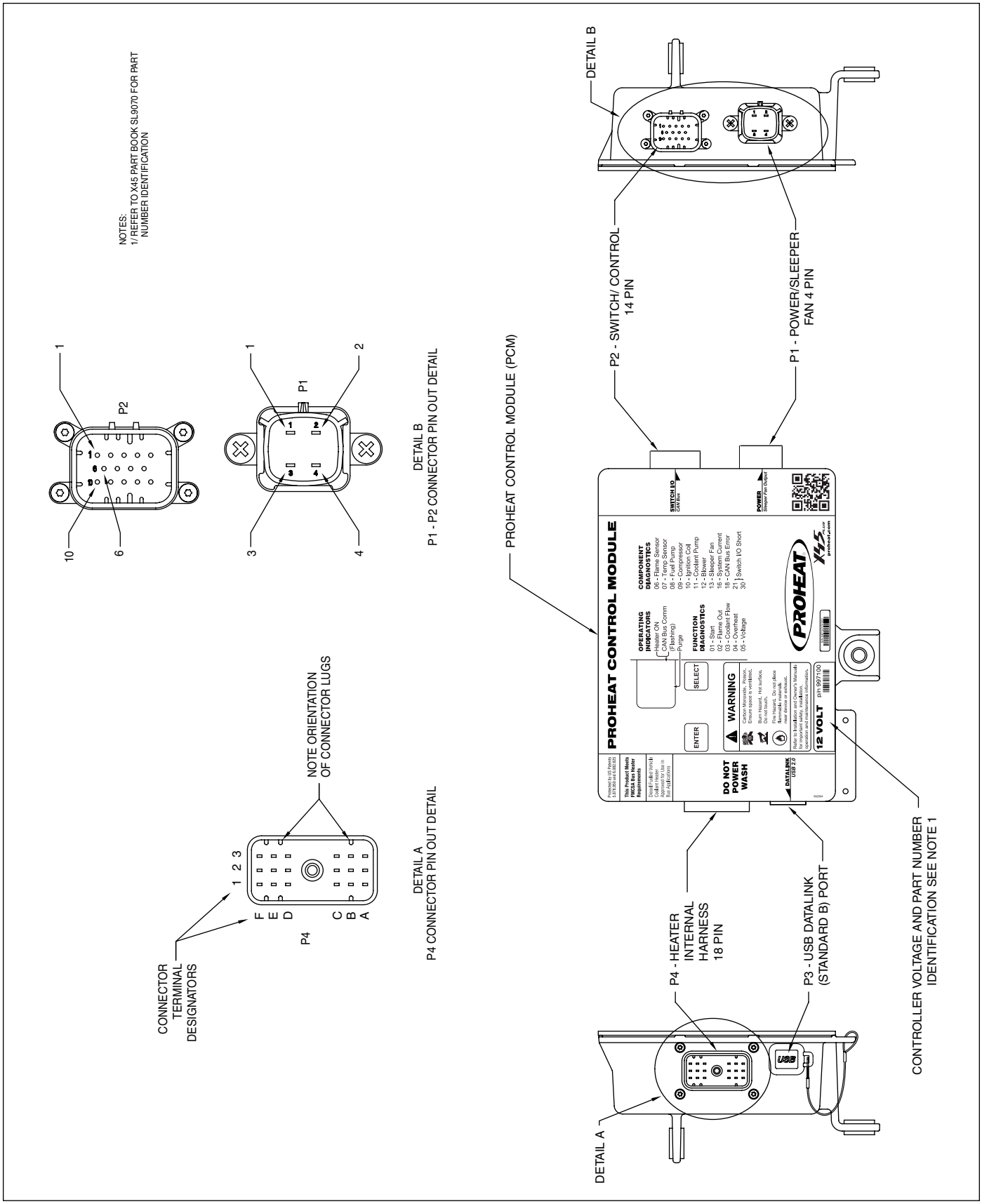
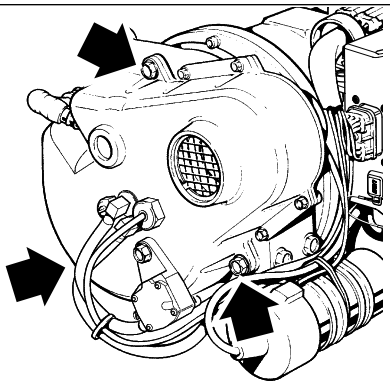


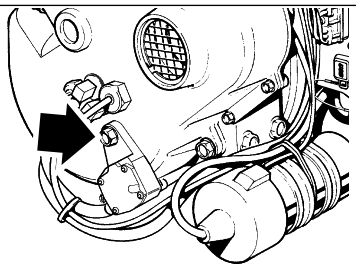
Figure 1-4. PCM Electrical Connections – X45 Plus

1.3 TORQUE SPECIFICATIONS



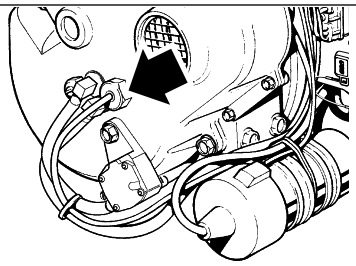
FAN END CASTING

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



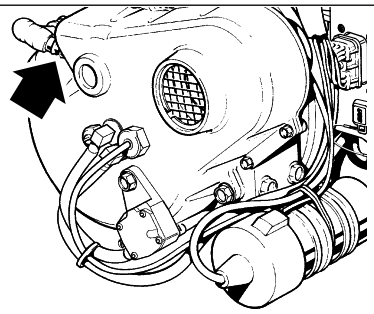
REGULATOR

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



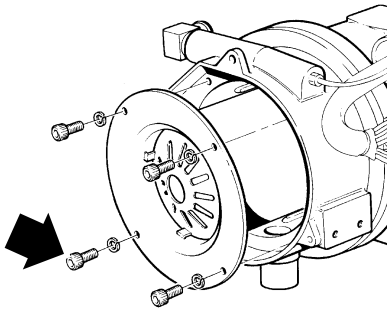
FLAME SENSOR

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



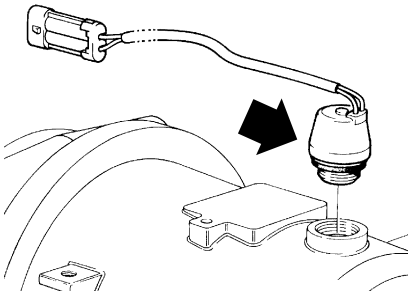
IGNITER

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



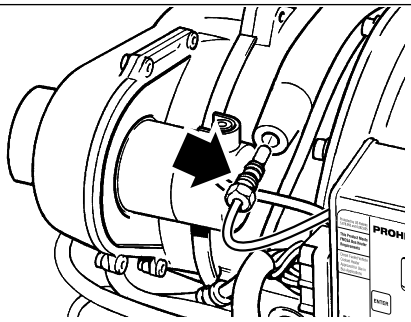
COMBUSTION TUBE

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



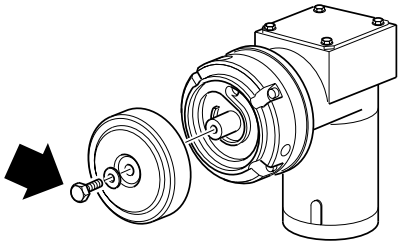
OVERHEAT SENSOR

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



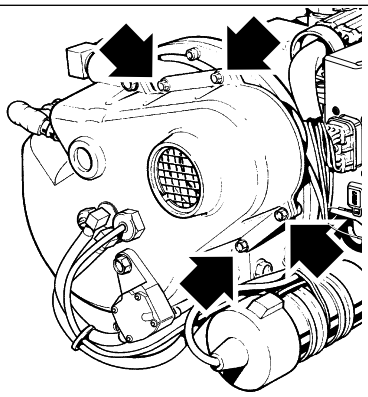
TEMPERATURE SENSOR

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



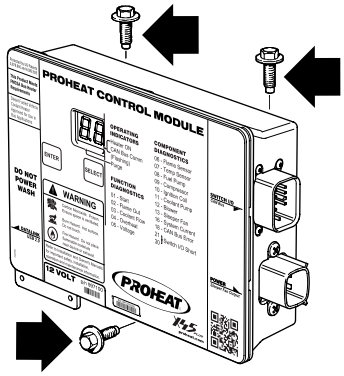
AIR FILTER

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



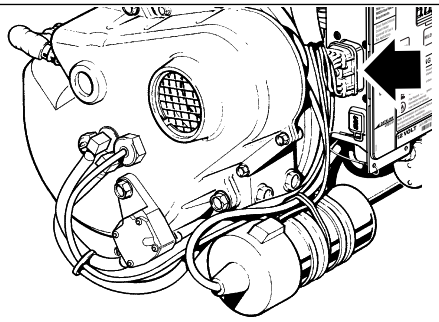
BLOWER ASSEMBLY

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



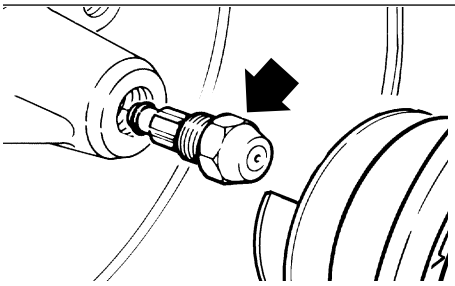
X45 PLUS PROHEAT CONTROL MODULE (PCM)

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



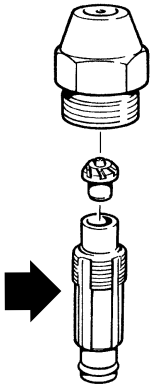
MAIN INTERNAL HARNESS

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



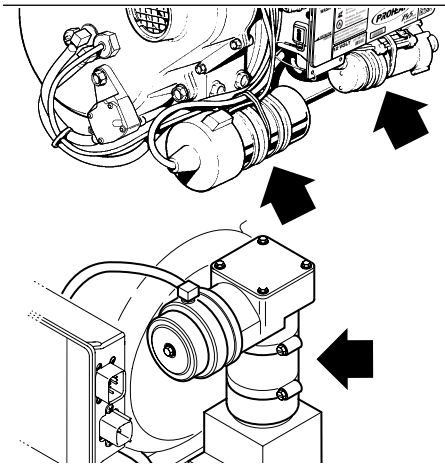
NOZZLE TO FAN END

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



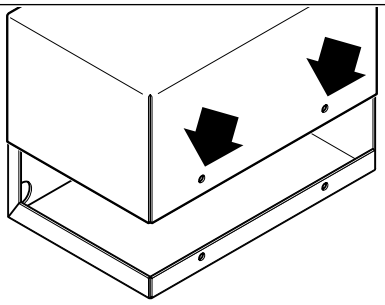
NOZZLE REASSEMBLY

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



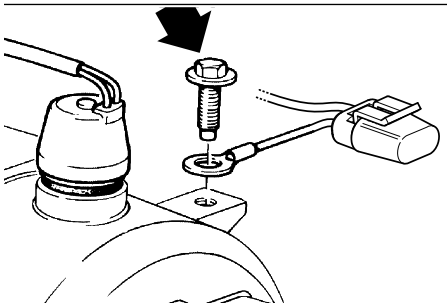
BAND CLAMPS

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



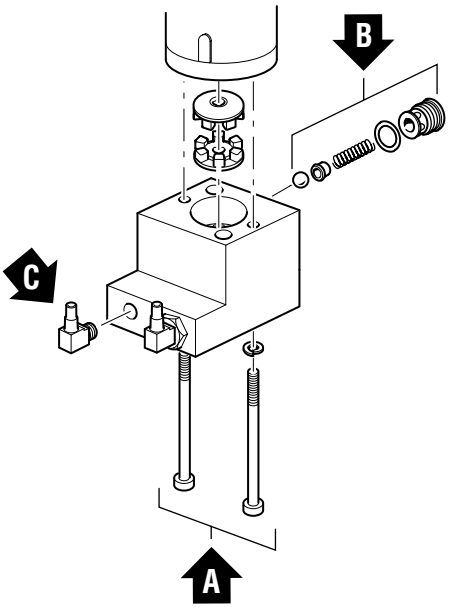
ENCLOSURE LID (Optional)

- 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

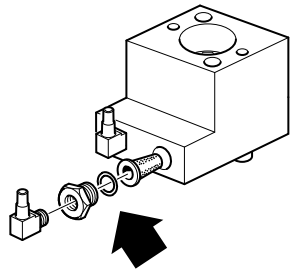
- Apply Loctite 242 to threads
- Torque bolts (2) to 25±3 in/lbs (2.8±0.3 Nm)

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 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 focus on truck applications and do not cover all of the possible installations. As seen in the figures below, the PROHEAT X45 Plus can be 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 eight 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.

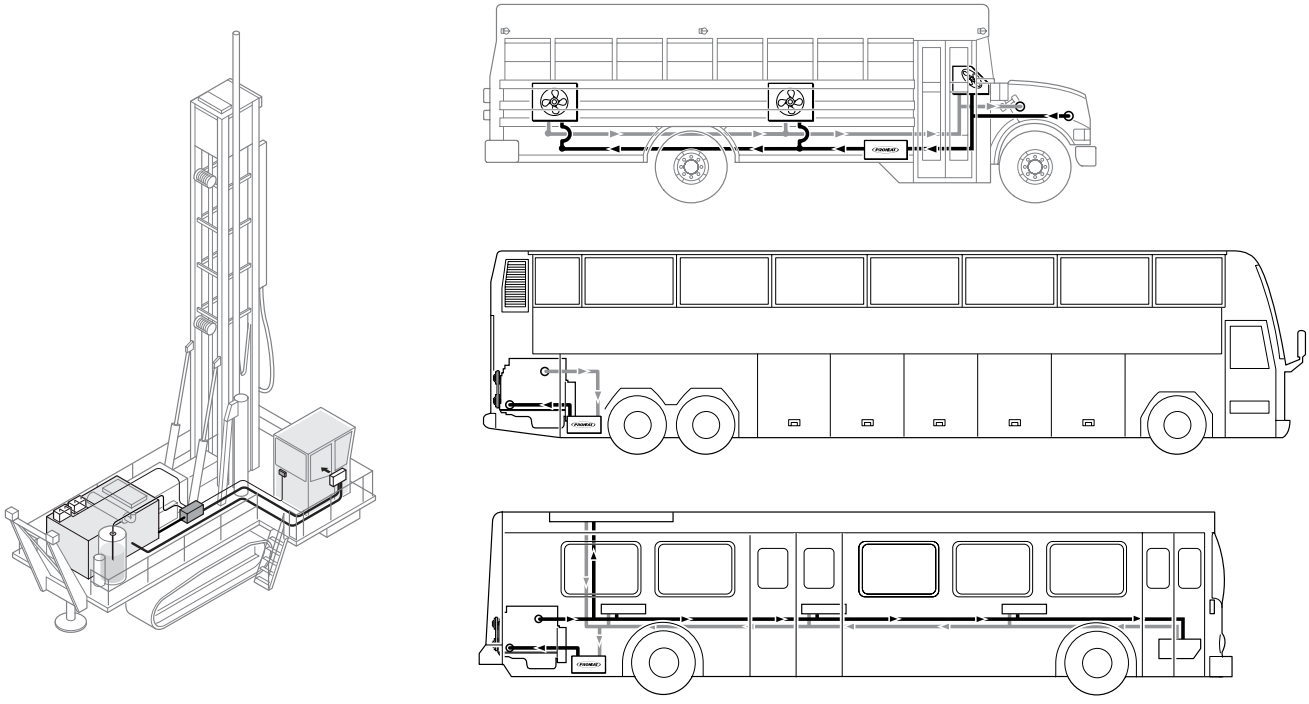


Figure 2-1. Other Applications

2.1 LOCATING THE HEATER

2.1.1 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.

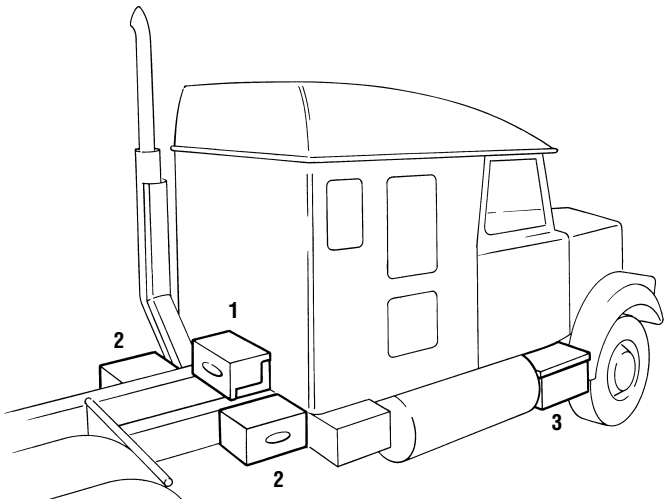


Figure 2-2. Recommended Mounting Positions

2.1.2 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 2-3)

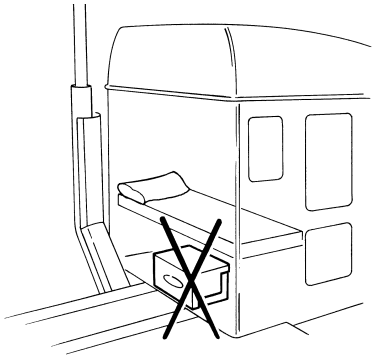


Figure 2-3.

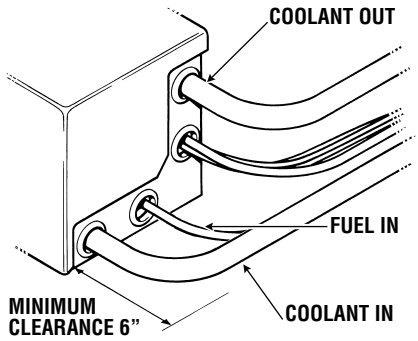


Figure 2-4. Allow minimum 6” clearance for hose connections.

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.

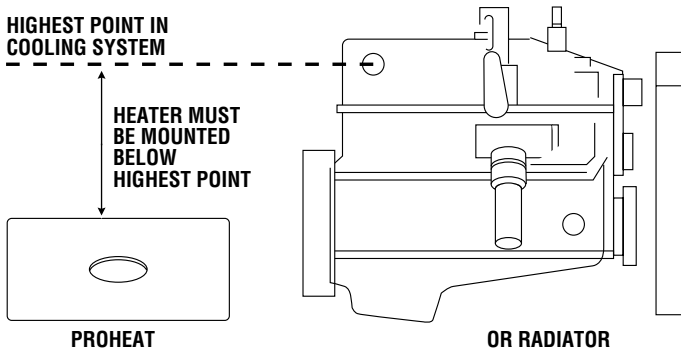


Figure 2-5. Height Requirement

2.1.3 MOUNTING THE PROHEAT HEATER IN AN ENCLOSURE

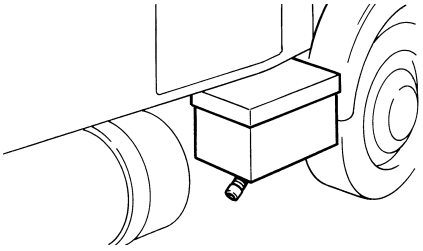


Figure 2-6. Adequate Air Flow

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.

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

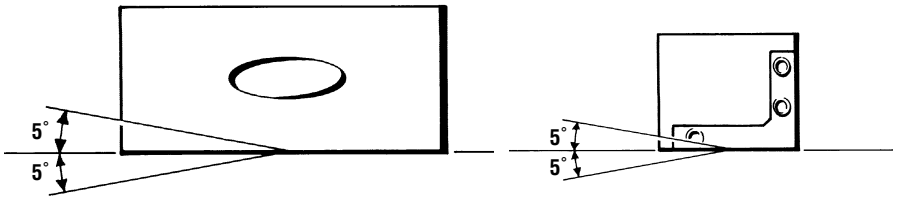


Figure 2-7. Mounting Angle

2.2 MOUNTING THE HEATER

Select Your Mounting Option

2.2.1 OPTION A – Heater With Enclosure

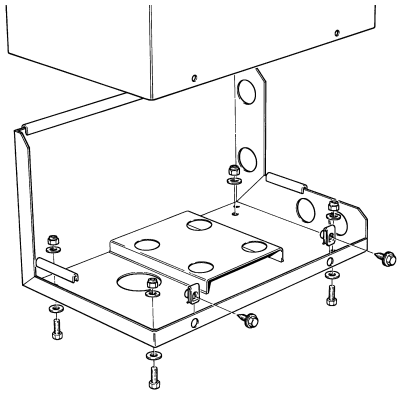


Figure 2-8. Mounting Tray

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.

NOTE: Ensure that the combustion tube can be removed for service. See figure 1-2 on page 1-3 for service space requirements.

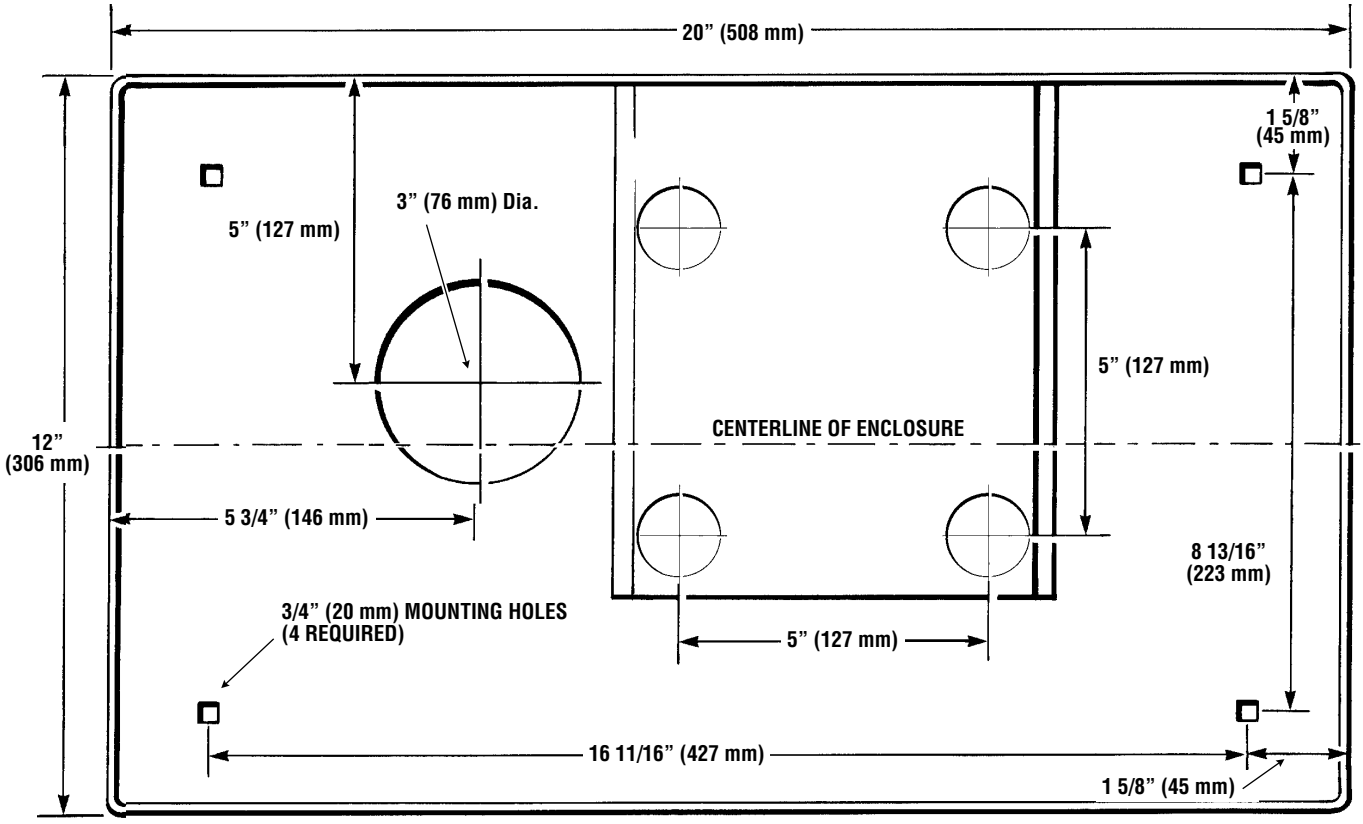


Figure 2-9. X45 Plus Enclosure Base Dimensions

2.2.2 OPTION B – Heater Without Enclosure

NOTICE

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

Heaters supplied without an enclosure need to be mounted in an existing enclosure on the vehicle, such as a tool box. Heater supplied with an auxiliary mounting plate.

1. Ensure that the proposed enclosure is big enough for the heater. 12.5”W x 11”H x 20.5”L (318 x 280 x 521 mm).
2. Using the indicated dimensions, drill the (4) mounting holes and exhaust pipe clearance hole.

   NOTE: Ensure that the combustion tube can be removed for service. See figure 1-2 on page 1-3 for service space requirements.

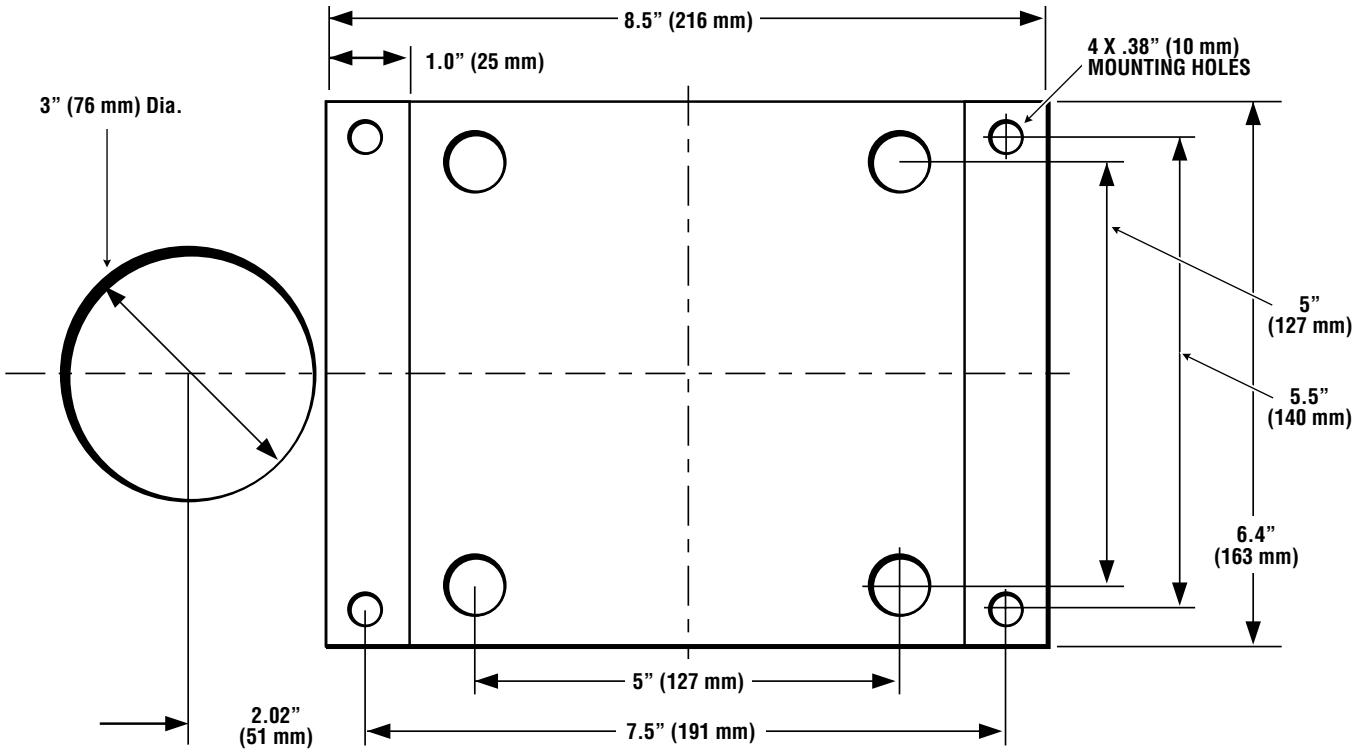


Figure 2-10. X45 Plus Mounting Plate Dimensions & Exhaust Hole

2.3 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 (such as brake lines, seals, wires, rubber hoses, or bumpers). The exhaust pipe may 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.

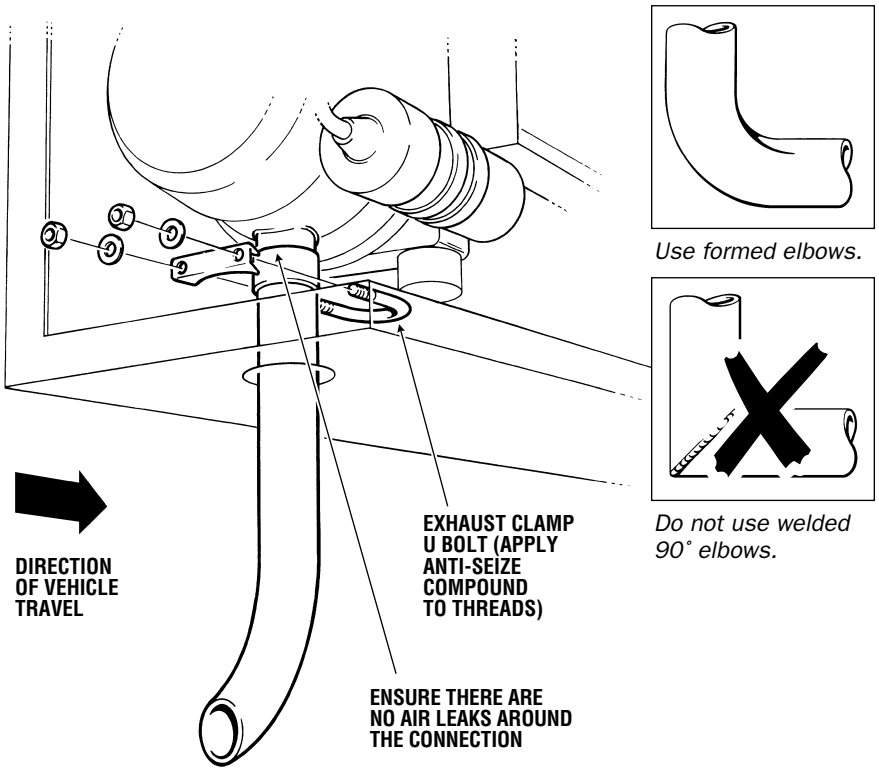


Figure 2-11. Exhaust Pipe

2.4 COMBUSTION AIR SUPPLY

The heater's combustion air intake must be in an area of calm, clean and dry air. If this is not possible, a snorkel hose may be used to draw combustion air from a remote source.

An air intake snorkel hose may be required to prevent the Proheat from drawing dust, dirt and moisture into the combustion chamber.

2.4.1 GENERAL CONSIDERATIONS

- Must not be taken from the passenger compartment.
- Snorkel hose or pipe must be smooth on the ID to prevent any disruption in air flow.
- The hose length should not exceed 7 ft.
- No more than 270° of total bends.
- The center line bend radius must be 3.5" or greater to prevent kinking of the hose.
- Route to an area of calm, clean and dry air.
- Clamps must be sized so they do not kink or crimp snorkel hose.
- The use of an air filter is not recommended.

2.4.2 AIR INLET SNORKEL HOSE OPTION

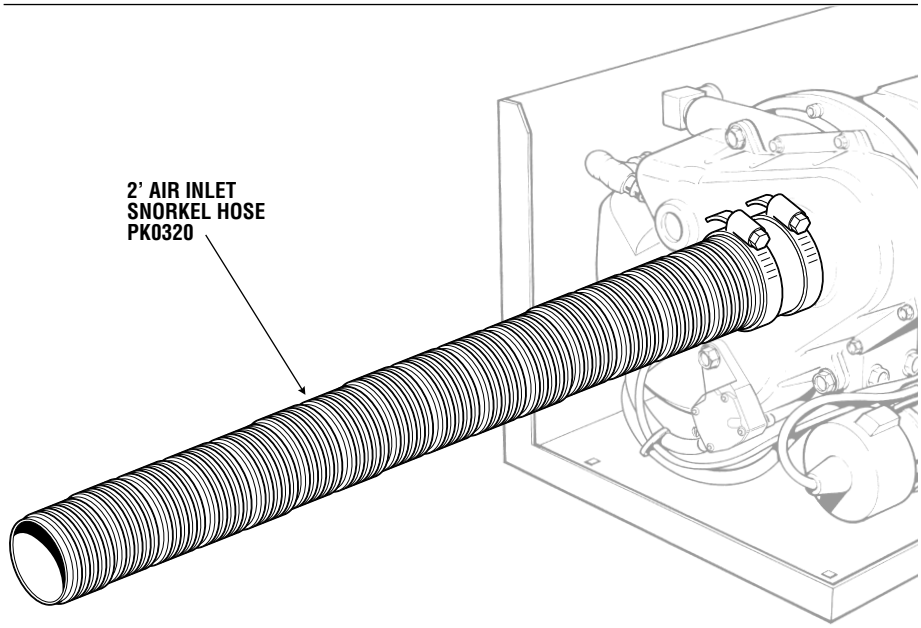


Figure 2-12. Air Inlet Snorkel Hose (Optional)

2.5 PLUMBING THE SYSTEM

2.5.1 GENERAL CONSIDERATIONS

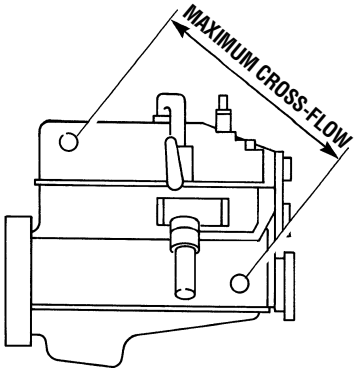


Figure 2-13. Maximum Cross-flow

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

- 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, using auxiliary heater core and fan kit PK0360 or similar.

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 2-14 or figure 2-16.
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.

2.5.2 OPTION A – Engine Heat or Supplemental Heat

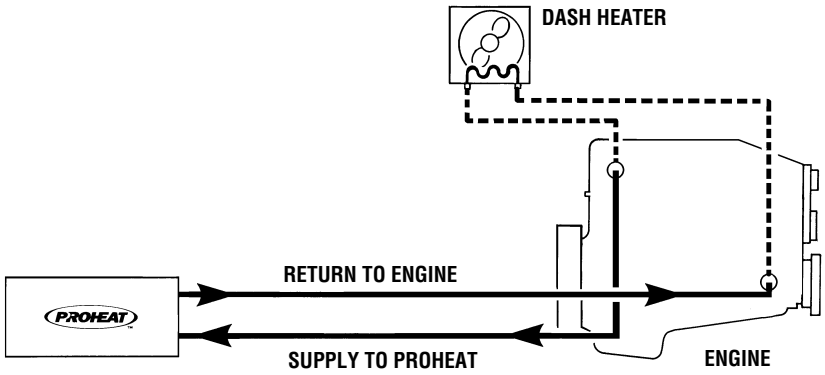


Figure 2-14. Engine Heat or Supplemental Heat

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.

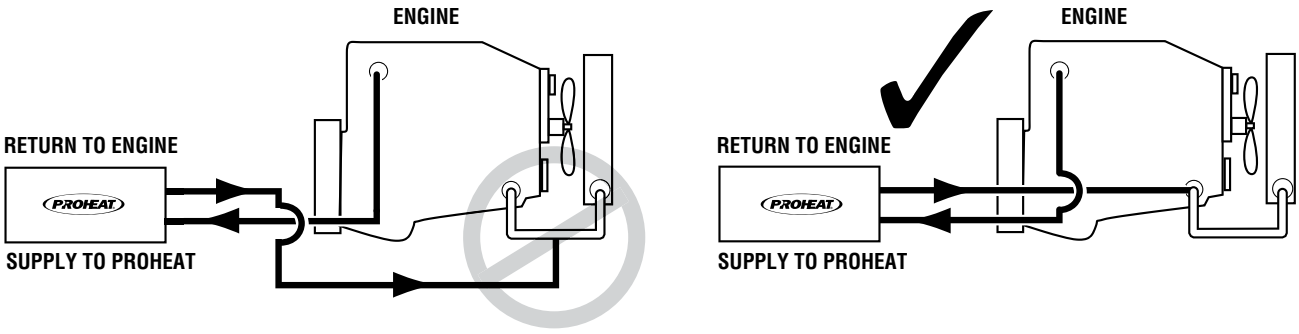


Figure 2-15. Correct Return Line Plumbing

2.5.3 OPTION B – Engine and Sleeper Heat

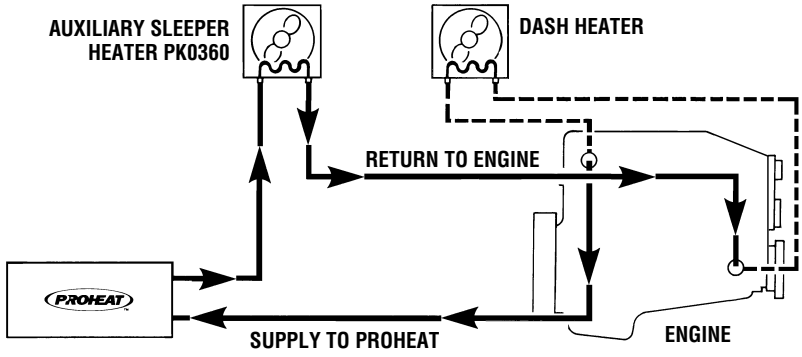


Figure 2-16. Engine and Sleeper Heat

2.6 WIRING & ELECTRICAL CONNECTIONS

2.6.1 GENERAL CONSIDERATIONS

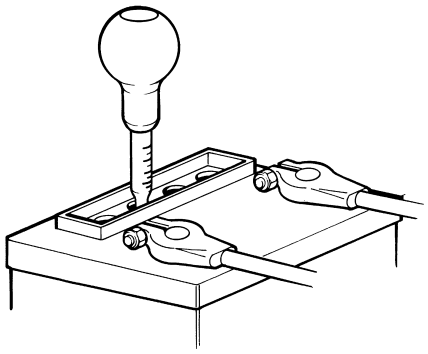


Figure 2-17. Test Battery

- 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 page 2-12).

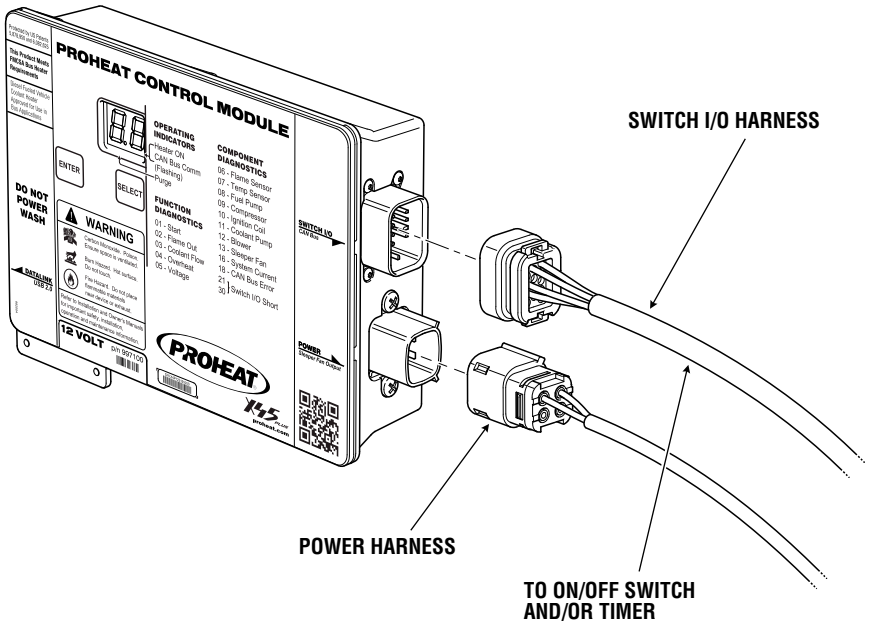


Figure 2-18. Major Electrical Connections

2.6.2 POWER CONNECTION TO BATTERIES

The new X45 Plus Proheat Control Module (PCM) requires a fuse to be installed on the positive power supply cable at the battery or power source.

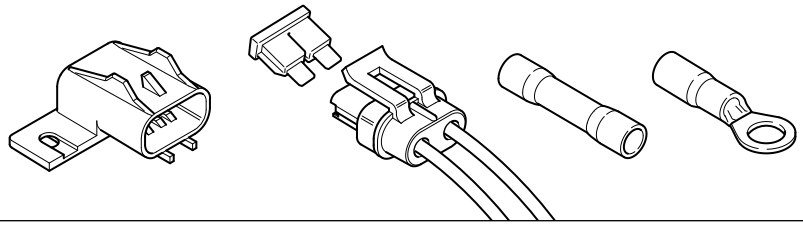


Figure 2-19. Fuse kit.

Installation Instructions

NOTICE

If batteries are equipped with a ground side disconnect, a second fuse kit must be installed on the power harness negative wire.

NOTICE

Remove and clean battery terminals. Prior to re-connecting, grease terminals with electrically conductive grease.

1. The fuse kit comes with a 15 amp ATO fuse and a pre wired fuse holder, one crimp and heat shrink ring terminal and one crimp and heat shrink butt splice.
2. Inspect the power harness from the Proheat to the batteries for corrosion, kinks, cuts or damage. Replace existing harness with a new X45 Plus power harness 305531K if needed and continue with fuse installation in step 3.
3. Strip outer wire jacket of the power harness back to expose the positive (red) lead (figure 2-21). Strip the lead as shown in figure 2-20, using the provided crimp and heat shrink butt splice connect the fuse to the end of the red wire, then crimp and heat shrink as per instructions on page 2-13. On the other side of the fuse connect the provided crimp and heat shrink ring terminal, then crimp and heat shrink as per instructions on page 2-13.

   Connect the leads to the battery terminals. (See figure 2-21.)

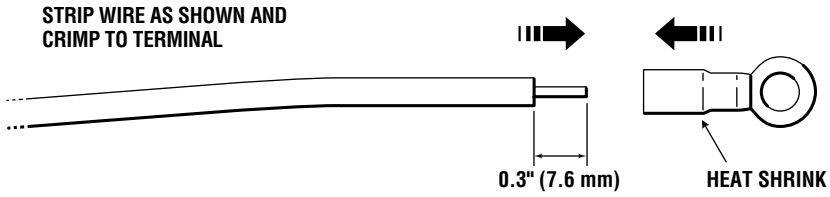
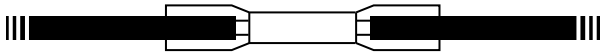


Figure 2-20.

Figure 2-21. Power Connection to Battery.

Crimping & Heat Shrinking Instructions

1.

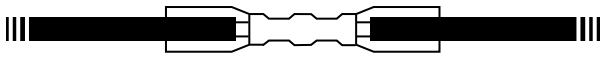


Strip the wires 0.3” (7.6 mm) from the end and insert into the crimp barrel.

⚠ WARNING

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

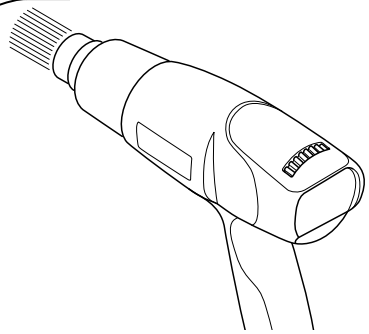
2.



Making sure the wire end is properly seated, make the crimp connection using a tool designed for insulated splices.

3.

Apply heat directly to the splice working from the center out to the edges, using a hot air gun, until the tubing shrinks and the adhesive flows. Allow to cool before inspecting splice and checking integrity.



2.6.3 HEATER MODES

The X45 Plus has four basic modes of operation:

Standard Mode
(Engine OFF or RUNNING) (Pre wired for included switch or optional T-II Timer)

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 or optional timer. Since the coolant pump runs continuously in this mode, it’s possible to accumulate a high number of coolant pump operating hours vs. heater run hours when used with the engine running. Use of supplemental mode is recommended if the heater is going to be used with the engine running). Please refer to the wiring diagrams on page 1-4 and page 2-16.

Supplemental Mode
(Engine RUNNING) (Optional add in harness needed)

This mode is generally used in buses (school, transit, and coach) to help heat the engine and passenger compartment all year round. This mode is typically automatically enabled any time the engine is running.

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.

To simplify heater 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 30 seconds*. This causes coolant in the engine to be circulated through the PROHEAT. If after 30 seconds* the coolant temperature is above 150° F (65° C)*, the

NOTICE

There is a 30-second delay in response to an “ON” and 5-second “OFF” signal* to allow time for the vehicle to start before the heater is activated in supplemental heat mode.

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.

The PROHEAT switches off when the engine stops so that the heater can’t be accidentally left running overnight.

Supplemental heat mode has priority over the preheat mode and will cause the preheat mode to drop out.

Please refer to the wiring diagrams on page 1-4 and page 2-18.

Supplemental Max Heat Feature (Optional add in harness needed)

- To use this feature supplemental mode must also be enabled, the cycle on/off temperature range shifts up to between 170–190°F (77 –88°C) to push the average coolant temperature higher.
- This mode is useful for Tier 4 engines to help maintain higher engine temperatures to reduce emissions and resulting regens, or when more heat is needed such as high HVAC demands.

Please refer to the wiring diagram on page 1-4.

Supplemental Priority Feature (Optional add in harness needed)

To use this feature supplemental mode must also be enabled, when active this gives priority to supplemental mode over standard mode. When both standard and supplemental modes are active, the heater will run in supplemental mode.

Please refer to the wiring diagram on page 1-4.

Preheat Mode (Engine off) (Optional add in harness needed)

Preheating the engine coolant is often essential to start engines in cold weather. And since much of an engine’s wear occurs during cold start-ups, preheating also reduces the wear and contributes to longer engine life and reduced operating costs.

The preheat mode is usually activated an hour or so before starting the engine using a momentary contact switch. 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 mode is it’s switched off automatically. No operator input is required. The PROHEAT has a built-in time-out feature to prevent the heater from running indefinitely. 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 press the momentary contact switch again.

Please refer to the wiring diagrams on page 1-4 and page 2-18.

Anti-freeze Heating Mode (Battery Save Mode) (Optional add in harness needed)

The anti-freeze heating mode is designed to minimize battery consumption and keep the coolant system warm or from freezing over a longer period of time such as a weekend. Anti-freeze mode is generally activated by a toggle switch. This mode is similar to the supplemental mode and only runs the coolant pump while heating and checking the temperature during the pre-run cycle. The difference is that when the heater is in standby (coolant pump off) the coolant pump is run every 20 minutes to sample the system coolant temperature to ensure the coolant temperature is maintained throughout the system. In Anti-freeze mode the coolant temperature will be maintained between 41°F and 60°F (5°C and 20°C)*.

When Anti- freeze mode is enabled and another heating mode becomes active it will override Anti-freeze heating mode but will not cancel it. Once the other heating mode is turned off the heater will return to Anti-freeze heating mode.

Please refer to the wiring diagram on page 1-4.

Global Low Temperature Feature (Optional add in harness needed)
To use this feature a heating mode needs to be enabled. This feature shifts all the cycle on/off temperature of all operating modes (Preheat, Standard and Supplemental) down to between 73–108°F (40–60°C)* so the overall average coolant temperature is lower.

This shift can prevent short cycling especially with smaller engines and smaller coolant circuits which saves fuel and battery power over a longer period of time as well as reducing heater maintenance due to sooting up.
The X45 Plus Switch / Control harness comes pre wired to run the heater in Standard mode with the included toggle switch or the optional T-II Timer.

Please refer to the wiring diagram on page 1-4.

For additional features or operating modes an add in harness kit is needed. See section 2.6.6 for optional connections.

** There are special OEM versions for supplemental heat 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. Please contact PROHEAT Technical Support for more information.*

2.6.4 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.

⚠ CAUTION

The switch is not waterproof and must be mounted in a dry location only.

NOTICE

Do not connect an ON/OFF switch and a timer in the same circuit.

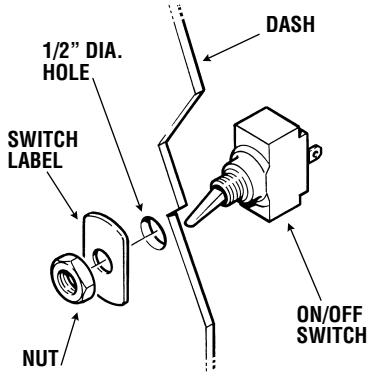


Figure 2-22. ON/OFF Switch Assembly

1. Select a suitable location in the vehicle dash for the ON/OFF switch. Switch is for dry locations only.

NOTE: Many dash panels have switches that are not used. 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 2-22.)
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 1/4" spade terminals.

NOTE: Use fully insulated disconnects when connecting switch.

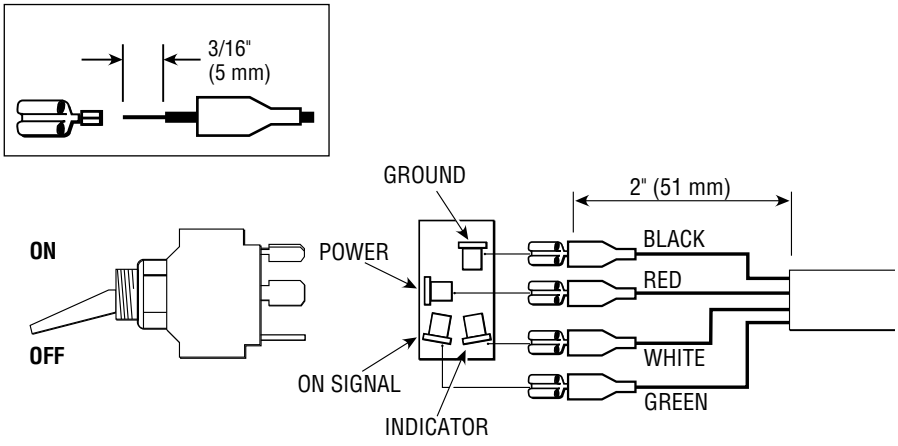


Figure 2-23. ON/OFF Switch Connections

6. Connect the terminals to the switch as shown. (Figure 2-23.)

NOTE: Connecting an ON/OFF switch and a timer in the same circuit will cause the indicator light to flash incorrectly.

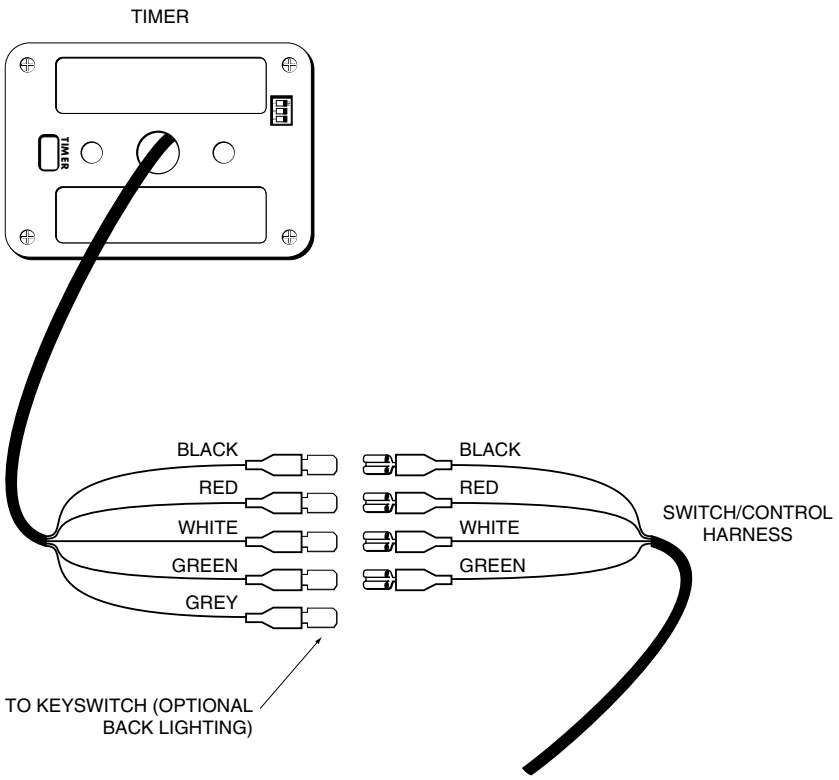
2.6.5 TIMER CONNECTIONS (OPTIONAL)

⚠ CAUTION

The switch power 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

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 2-24. Timer Connections

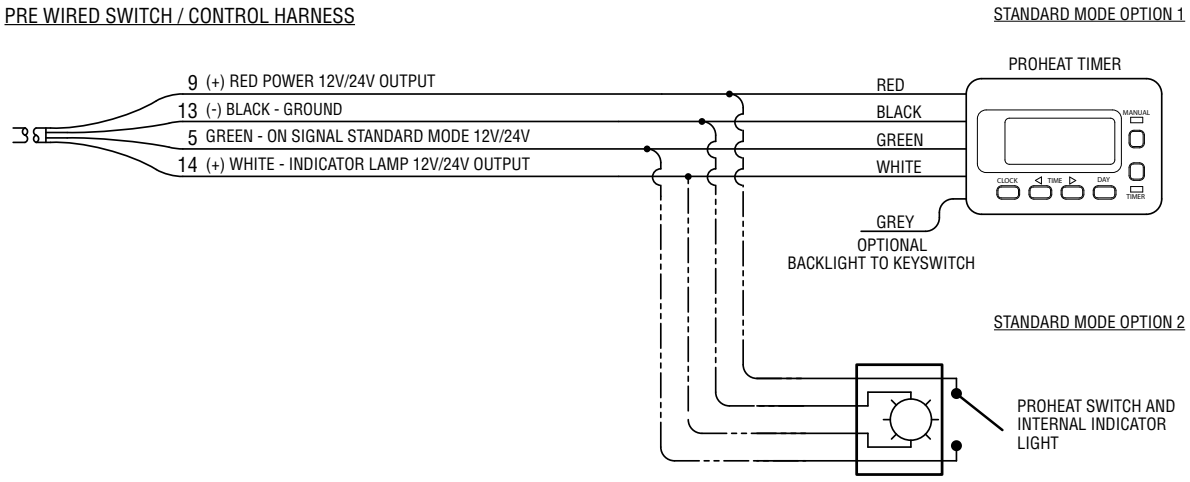


Figure 2-25. Pre wired switch/control harness

2.6.6 OPTIONAL MODES AND FEATURES WIRING

To enable optional modes and features the add in harness must be added to the corresponding pin on the switch/control harness.

PIN#	DESCRIPTION
1.	Autostart output – (high side switched) (1 amp max).
2.	Anti-freeze switch input – active high.
3.	Preheat momentary switch input – active high.
4.	Supplemental switch input – active high.
5.	Green – main switch input (standard "ON" signal or pre-heat unlatch) – active high.
6.	Supplemental max heat switch input – active high.
7.	Auxiliary output ground (1 amp max).
8.	Not used.
9.	Red – power output (constant power. Timer/switch remote panel) (1 amp max).
10.	Yellow – CANbus high.
11.	Green – CANbus low.
12.	Black – CANbus shield.
13.	Black – ground (indicator ground) (1 amp max).
14.	White – indicator output (high side switched. Dash or Proheat toggle switch light) (1 amp max).

NOTE: *Pins 5, 9, 13 & 14 are pre populated from the factory.*

1. Carefully prying between the black edge of the connecter and one of the corners of the red wedge lock until it is released from (but not completely out of) the connector body. Repeat if necessary on the opposite corner. The red wedge lock is now in the open position.

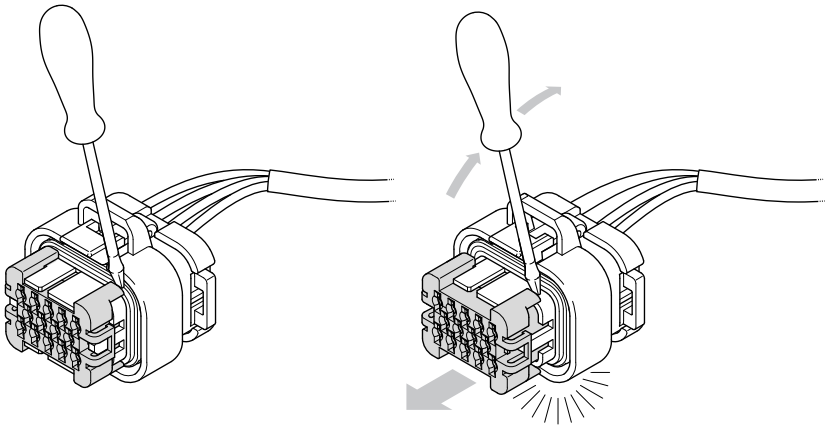


Figure 2-26.

2. From the wire side of the connector, remove the cavity plug from the corresponding terminals and discard.

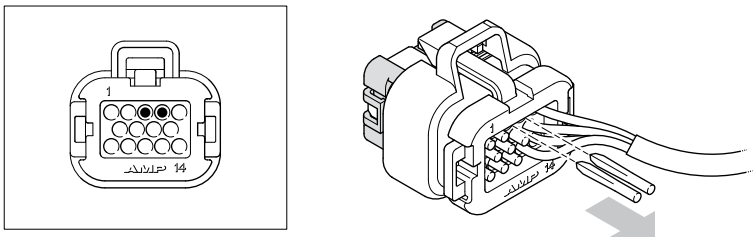


Figure 2-27.

NOTICE

DO NOT attempt to insert any contacts with the red wedge lock in the closed position.

3. Next align the wire with the cavity. Insert until there is an audible and tactile click. DO NOT force the wires. If difficulty inserting the wires, ensure the red wedge lock is in the open position. Repeat steps 2 & 3 for each option you selected.

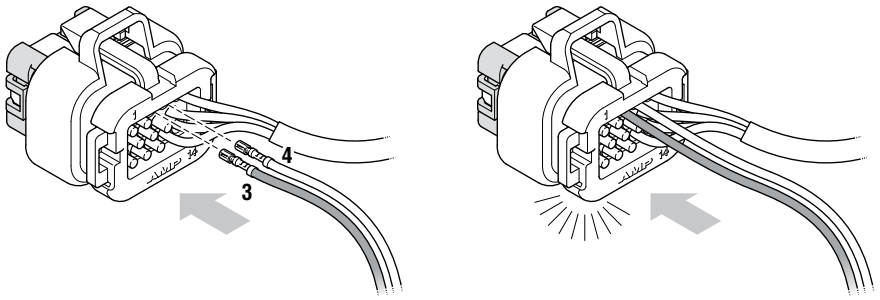
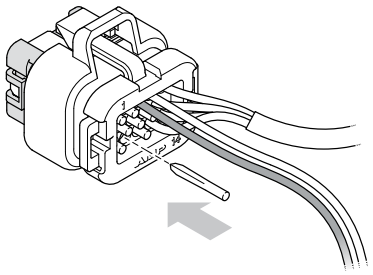


Figure 2-28.

NOTICE

All unpopulated cavities must have plugs installed (wide end first).



NOTICE

If the wire needs to be removed, put the red wedge lock into the open position, then from the wire side gently pull the wire from the cavity while rotating (a quarter turn each direction) back and forth until the contact and wire is removed from the connector. Ensure all open cavities are plugged.

4. Push the red wedge lock in all the way until it's in the locked position. Then pull slightly on wires to ensure they are fully seated and locked.

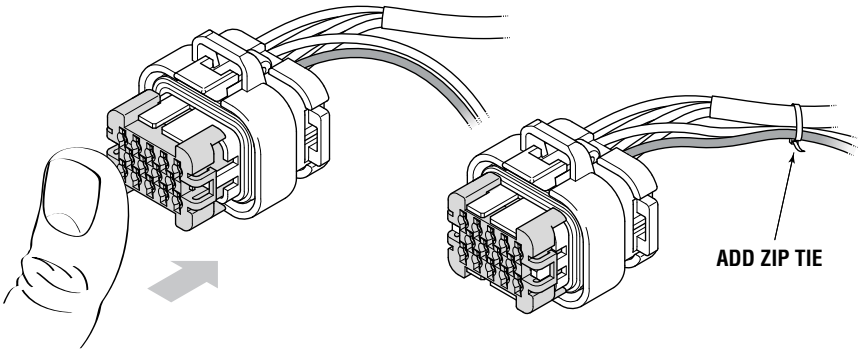
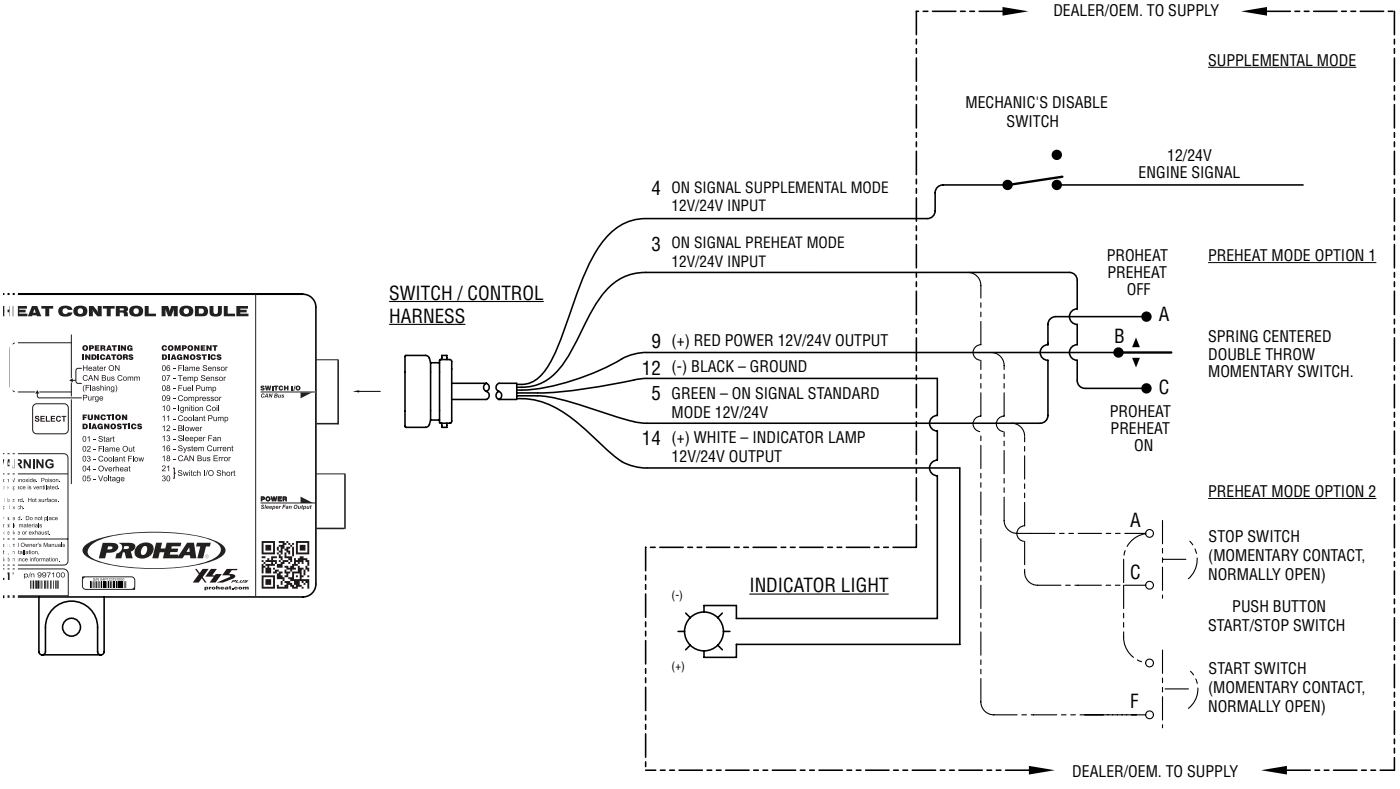


Figure 2-29.

5. Add a loop of tape or zip tie to tie the harnesses together.

The harness is now ready to be connected.



See page 2-15 for wiring

Figure 2-30. Preheat and Supplemental Wiring Diagram Examples

2.6.7 OPTIONAL AUXILIARY SLEEPER HEATER INSTALLATION

To enable the sleeper fan output feature, the sleeper fan add in harness must be installed. Follow the instructions below to install.

PIN#	DESCRIPTION
1.	Black – battery negative (ground).
2.	Red – battery positive (fuse/breaker 15 amp).
3.	White – sleeper fan output (high side switched) (3 amps max).
4.	Black – sleeper fan output ground (3 amps max).

NOTE: *Pins 1 & 2 are pre populated from the factory.*

Figure 2-31. X45 Plus Sleeper Fan Add In harness.

1. Carefully insert a standard screwdriver into the slot on top of white wedge lock.
2. Carefully pry the white wedge lock forward and listen for audible click. The white wedge lock is now in the open position.
3. Continue to pry the white wedge lock forward until its free from the connector body.

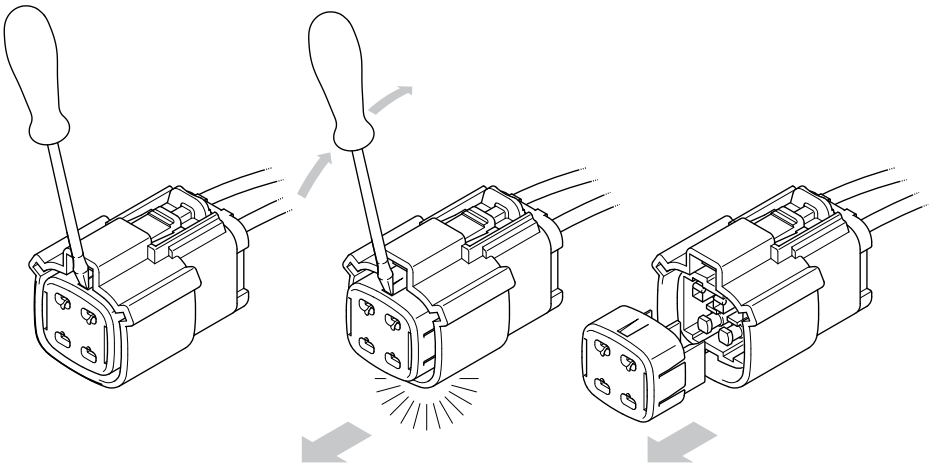


Figure 2-32.

4. Remove the two cavity seal plugs by gently prying up on the lock tab and pull the cavity plug out the back (wire side) of the connector.

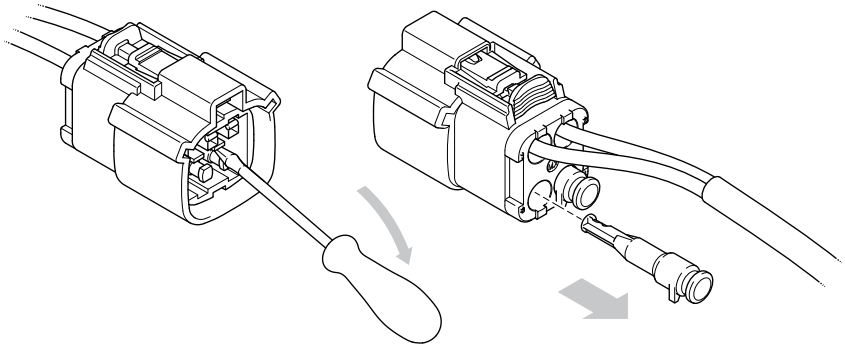


Figure 2-33.

5. Replace the white wedge lock and push it all the way until it's in the locked position.
6. Next move the white wedge lock back to the open position as per steps 1 and 2.

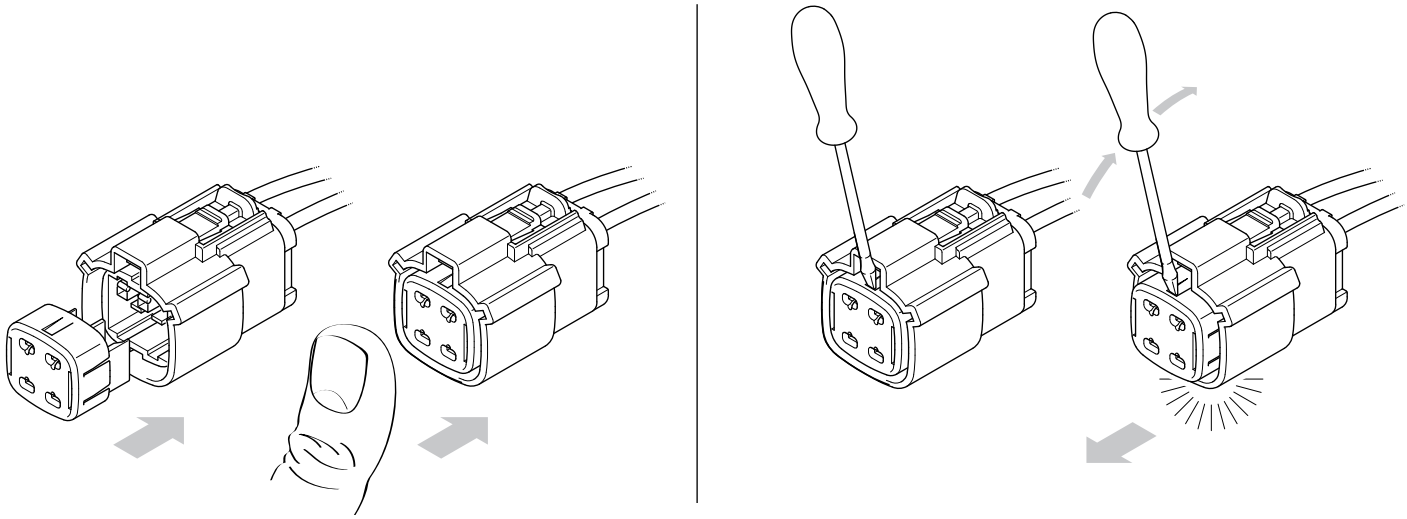


Figure 2-34.

7. Align the tab on the terminal with the keyway on the connector and insert the **white wire into cavity 3** and the **black wire into cavity 4**. Push in until the terminal is seated and cannot be pulled out.

NOTICE

DO NOT attempt to insert any contacts with the white wedge lock in the closed position.

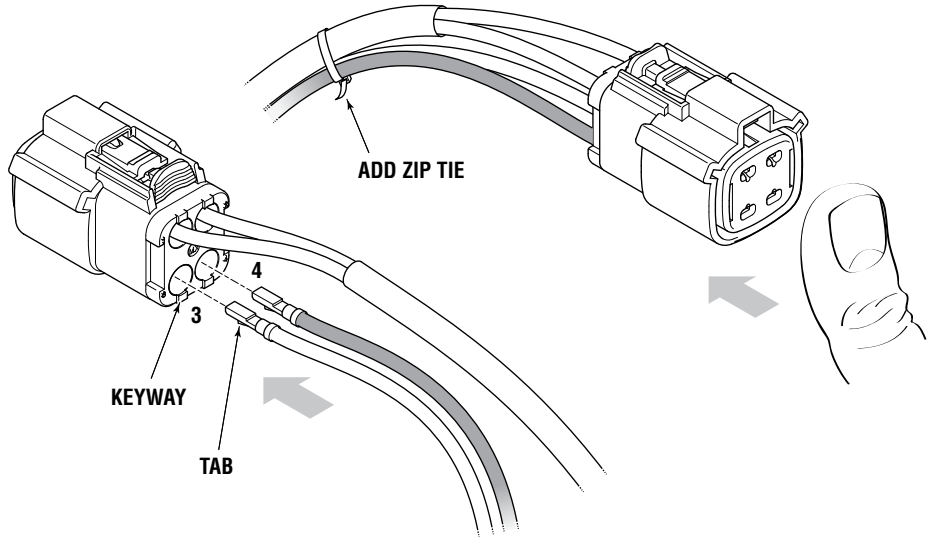


Figure 2-35.

8. Push the white wedge lock in all the way until it's in the locked position. Then pull slightly on wires to ensure they are fully seated and locked.
9. Add a loop of tape or zip tie to tie the harnesses together.

The harness is now ready to be used with the sleeper fan.

1. Make sure the vehicle ignition is switched “OFF.”
2. Locate the auxiliary heater in a suitable area of the vehicle.
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 2-37)
4. Remove the adjusting knob and face cover. Mark and drill mounting holes. Mount thermostat using the screws provided. (Figure 2-38)
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.

⚠ 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

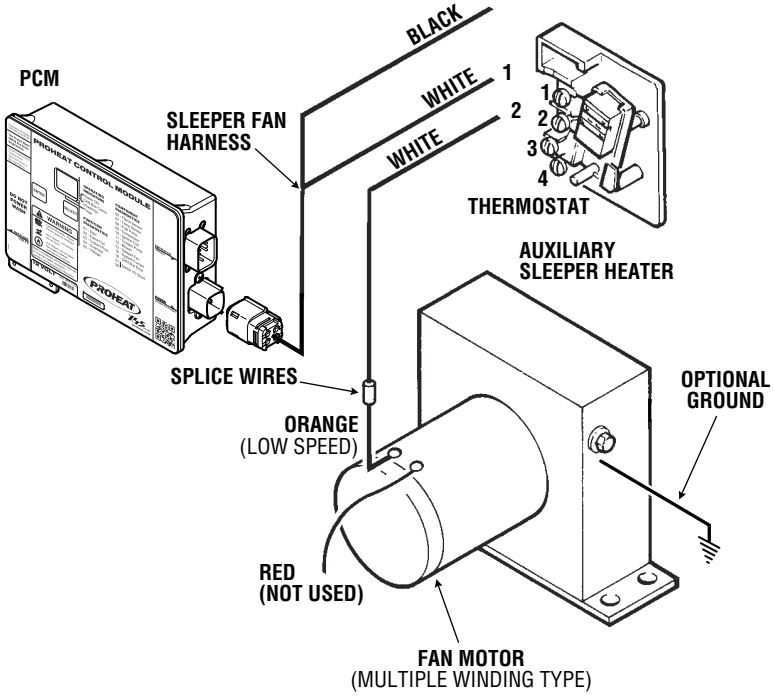


Figure 2-36. Auxiliary Sleeper Heater Installation

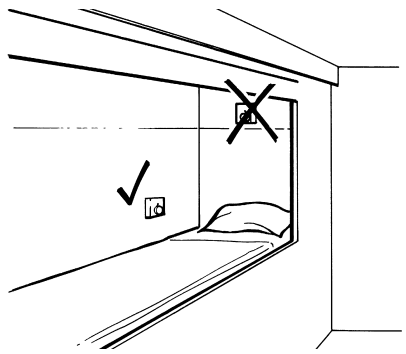


Figure 2-37. Thermostat Location

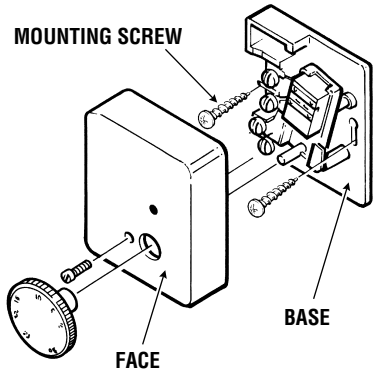


Figure 2-38. Thermostat Detail

2.7 FUEL SYSTEM

2.7.1 GENERAL CONSIDERATIONS

⚠ 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.

- Use a dedicated 1/4" ID fuel line between the fuel tank and heater meeting SAE 30R9. (Fuel line length is 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.
- 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.

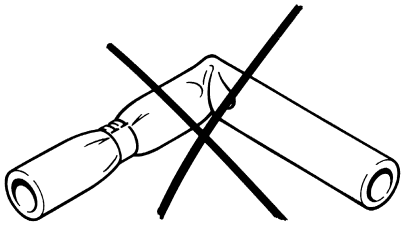


Figure 2-39. Do not kink or pinch fuel line when routing lines

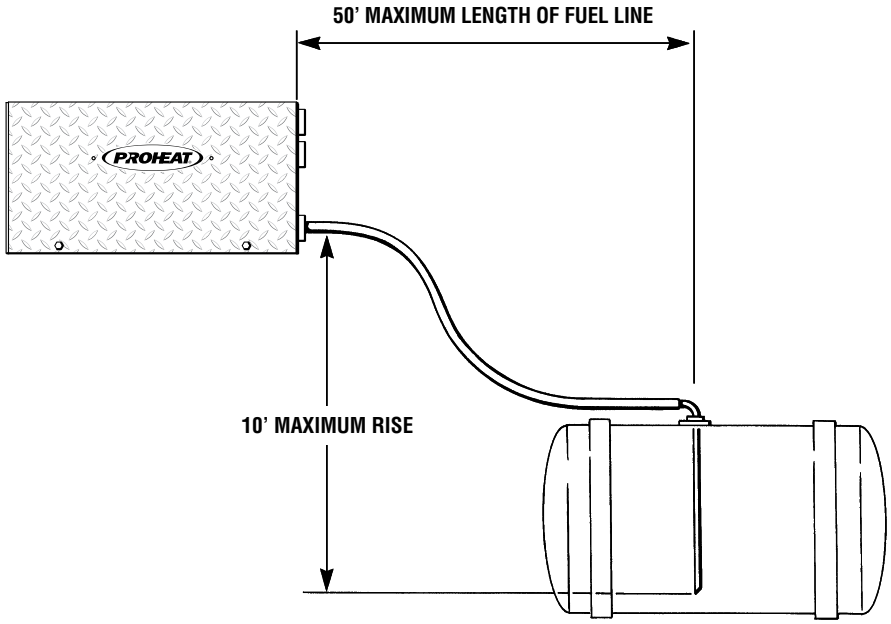


Figure 2-40. Fuel Supply Height Requirement

You Choose ☞ **Select Your Fuel Pick-up Installation Option**

Option A: Fuel pick-up to be installed in an existing 1/4"or 1/2" 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.

2.7.2 OPTION A – 1/4” or 1/2” NPT Port

Locate an existing pipe thread port in the vehicle fuel tank and select the 1/4” or 1/2” 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.

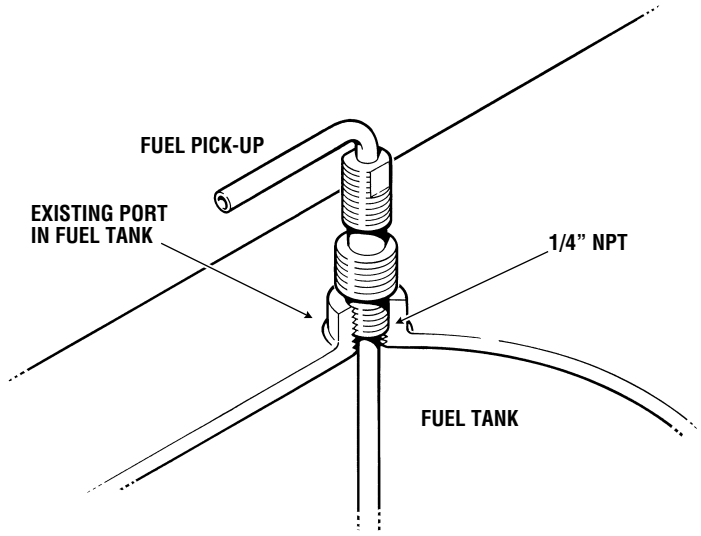


Figure 2-41. 1/4” NPT Port

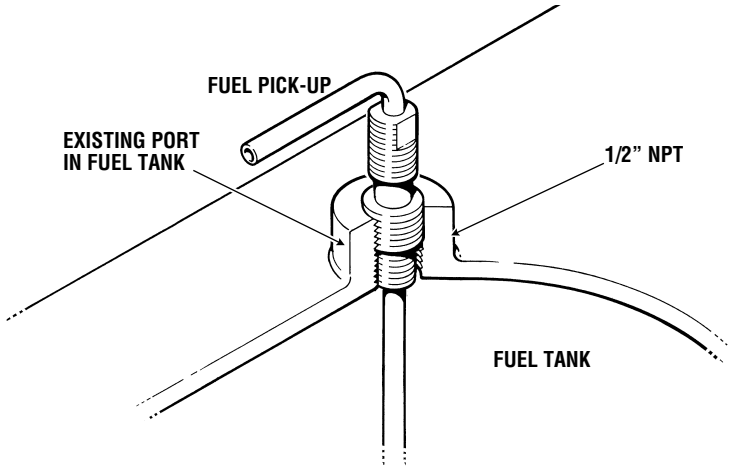


Figure 2-42. 1/2” NPT Port

2.7.3 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.

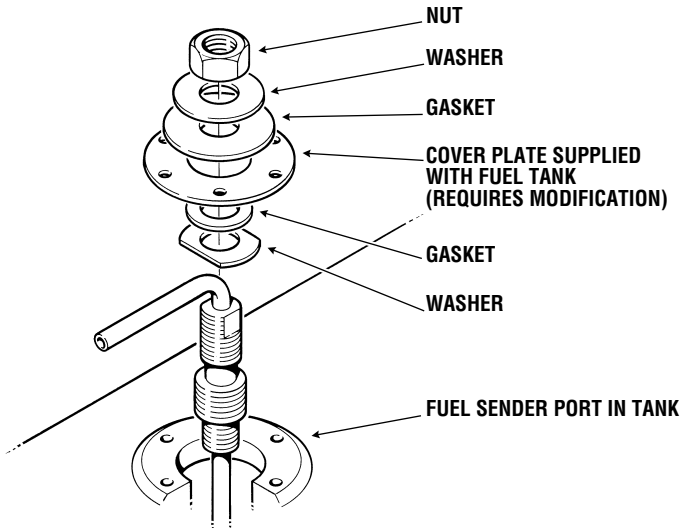


Figure 2-43. Blank Fuel Sender Port

2.7.4 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.

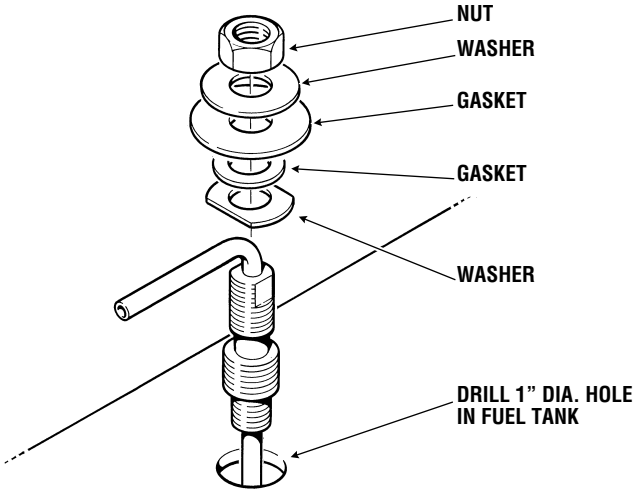


Figure 2-44. Drill Hole in Tank

2.7.5 INSTALLATION

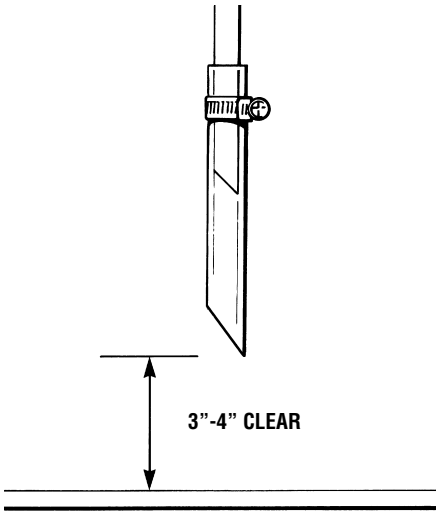


Figure 2-45. For some situations where the fuel pick-up is too far from the bottom of the tank, an extension from left over fuel line can be added.

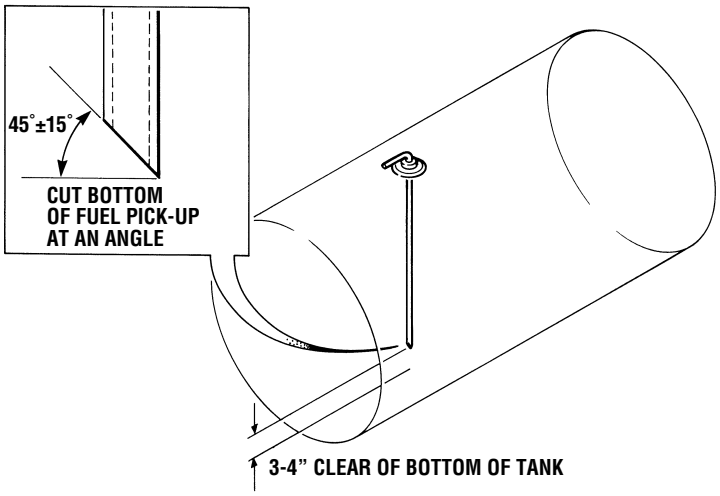


Figure 2-46. Fuel Pick-up Depth

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 2-46.
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.

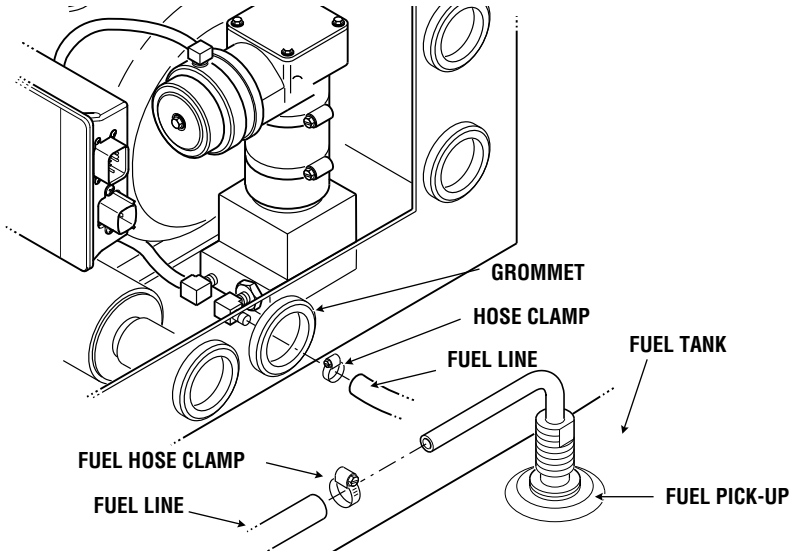


Figure 2-47. Fuel Line Connection Detail

2.8 FIRST TIME STARTUP

1. Inspect the entire installation for:
   - loose bolts
   - loose hoses and hose clamps
   - loose wires and wire connections
   - kinked or pinched hoses or wires
   - battery connection for correct polarity, and
   - 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:
   - make sure the coolant is flowing freely
   - inspect hoses and fittings for leaks
   - 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 4-3 for more information.
7. Load the configuration file if needed. See Section 2.8.1 on page 2-27.
8. 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 3-8 and page 3-9 for more information.

   Sequence of Events:
   - Coolant temperature must be less than 150˚F (65˚C).
   - "ON" light on PCM should be lit.
   - You should hear the coolant pump, blower, and compressor start. Looking through the inspection port you should see a spark and a flame.
   - 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. See *Troubleshooting & Repair Manual*.

9. 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 Cycle Off

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.

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

11. 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.

NOTICE

To ensure full warranty coverage, complete the warranty card and mail to PROHEAT.

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

13. Inspect the installation again for leaks.

14. Install the enclosure cover.

2.8.1 PROGRAMING A REPLACEMENT PCM/CHANGING THE PCM CONFIGURATION

PCM Kits: First time power up

When the replacement X45 Plus PCM is powered up for the first time the display will be flashing "CC" and requires a configuration number to be selected before the PCM will function.

	OLD				NEW		
	G-I PCM	G-II PCM	G-III PCM		X45 Plus Config file	2 digit code	
X45 12V Sleeper Fan	~	903100	999100		999110	10	All 12 Volt models Standard Voltage and Temperature Range
X45 12V Aux Input	~	904200	999100				
X45 12V School Bus	~	904300	904300		999130	30	All 12 Volt School Buses Standard Voltage and Temperature Range
X45 12V School Bus Special	~	~	999350		999135	35	12 Volt School Bus Special • Voltage range 11.2–16VDC • Temperature range 160–185°F (71–85°C)

	G-I PCM	G-II PCM	G-III PCM		X45 Plus Config file	2 digit code	
X45 24V Aux Input	985628	905300	999400		999140	40	All 24 Volt models Standard Voltage and Temperature Range

1. Use the (right) SELECT button to toggle up through the configuration numbers, configuration display should continue to flash during setting (10, 30, 35, and 40) until the desired configuration number is displayed.
2. Press the (left) ENTER button and hold for 2 seconds to lock in configuration. The configuration number will flash 4 times to indicate confirmation and then go ON solid for 2 seconds before the display is turned off.
3. Once the configuration number has been set, apply the correct identification decal.
   - Red for all 12 volt models
   - Yellow for all School Bus models
   - Green for all 24 volt models
4. PCM is now in the off state and is ready to use.

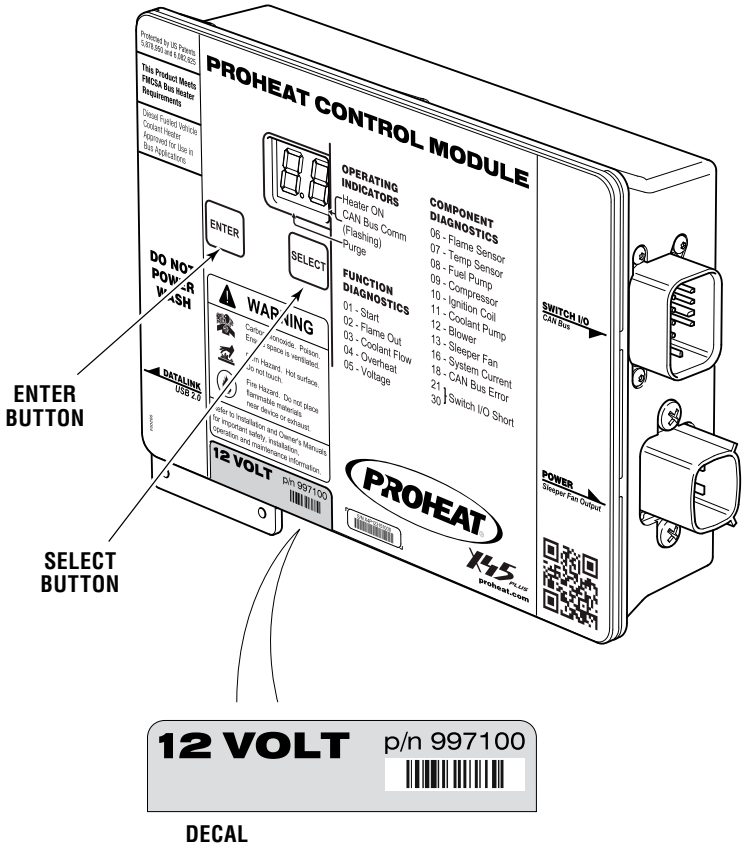


Figure 2-48. X45 Plus PCM

Identifying the saved PCM configuration number.

To identify the current saved configuration number, the power to the PCM must be disconnected for 20 seconds.

When the power is reconnected, all of the LED's flash twice "88" on power up, Followed by a 2 second display of the configuration code.

PCM configuration change

- If the wrong configuration is saved in the PCM or if change is desired.
- Press and hold both SELECT and ENTER buttons for 5 seconds until the configuration change indicator "CC" is flashing.

Use the (right) SELECT button and set the correct configuration as per steps 1 and 2 above.

3.0 PRINCIPLES OF OPERATION

3.1 COMPONENT DESCRIPTION

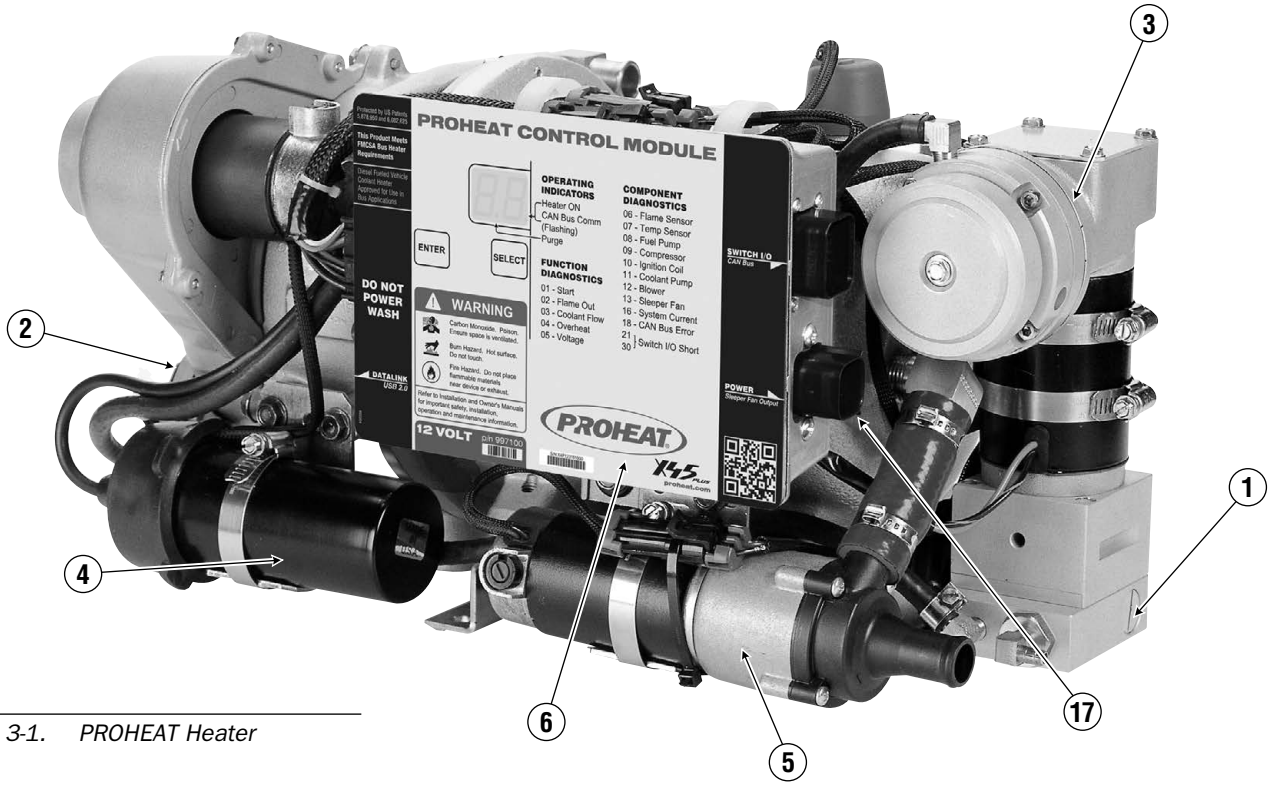


Figure 3-1. PROHEAT Heater

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.)

6. PROHEAT Control Module (PCM)

The PCM utilizes a microprocessor to monitor operating conditions and control outputs 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.

NOTE: See “Modes of Operation Section” for a description of the operating modes used.

NOTE: The PROHEAT PCM “Sleeper Fan” will be turned off during ignition.

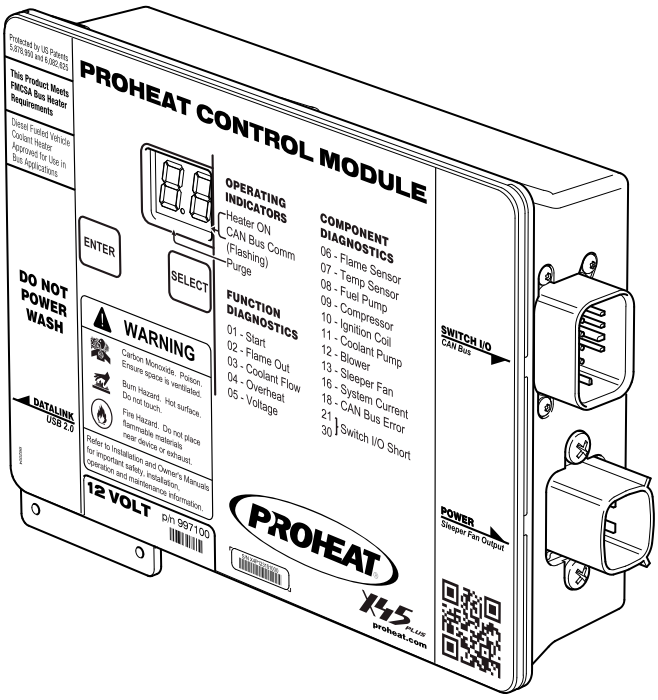


Figure 3-2. LED will light to indicate a problem. Switch or timer indicator light will flash to indicate the diagnostic code (page 4-3)

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 that 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) 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.

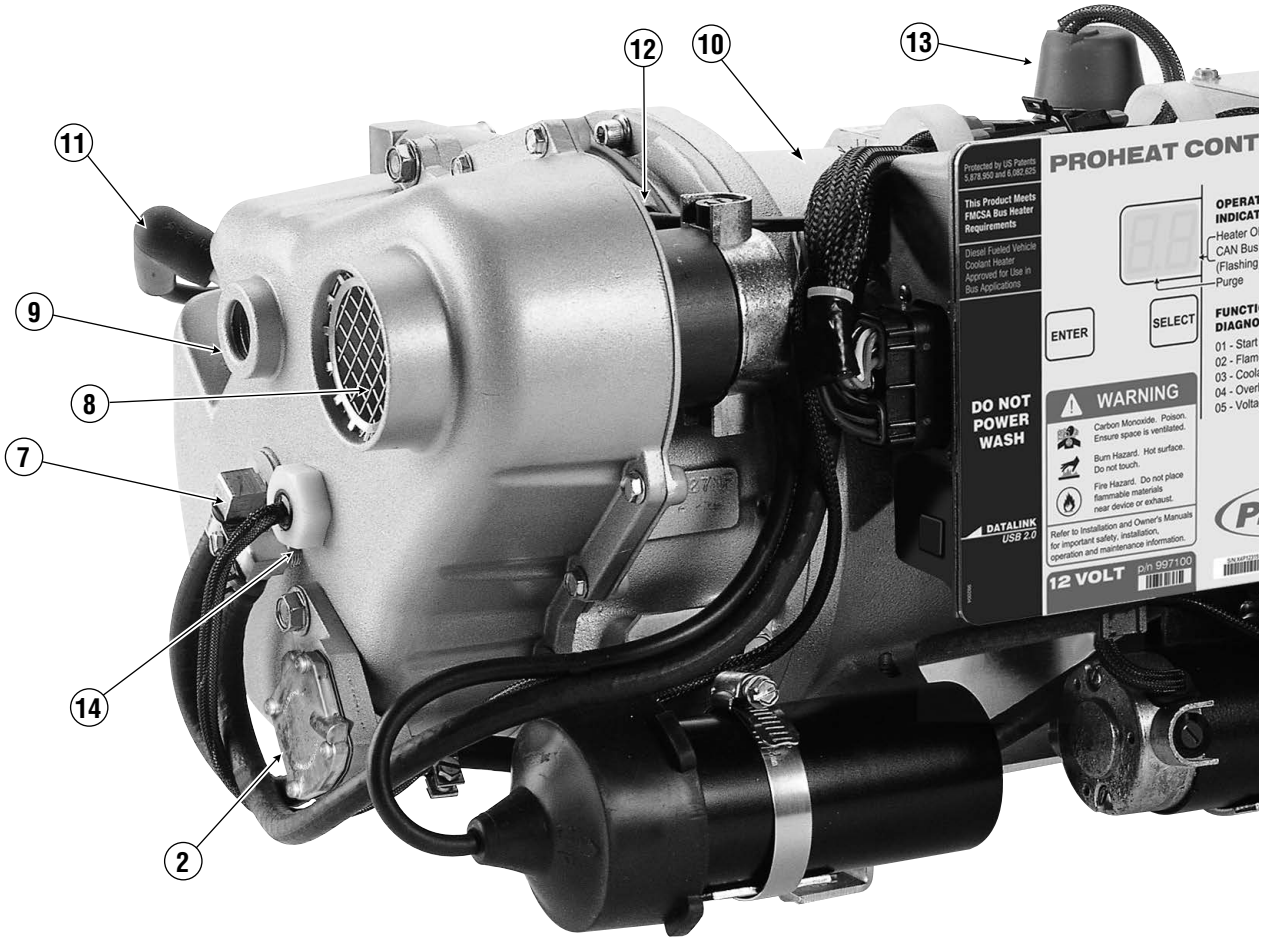


Figure 3-3. PROHEAT Heater Detail

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. The flame sensor signals to the PCM that the air/fuel mixture is burning properly.

15. On/Off Switch

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 4-3 for details.)

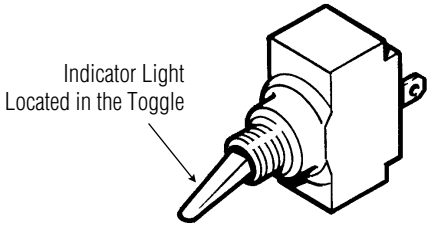


Figure 3-4. ON/OFF Switch

16. Optional 7-Day Timer

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 4-3 for details.)

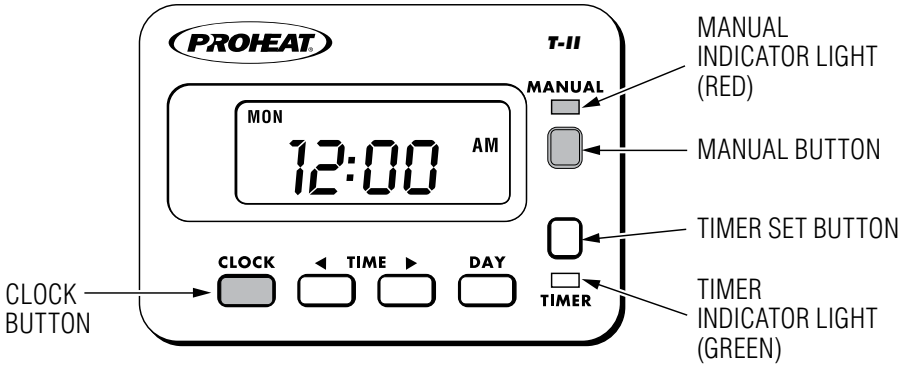


Figure 3-5. 7-Day Timer

17. Optional Add In Sleeper Fan Harness

The PROHEAT X45 Plus Control Module is equipped with a 3 amp limited output. It is used to drive fans or other equipment as determined by the installation *(see page 2-1)*. The output is ON 60 seconds after switch ON. In addition, it is also ON when there is a functional error (see page 4-1 for details).

3.2 THEORY OF OPERATION

There are four basic systems within the PROHEAT.

1. Air Compressor

The purpose of the air compressor is to deliver a metered amount of clean compressed air to the nozzle.

As the motor turns it drives a diaphragm type compressor. The compressor draws fresh air through an air filter located on the front of the compressor. It's then compressed and delivered to the nozzle in the fan end casting via a hose.

2. Fuel Supply System

The purpose of the fuel supply system is to deliver clean, air-free fuel to the fuel regulator.

As the compressor motor turns, it directly drives a positive displacement type gear pump. The fuel pump draws (under a vacuum) fuel from the fuel tank through the fuel line. The fuel then enters the sintered fuel filter located behind the fuel inlet fitting on the front of the pump. The fuel then enters the fuel pump gears. The fuel pump then pressurizes the fuel to 5–10 psi. This pressure is controlled via the fuel pump relief valve. The fuel then enters the fuel regulator via a hose. The fuel regulator then reduces the fuel pressure to 0 PSI. The fuel is now drawn from the regulator by the low pressure created by the nozzle (like a carburetor float bowl).

3. Nozzle

The purpose of the nozzle is to atomize the fuel and set the fuel/air ratio.

The compressed air travels over the body of the nozzle. As it reaches the end of the nozzle, it passes through a restriction. This creates a negative pressure or venturi effect (like a carburetor). This negative pressure extends back through the centre of the nozzle all the way to the fuel regulator. This negative pressure causes fuel to be siphoned from the fuel regulator (like a carburetor float bowl). The compressed air and fuel are then mixed at the end of the nozzle into a very fine mist of fuel/air that is sprayed into the combustion chamber in the shape of a cone.

4. Combustion Air System

The purpose of the combustion system is to deliver a metered amount of air to the combustion tube. This provides the majority of the air needed to combust the atomized fuel/air mist created by the nozzle, and to cool the combustion chamber when the heater cycles off.

As the blower motor turns, it directly drives the combustion air blower blade. The combustion air is not filtered so it needs to come from a clean area. A snorkel hose is sometimes used to draw air from a clean source. The air is then directed into the combustion tube. The fan end casting is shaped in such a way that it causes the air to swirl into the combustion tube. The swirling air then mixes with the atomized fuel/air cone from the nozzle. Once lit this creates an intense flame in the combustion tube. The hot gases then reach the end of the combustion tube and make a 180 degree turn to enter the heat exchanger. The heat exchanger has fins that transfer the heat to the coolant that flows around the heat exchanger. The gases then enter the exhaust system and are directed away from the vehicle.

All four systems must work together to produce safe, smoke-free operation of the PROHEAT. It is important for the service technician to understand the four systems and how a change in one system can result in improper combustion.

Examples: An increase in the compressor air pressure over the nozzle will add more atomized fuel into the combustion tube. However, the combustion air provided by the combustion air blower remains constant resulting in a rich air/fuel mixture and possibly black smoke from the exhaust.

A restriction in the amount of air through the combustion chamber (restricted air intake, dirty heat exchanger plugged exhaust) will also result in a rich air/fuel mixture as the compressor air pressure (and atomized fuel flow) remains constant.

A restriction in the fuel line, filter, or nozzle fuel passage will reduce the atomized fuel/air flow into the combustion tube. However, the combustion air provided by the combustion air blower remains constant resulting in a lean air/fuel mixture and possibly gray/white smoke from the exhaust.

A decrease in the compressor air pressure over the nozzle will reduce the amount of atomized fuel/air into the combustion tube. However, the combustion air provided by the combustion air blower remains constant resulting in a lean air/fuel mixture and possibly gray/white smoke from the exhaust.

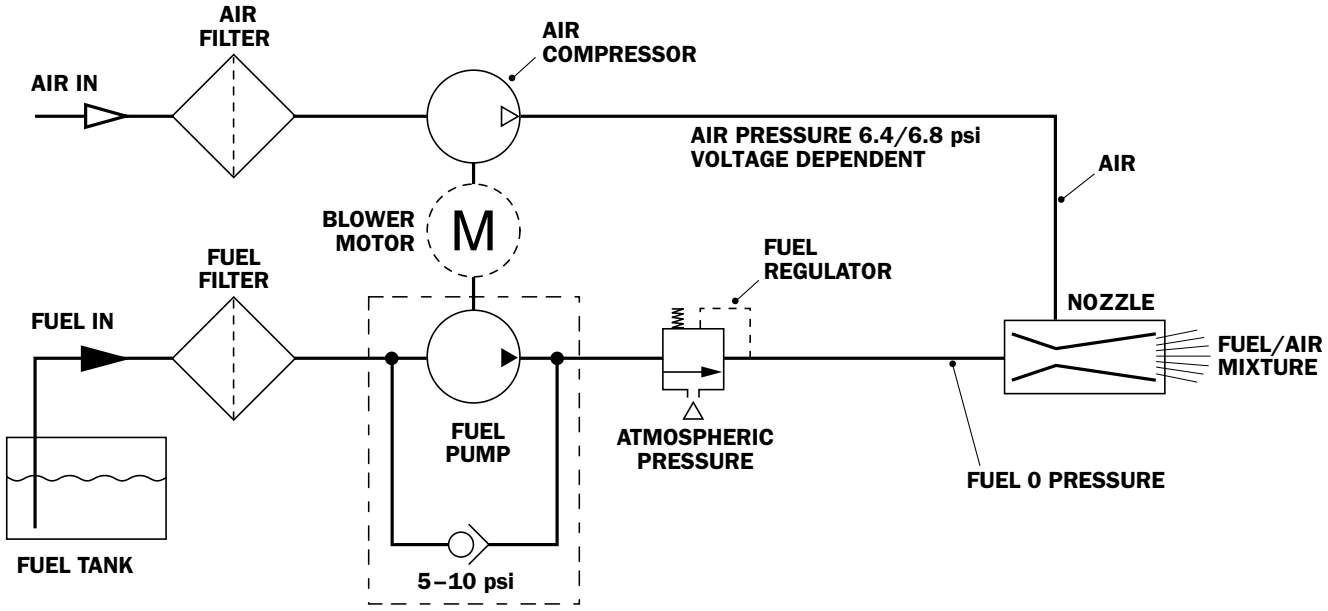


Figure 3-6. Fuel Delivery Theory of Operation

3.3 MODES OF OPERATION

The PROHEAT X45 Plus has four modes of operation: standard, preheat, supplemental, and anti-freeze. For a general description of the modes, see Heater Modes starting on page 2-13.

STANDARD MODE

- normal operation of the Proheat
- overrides *Supplemental Mode*
- overrides and cancels *Preheat Mode*
- overrides *Anti-Freeze Mode*

- *Optional Global Low temperature feature*

SUPPLEMENTAL MODE (engine running)

- similar to *Standard Mode* except: coolant pump does not run when Proheat is not firing
- overrides and cancels *Preheat Mode*
- overrides *Anti-Freeze Mode*
- 30 second signal required before mode enabled
- 5 second delay required for mode switch off

- *Optional Supplemental Max Heat feature*
- *Optional Global Low temperature feature*
- *Optional Supplemental Priority feature*

PREHEAT MODE (engine off)

- similar to *Standard Mode* except: 90 minute time out
- overrides *Anti-Freeze Mode*
- activated via momentary contact push button switch with latching internal to the G-II PCM

- *Optional Global Low temperature feature*

ANTI-FREEZE MODE (engine off)

- similar to *Supplemental Mode* except: coolant pump runs at set intervals when Proheat is not firing to check actual system temperature

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- *Optional Global Low temperature feature*

GLOBAL LOW FEATURE

- *Shifts all the cycle on/off temperature of operating modes (Preheat, Standard and Supplemental) down to between 73–108°F (40–60°C)*

SUPPLEMENTAL MAX HEAT FEATURE

- *Changes the supplemental mode cycle on/off temperature range to 170–190°F (77–88°C)*

SUPPLEMENTAL PRIORITY FEATURE

- *Overrides Standard Mode but does not cancel Standard Mode*

3.3.1 STANDARD MODE

1. Switch "ON" Standard Mode Signal

The ON/OFF switch lamp, timer or OEM indicator (installation options) will light. In addition, the X45 Plus PCM ON Indicator will light. If the coolant temperature is below 150°F (65°C) the PROHEAT enters **Pre-check**. If the coolant temperature is above 150°F (65°C) the PROHEAT enters **Standby**.

2. Pre-check

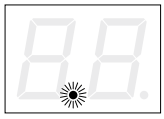
The PCM performs self diagnosis checking sensors for correct range, electrical components for over-load and for a flame presence. If there are no errors indicated, the PROHEAT goes to **Ignition**.

3. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor, and fuel pump. The ignition electrode can spark for up to 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to full output and turns the Ignition off. Once the heater enters full output the sleeper fan output turns on if equipped. See page 3-4 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 3-2).
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 Manual*)

- the PROHEAT is operating at full output when it is shut "OFF"

3.3.2 OPTIONAL SUPPLEMENTAL MODE

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), and then 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

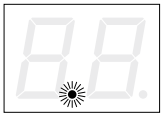
The PCM performs a short diagnostic cycle. This takes a few seconds to check components for proper ranges, checking for the presence of a flame, short-circuits, and open circuits. If there are no errors indicated, the PROHEAT goes to ignition.

5. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor, and fuel pump. The ignition electrode can spark for up to 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to full output and turns the Ignition off. 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.

NOTICE

If supplemental priority is selected, supplemental mode will have priority over other modes.

8. Remove Supplemental Signal for 5 Seconds

The "ON" light and the heater indicator turn off after 5 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 sleeper fan output turns off if connected and 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 Manual*)
- the PROHEAT is operating at full output when it is shut off

3.3.3 OPTIONAL PREHEAT MODE

1. Activate Preheat Signal

Push the preheat button and the PCM "ON" LED 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.

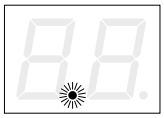
3. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor, and fuel pump. The ignition electrode can spark for up to 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to full output and turns the Ignition off. 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 shut off.
If PROHEAT is in standby, it shuts off immediately.
When switched "OFF," the sleeper fan output turns off if connected and 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 Manual*)
- the PROHEAT is operating at full output when it is shut "OFF"

3.3.4 OPTIONAL ANTI-FREEZE MODE

1. Switch "ON" Anti-freeze Mode Signal

The "ON" light and heater indicator will turn "ON" after receiving the signal. In addition, the hour meter (auxiliary output) will be powered.

2. Anti-Freeze Standby

The PROHEAT monitors coolant temperature until it drops below 41˚ (5°C), and then goes to pre-run temperature, or every 20 minuets the heater goes to Pre run interval

3. Pre-Run Temperature

The coolant pump operates for 30 seconds to circulate coolant through the system. If the coolant temperature rises above 41˚ (5°C), the pump shuts off and the PROHEAT returns to anti-freeze standby. If the coolant temperature remains below 41˚ (5°C), the PROHEAT goes to pre-check.

4. Pre-Run Interval

Every 20 minutes the coolant pump is operated for 30 seconds to circulate coolant through the system and the temperature is again checked. If the coolant temperature rises above 41˚ (5°C), the pump shuts off and the PROHEAT returns to supplemental standby. If the coolant temperature remains below 41˚ (5°C), the PROHEAT goes to pre-check.

5. 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.

6. Ignition

The blower starts first, followed by the coolant pump, ignition spark, air compressor, and fuel pump. The ignition electrode can spark for up to 60 seconds. Once the flame sensor detects a good flame, the PROHEAT goes to full output and turns the Ignition off.

7. Full Output

The PROHEAT runs at full output until the coolant temperature reaches 68˚ (20°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).

8. Cool Down 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 anti-freeze standby and repeats steps 2 to 8 until switched off.

9. Switch "OFF"

The "ON" light and the heater indicator turn off once the "ON" signal is removed. If the PROHEAT is in the anti-freeze standby or any 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 sleeper fan output turns off if connected and 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 Manual)
- the PROHEAT is operating at full output when it is shut "OFF"

4.0 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 4-5.
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 4-44 to page 4-45.)

4.0.1 TROUBLESHOOTING A PROBLEM

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.
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).
3. If no code is indicated, turn the PROHEAT off and then on again using the existing operational switches or timer.
4. Let the PROHEAT attempt to start and/or operate. Observe the operation.

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 4.3 on page 4-45.

Mechanics Mode

- Heater can be to be turned on in a special “Mechanics mode” by holding the (left) Enter button for 1 second and pressing the (right) Select button momentarily (.25s) to turn the heater on. The heater will run for 5 minutes and then automatically turn off.
- Cycle on temperatures is 160°F (71°C) and cycle off temperature at 185°F (85°C) during this special “Mechanics mode”

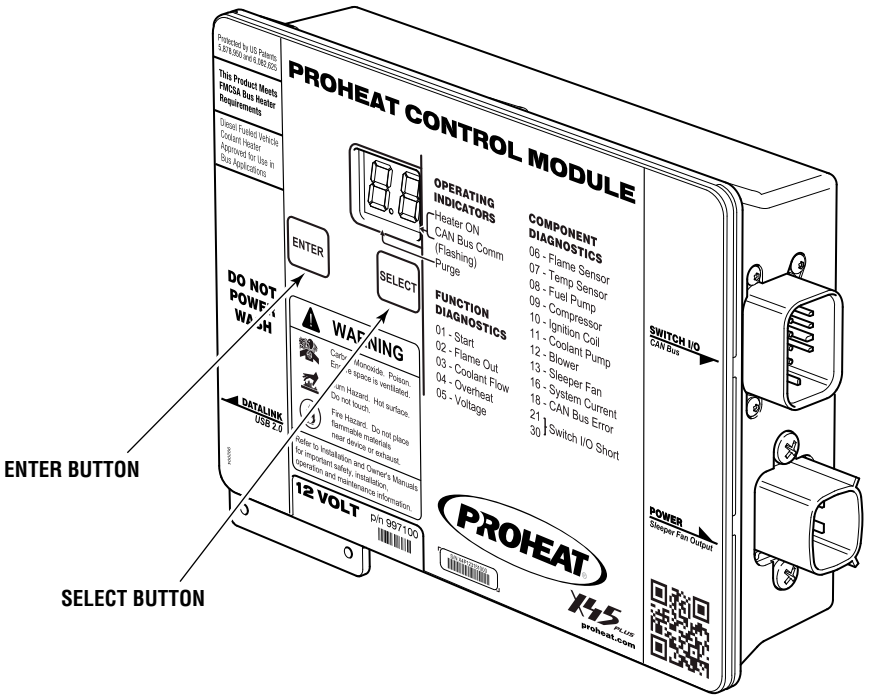


Figure 4-1. PCM – Mechanics Mode

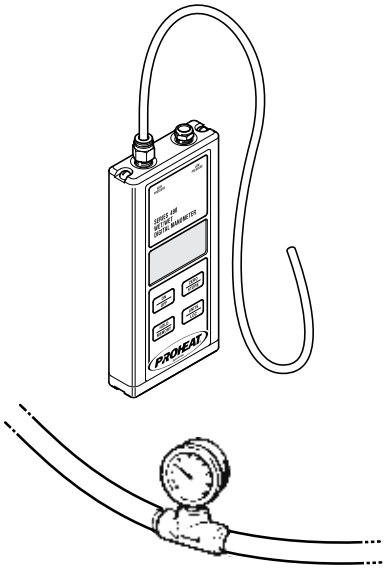


Figure 4-2. Troubleshooting Tools

Mechanics mode can be turned off by holding the (left) Enter button for 1 second and pressing the (right) Select button momentarily (.25sec)

Secondary function of Mechanics mode

If heater is activated via any analog or CAN input it can be temporary turned off from any ON mode by pressing and holding the (left) Enter button for 1sec and momentarily pressing the (right) Select button (.25sec). This will leave the heater off until the current ON request has been removed or any new on command is received.

Troubleshooting and Repair Tools Required

- **Digital Air Compressor Test Gauge** (PROHEAT P/N PK0037)
  Allows the service technician to check compressor pressure in order to ensure correct fuel delivery. (**NOTE:** The analog air pressure gauge PK0060 can also be used.)

4.1 OPERATION INDICATORS, FUNCTION AND COMPONENT DIAGNOSTICS

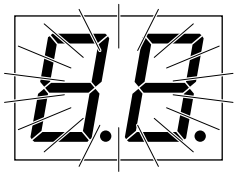
4.1.1 OPERATION INDICATORS

Operation States:

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

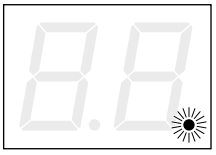
The operation indicators signal normal functioning of the PROHEAT. These three states do not indicate a fault.

Power Up



The power up indicator communicates that the PROHEAT power has been supplied. All segments of the LED momentarily flash “88” twice, followed by a 2 second display of the configuration code number (if configuration is set) or “CC” (if configuration is not set).

On



The ON indicator code communicates:

On solid – Heater is switched on via analog switch inputs and is operating normally.

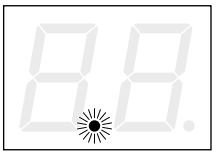
Off then two flashes then off again – Heater is connected to CANBus network and is communicating on the network but is not switched on.

On solid with two flashes then on solid again – Heater is switched on Via Analog or CANBus switch inputs and is communicating on the network.

⚠ WARNING

The “ON” LED indicates that the heater can start at any time. Refer to page 3-7 to page 3-10 .

Cool Down



The PROHEAT will be in the Cool Down (Purge) state as defined in Modes of Operation *(see page 3-7)* when “Pu” is displayed.

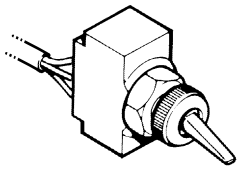


Figure 4-3. Remote On/Off Switch.

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 Plus 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, the wrong PCM configuration was selected. All mechanical problems with the fuel pump will be indicated as either a Start (1) or a Flame Out (2) diagnostic code.

NOTICE

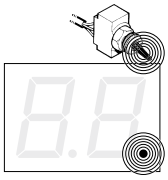
LOCKOUT MODE
After 10 consecutive start faults (Code 01) or after two Cool Down (Purge) attempts (Code 06) the X45 Plus PCM will go into Lockout mode, Power to the X45 Plus PCM must be removed and reapplied to exit Lockout mode.

CODE No.	Description of Operating State and Diagnostic Codes	No. of Flashes
Operation Indicators		
CC	Configuration Not Selected	No indicator
Function Diagnostics		
01	Start (Lockout mode after 10 consecutive start faults)	1
02	Flame Out	2
03	Coolant Flow	3
04	Overheat	4
05	Voltage	5
Component Diagnostics		
06	Flame Sensor (Lockout mode after two consecutive Cool Down (Purge) attempts	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
15	Not Used	-
16	System Current	16
17	Not Used	-
18	CANbus	18
19	High Ambient PCM Temperature	19
20	Not Used	-
21–29	Outputs 1–9 Fault	

Figure 4-4. Function Display Panel Detail & Error Flash Codes

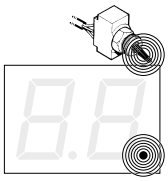
4.1.2 EXAMPLE PROHEAT BEHAVIOR ERROR – CODE 01

The following is an example of an X45 Plus PROHEAT behavior during an error. The following example shows the sequence of events when the PROHEAT is switched "ON" in the standard mode (similar for preheat and supplemental Modes). This sequence of events occurs for Codes 01 through 12. Codes 13, 14, 19 and 21 to 29 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.



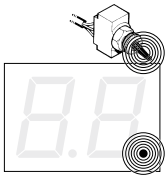
1. Switch "ON" Standard Mode Signal

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.



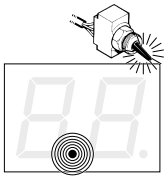
2. Pre-check

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

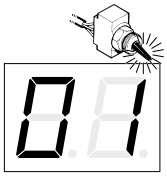
If the flame sensor does not see a flame in 60 seconds after entering ignition, the air compressor and fuel pump shut off immediately. The blower and coolant pump continue to run.

Code 01 will be displayed. 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, 14, 19 and 21 to 29 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, 14, 19 and 21 to 29). 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: To restart the heater, turn the switch "OFF" and back "ON."

4.1.3 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.

Configuration

A conflagration code is displayed if the PCM is powered up and no configuration number is set.

- No heater operation will occur until heater has been configured
- No response to CAN commands
- No analog outputs will occur

First Time Power Up

When the replacement X45 Plus PCM is powered up for the first time the display will be flashing “CC” and requires a configuration number to be selected before the PCM will function.

	OLD				NEW		
	G-I PCM	G-II PCM	G-III PCM		X45 Plus Config file	2 digit code	
X45 12V Sleeper Fan	~	903100	999100		999110	10	All 12 Volt models Standard Voltage and Temperature Range
X45 12V Aux Input	~	904200	999100				
X45 12V School Bus	~	904300	904300		999130	30	All 12 Volt School Buses Standard Voltage and Temperature Range
X45 12V School Bus Special	~	~	999350		999135	35	12 Volt School Bus Special • Voltage range 11.2–16VDC • Temperature range 160–185°F (71–85°C)

	G-I PCM	G-II PCM	G-III PCM		X45 Plus Config file	2 digit code	
X45 24V Aux Input	985628	905300	999400		999140	40	All 24 Volt models Standard Voltage and Temperature Range

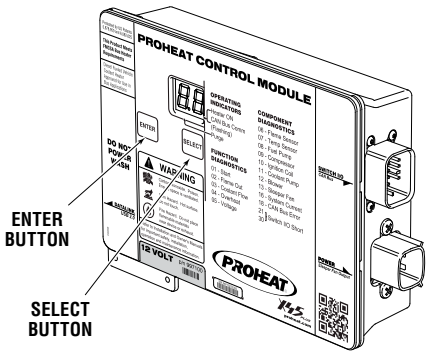


Figure 4-5. X45 Plus PCM

1. Use the (right) SELECT button to toggle up through the configuration numbers, configuration display should continue to flash during setting (10, 30, 35, and 40) until the desired configuration number is displayed.
2. Press the (left) ENTER button and hold for 2 seconds to lock in configuration. The configuration number will flash 4 times to indicate confirmation and then go ON solid for 2 seconds before the display is turned off.
3. Once the configuration number has been set, apply the correct identification decal.
   - Red for all 12 volt models
   - Yellow for all School Bus models
   - Green for all 24 volt models
4. PCM is now in the off state and is ready to use.

1 Start

NOTICE

After 10 consecutive start faults the X45 Plus PCM will go into Lockout Mode.
Power to the X45 Plus PCM must be removed and reapplied to exit Lockout mode.

A START diagnostic code indicates that the flame sensor did not detect a flame or the flame was too weak to be detected 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 Start diagnostic code based on:

1. **Fuel System**
   Go to page 4-8.
   - 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 4-21.
   - 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 4-22.
   - 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 Plus fuel system operates on a venturi-style atomizing nozzle technology. It operates similarly to a compressed air paint sprayer.

As shown in figure 4-6, 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 that 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 4-6 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.

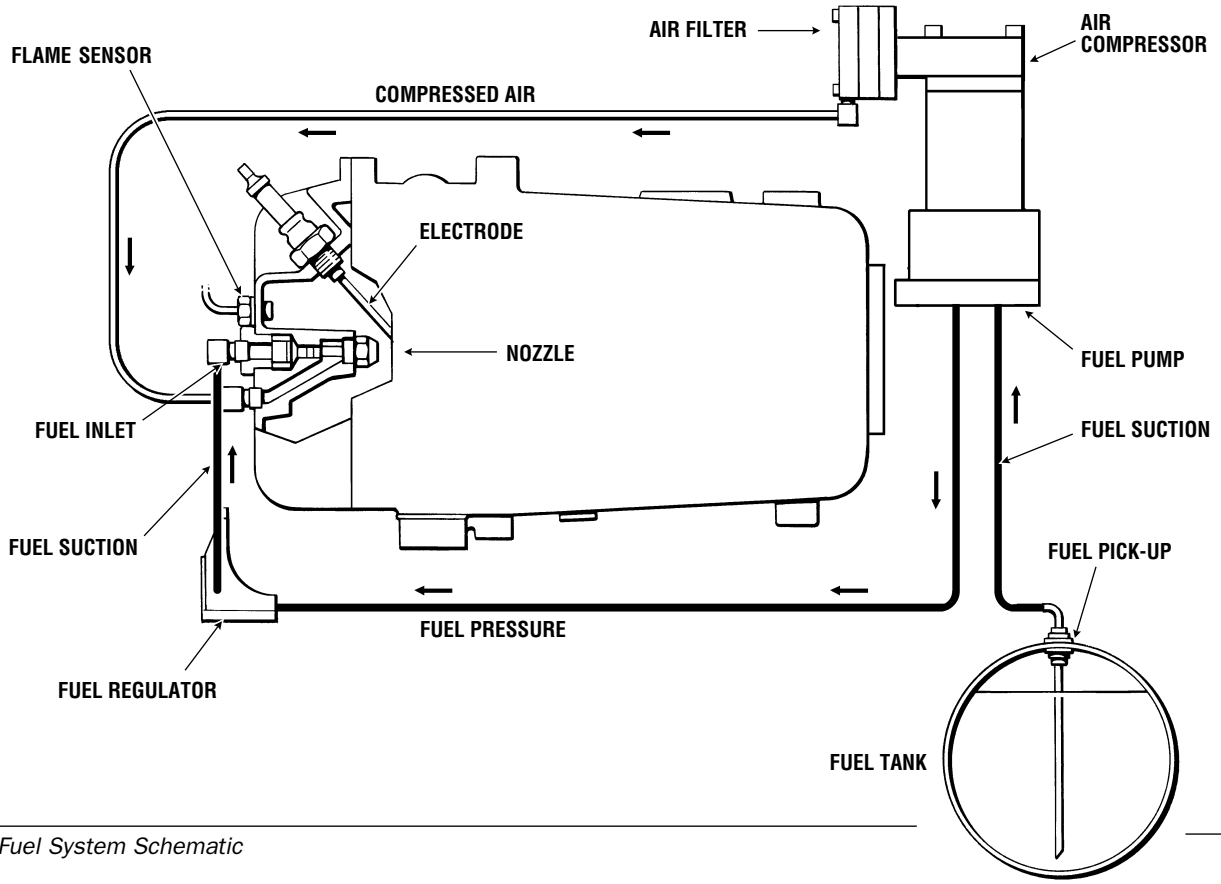


Figure 4-6. Fuel System Schematic

Check Fuel System

Test Procedure — Supplying fuel from a remote source:

1. Remove the fuel supply line from the outlet of the fuel regulator.
2. Put this end of fuel into a small container of clean fuel that is about the same level as the regulator center as shown in figure 4-7. This will remove the vehicle fuel supply, fuel pump and regulator from the fuel delivery.
3. 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.

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

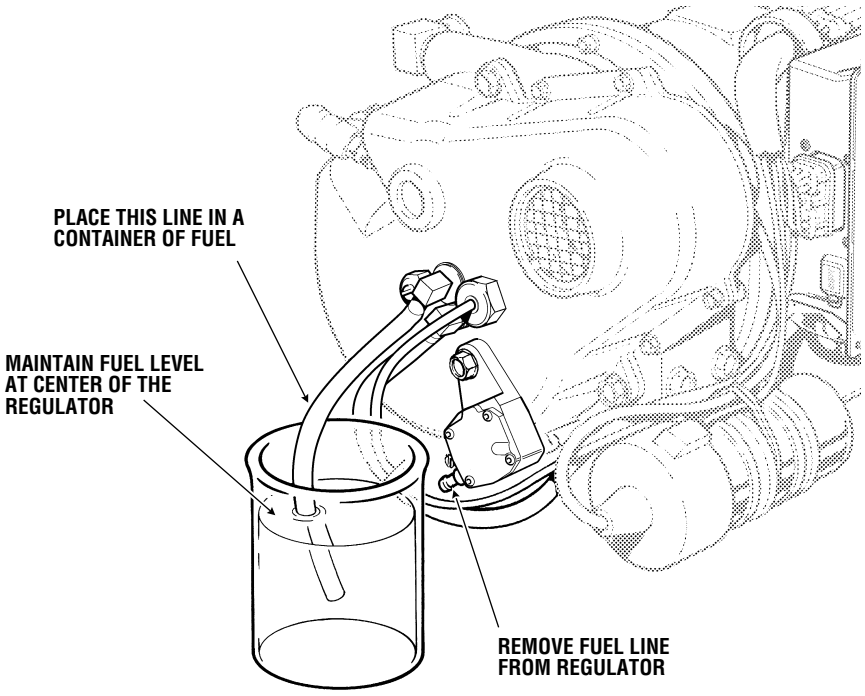


Figure 4-7. Eliminating Fuel Pump and Regulator from System

Check Regulator

Check regulator for damage, contamination, and mechanical operation.

Test Procedure:

1. Remove fuel line that goes from the outlet of the regulator to the nozzle.
2. Start the heater. No fuel should be exiting the outlet of the regulator.

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

3. Install clear plastic hose that replaces the hose removed.
4. 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 Step 4, replace the regulator.

Check Vehicle Fuel Supply and Fuel Pump

1. Vehicle fuel level and/or for fuel gelling during cold weather.
2. Air leaks and/or restrictions in the fuel supply lines to the PROHEAT.
3. The PROHEAT operation when supplying fuel from a direct source.

Test Procedure — Fuel Supply Inspection:

1. Is there fuel in the tank?
2. 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:

1. Disconnect the fuel line at the inlet to the regulator and place into a cup.
2. Start PROHEAT. Ensure that fuel flows out of the fuel line in a steady, uninterrupted, and clear stream of fuel.
3. If fuel does not flow, check filter and relief valve for contamination.

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

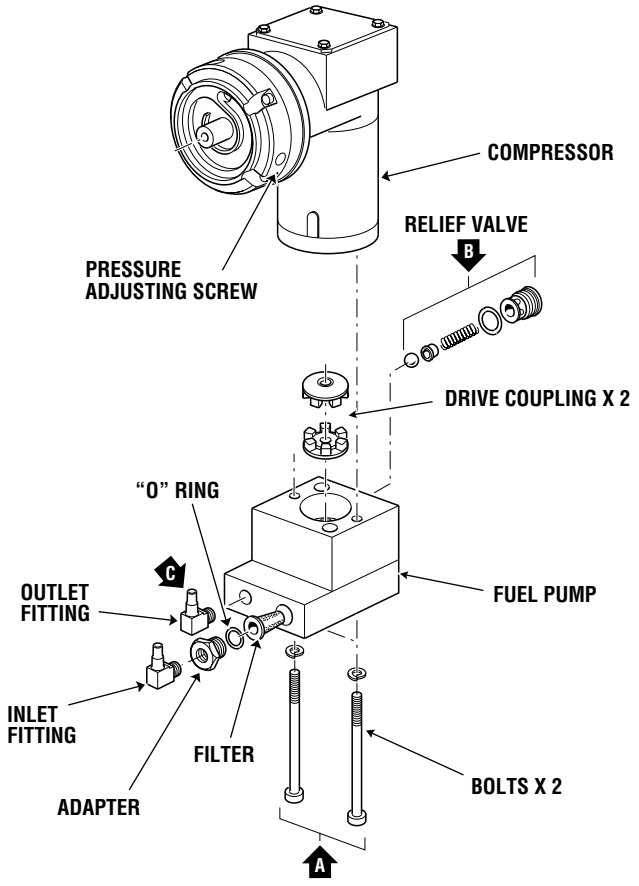


Figure 4-8. Compressor / Fuel Pump Assembly

Check Fuel Pump Pressure and Service

⚠ 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.

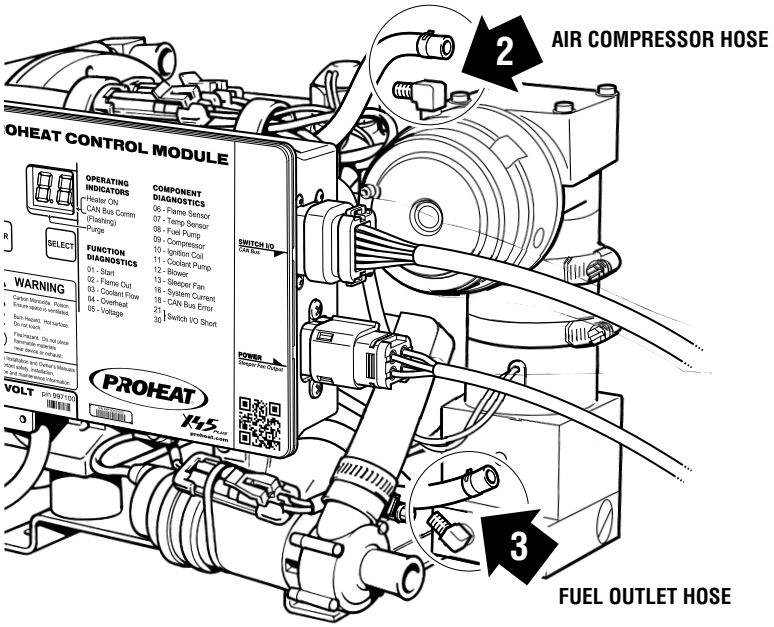


Figure 4-9. X45 Plus Heater

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

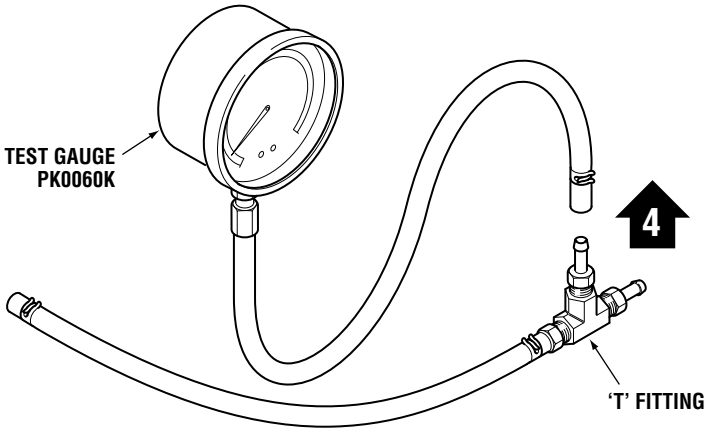


Figure 4-10. Test Gauge

NOTICE

Calibrate gauge before each use. See installation instructions # 990614 available at www.proheat.com for more information.

NOTICE

It is normal to get a start error code 1 or a flame out Code 2 during the test. The compressor/fuel pump motor will only run for the first 60 seconds during this test. See Service Manual for operating sequence.

5. Install test gauge PK0060 on fuel pump outlet.

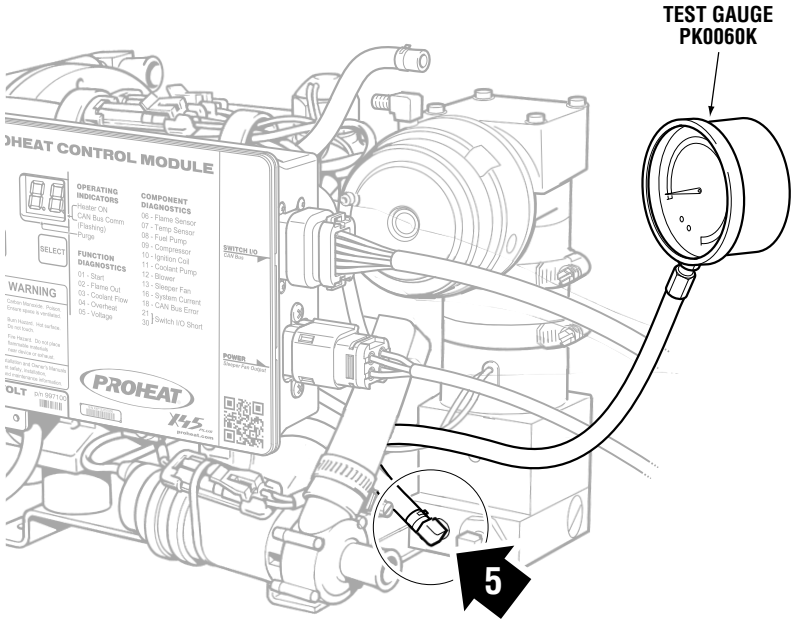


Figure 4-11. Installation of Test Gauge

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.

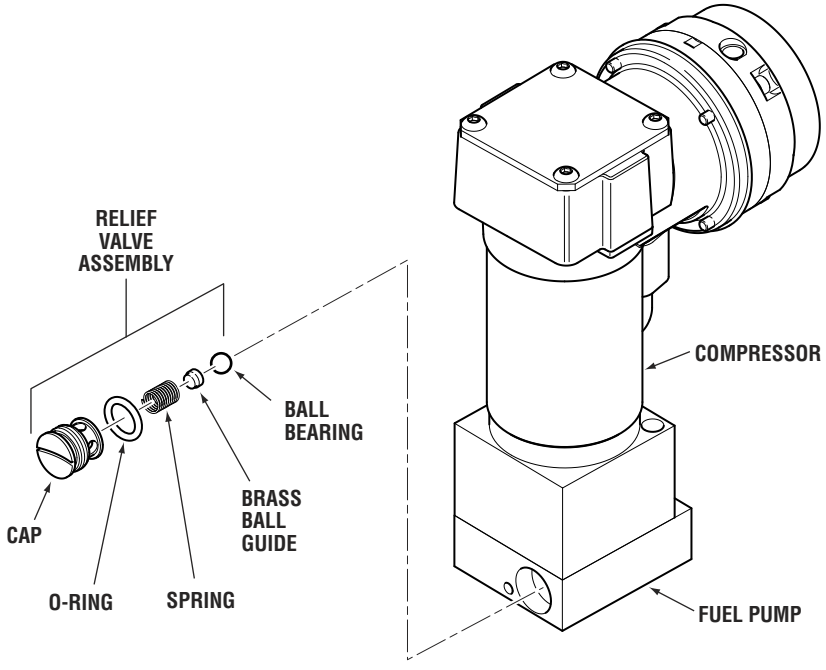


Figure 4-12. Pressure Relief Valve

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.

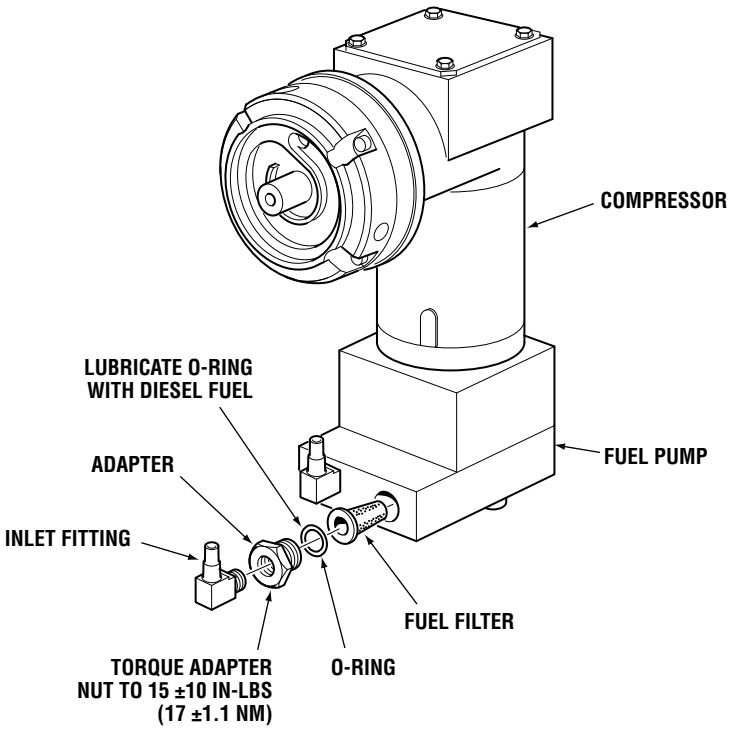


Figure 4-13. Check Valve Filter

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

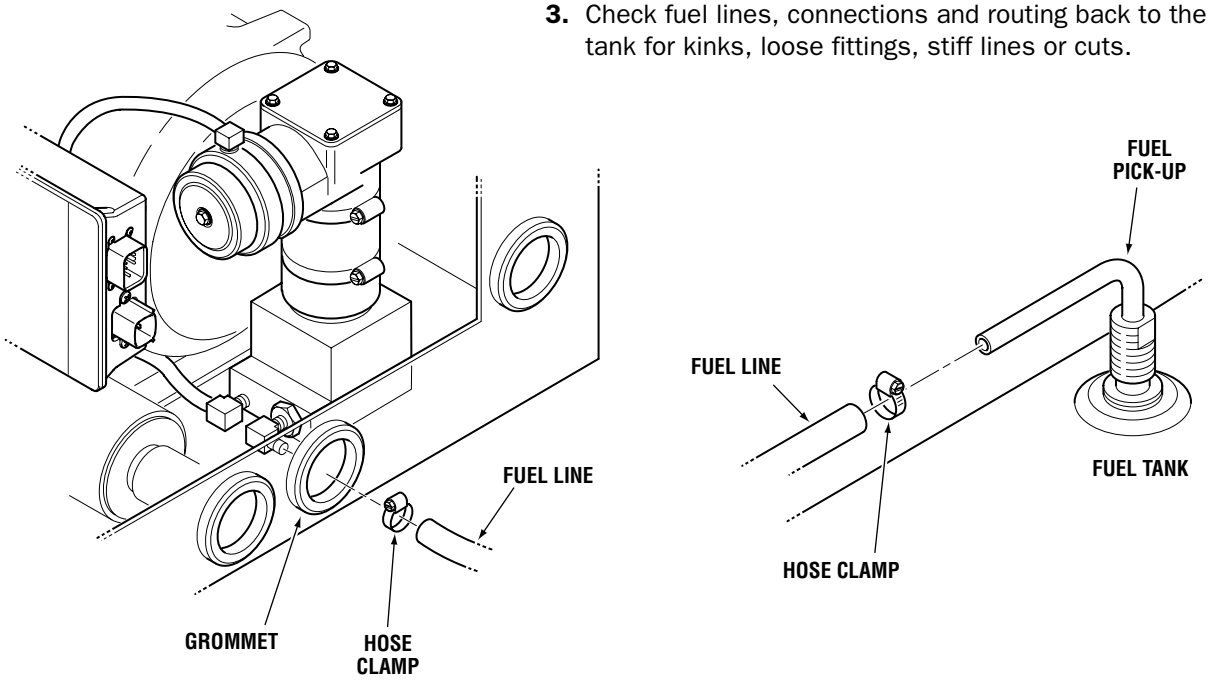


Figure 4-14. Check Fuel Lines, Connections and Routing

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.

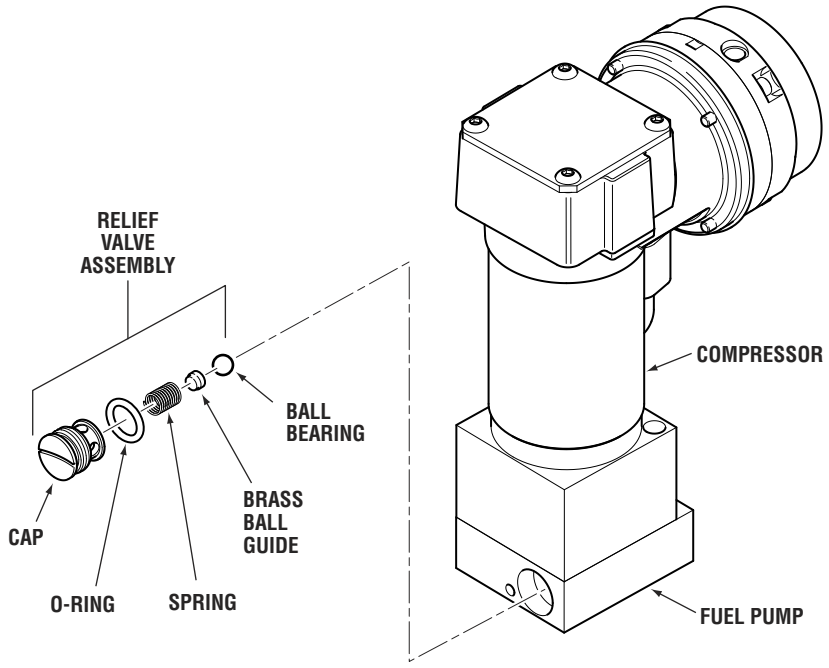


Figure 4-15. Pressure Relief Valve

7. 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.

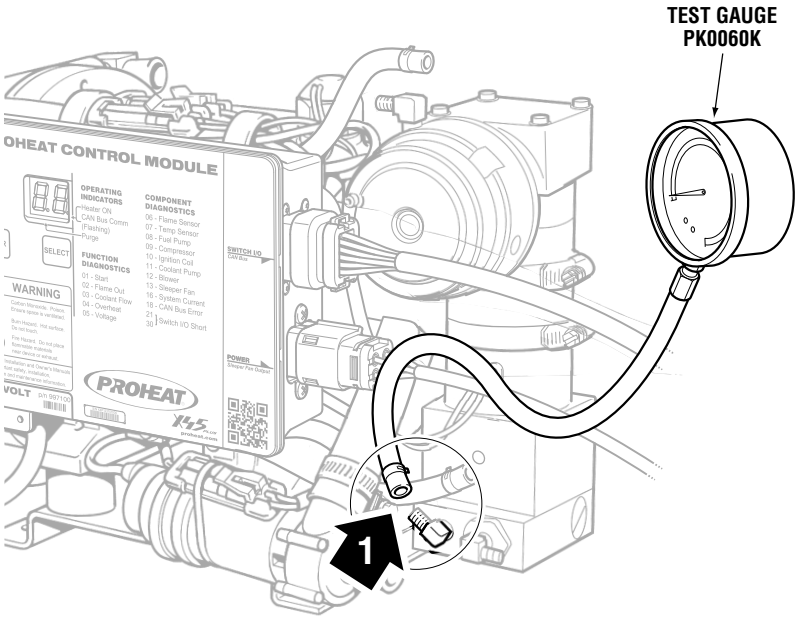


Figure 4-16. Remove Test Gauge

2. Reconnect fuel line to fuel pump outlet.
3. Reconnect air hose at compressor.

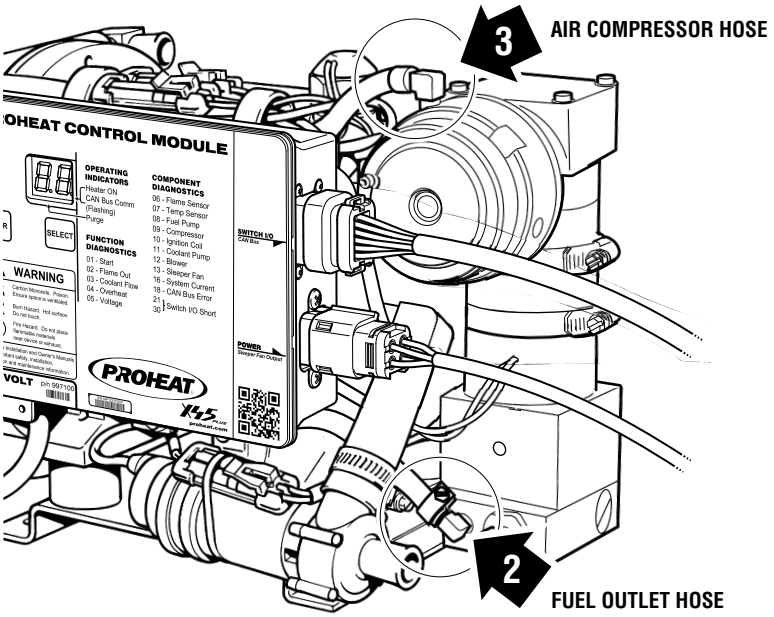


Figure 4-17. Reconnect Fuel Lines and Air Hose

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

Check Air Compressor Pressure and Operation

⚠ WARNING

Shock hazard due to high secondary coil voltage.

Test Procedure — Air Compressor pressure:

1. Run heater until warm to the touch. This ensures the heater components are up to normal operating temperature.
2. Switch heater “OFF”.
3. Connect Digital Manometer PK0037 (or analog gauge PK0060) in-line as shown in figure 4-18.

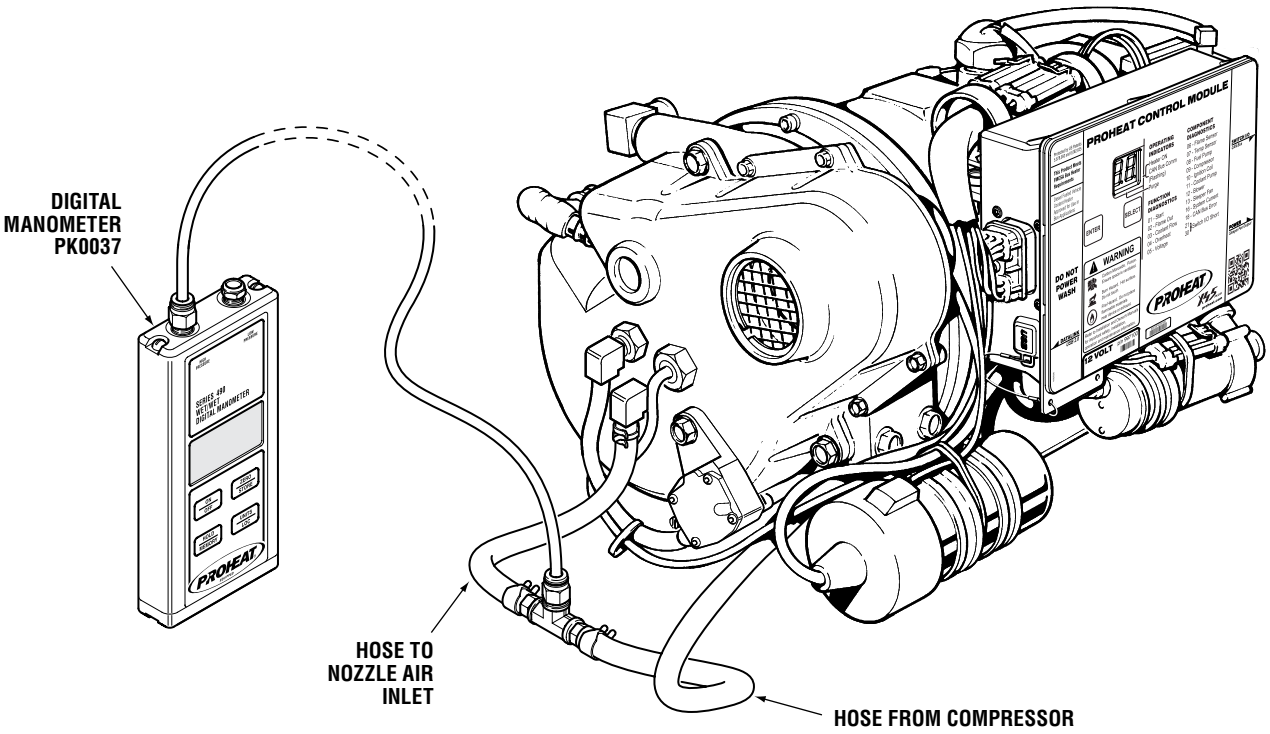


Figure 4-18.

NOTICE

If using PK0060, Analog Air pressure gauge, calibrate gauge before each use. Refer to: installation instructions # 990614 available at www.proheat.com

NOTICE

Remove pressure gauge when finished with measuring & setting procedure.

NOTICE

For sustained operation above 7000 feet (2134 m) the compressor must be adjusted in order to maintain proper combustion.

4. Locate the rubber boot on the positive end of the ignition coil and peel it back to expose the positive terminal.
5. Select the DC Volts range of a multimeter and connect as per figure 4-19. 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.
6. With the heater running in full output (flame on and ignition is off) read the voltage at the coil to ensure voltage is nominally 12 +/- 1V for 12 V models and 24+/- 1V for 24 V models. Check air pressure reading using the correct altitude for your location.
7. The reading must be within the range of the shaded area as shown in figure 4-20.

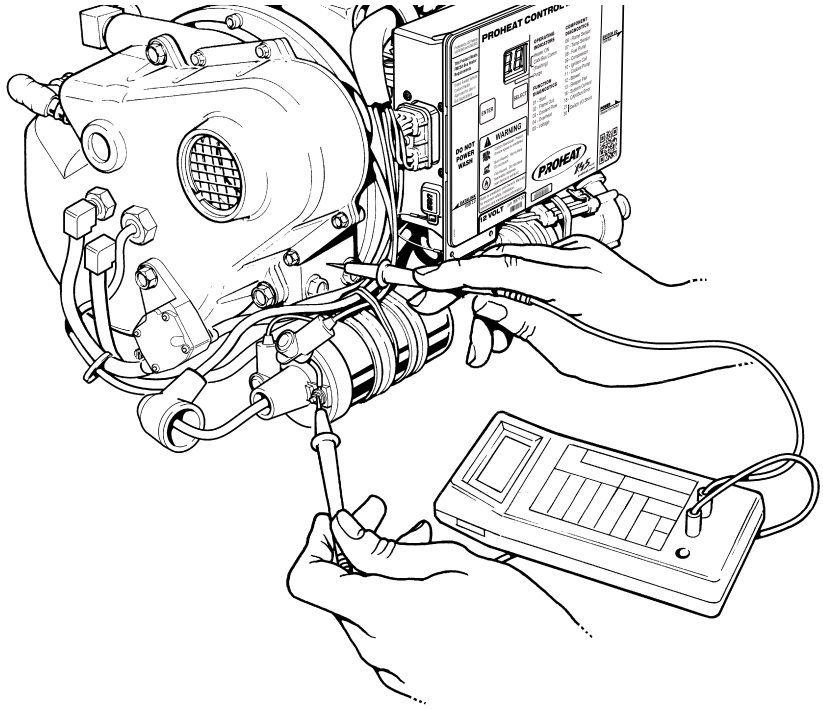


Figure 4-19. Check Coil Voltage

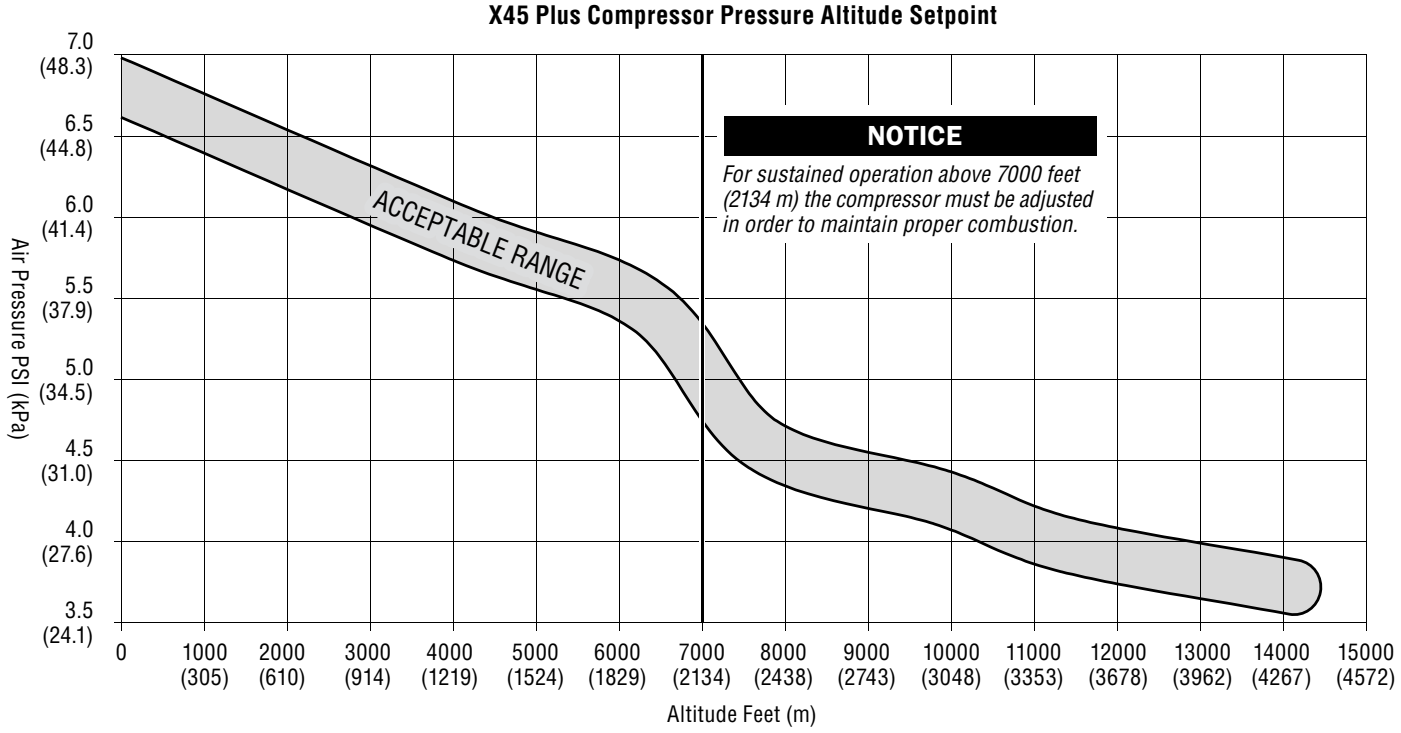


Figure 4-20. System Air Pressure Chart

Air Pressure Checks

If air pressure is outside the recommended setting for your location please perform the following checks before adjusting the compressor:

Low Pressure Reading – Check:

Ensure the coil voltage is nominally 12 ±1V for 12V models and 24 ±1V for 24V models. If voltage is low, charge batteries and check compressor reading again.

1. Inspect air line from compressor outlet to fan end inlet for leaks, kinks or other restrictions..
2. Check condition of air compressor filter. Retest with the filter removed.

High Pressure Reading – Check:

Ensure the coil voltage is nominally 12 ±1V for 12V models and 24 ±1V for 24V models. If voltage is high, stop charging batteries (turn engine off) and check compressor reading again.

1. Nozzle and cavity for blockage. Refer to Step 5 on page 5-10 of the X45 service manual.

NOTICE

Altitude correction is needed above 7,000 feet (2134 m) (see figure 4-20).

Compressor Adjustment

If after performing the above checks and the air pressure is still outside the recommended setting for your location, adjust the air pressure by turning the screw as shown in figure 4-21.

NOTICE

If the air compressor pressure cannot be adjusted back into normal range, repair or replace air compressor. Refer to parts manual.

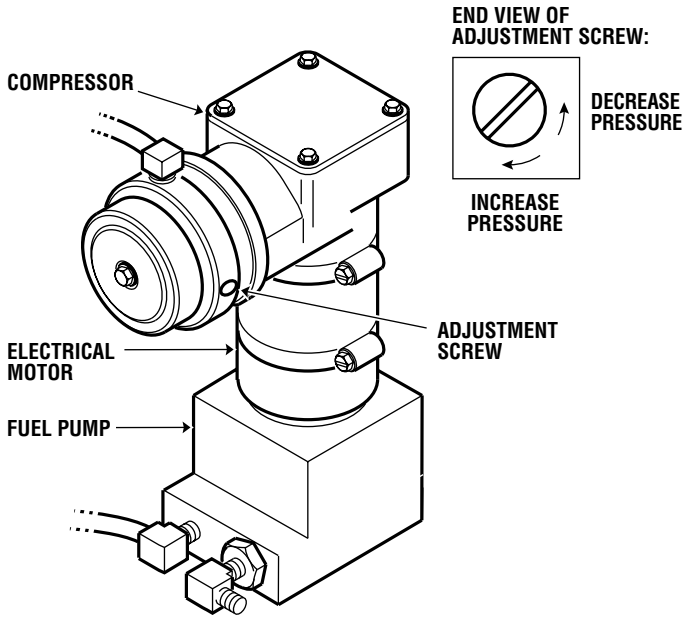


Figure 4-21. Compressor / Fuel Pump Assembly

Check Fuel Nozzle and O-ring

Check for fuel nozzle and O-ring damage and/or contamination.

Test Procedure — Fuel nozzle removal, inspection & cleaning or replacement:

1. Remove three (3) bolts from the fan end and open up heater.
2. Remove nozzle from fan end.
3. Disassemble, inspect, clean, and reassemble fuel nozzle (Figure 4-23).

   Fuel nozzle disassembly, inspection, cleaning & reassembly:

   - Hold the fuel nozzle stem lightly but firmly in a vise using soft jaws, taking 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 (3.3±0.3 Nm).
4. Inspect the fuel nozzle cavity and clean as necessary using electrical contact cleaner or warm soapy water
5. 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).
6. 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.

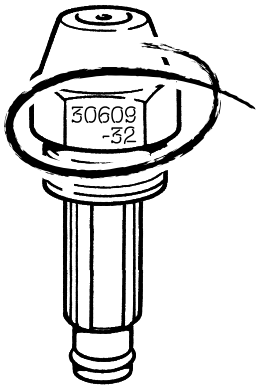


Figure 4-22. Nozzle Number Location

NOTICE

DO NOT use a tip cleaner in the fuel orifice.

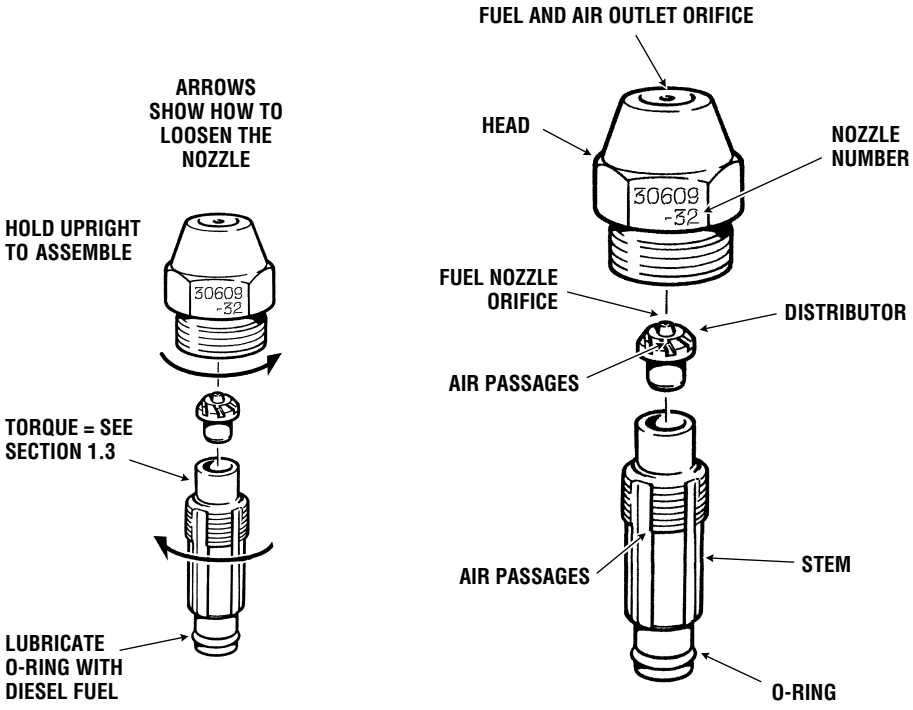


Figure 4-23. Fuel Nozzle Assembly

Check Ignition Coil and Electrode Gap

1. Electrode cleanliness.
2. Electrode positioning for proper gap.

Test Procedure — Ignition system and electrode spark inspection:

⚠ WARNING

The PROHEAT chassis is grounded to the PCM as shown in figure 4-25. Ensure that the ground is securely connected. Failure to ensure a proper ground may result in electrical shock.

1. 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.

2. Remove three (3) bolts from the fan end and open up heater.
3. Check the electrode for carbon buildup and clean as required.
4. Check electrode gap as per figure 4-24.
5. Reinstall fan end and torque three (3) bolts to 75±5 in/lbs (8.5±0.5 Nm).

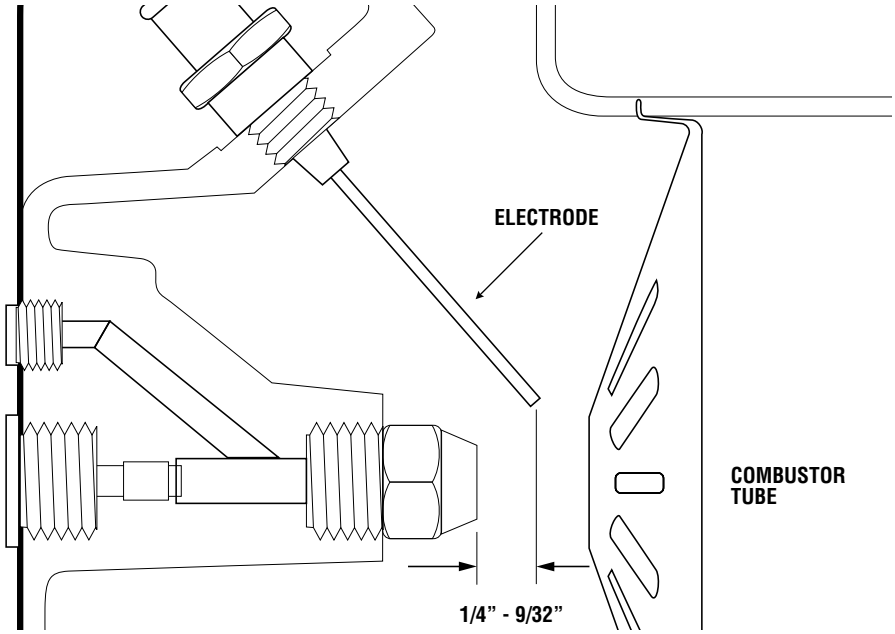


Figure 4-24. Electrode Gap Detail

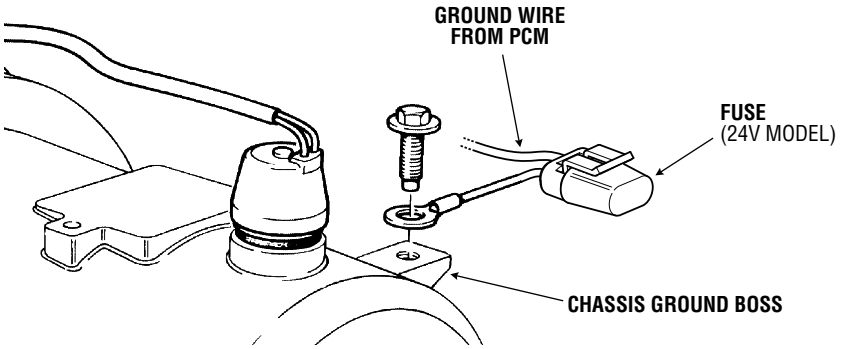


Figure 4-25. PROHEAT Ground Boss

Check Flame Sensor

NOTICE

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

Test Procedure — Flame Sensor Circuit:

Check cleanliness of the flame sensor. To test flame sensor for operation:

Spare Flame Sensor Available – Check:

1. Ensure unit is powered off. Disconnect flame sensor.
2. Connect known good flame sensor to harness.
3. Hold up known good flame sensor to inspection port.
4. 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.

Spare Flame Sensor Not Available – Check:

NOTICE

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

1. Ensure unit is powered off. Disconnect and remove flame sensor from fan end casting.
2. Shine incandescent flashlight directly at sensor.
3. Start heater with a flashlight shined directly at the sensor.
4. 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:

1. A flame is detected during the ignition period and during full output.
2. The flame goes out or fails to be detected.
3. The ignition is switched on for a maximum of 10 seconds to try and reestablish the flame.
4. If the flame is not detected within 10 seconds, the flame out diagnostic code is displayed.
5. The PROHEAT goes into Cool Down (Purge) mode and attempts to restart after Cool Down (Purge) is complete.

A flame out diagnostic code indicates that:

- A flame was detected therefore there was a spark and the ignition system works.
- The flame was detected therefore the flame sensor works.
- The fault is in the fuel supply system.
- The flame sensor could be dirty.

Troubleshoot the flame out diagnostic code based on:

1. **Fuel supply to the PROHEAT.**
   Go to page 4-8 and perform fuel system check.
   - Fuel tank pick-up
   - Fuel fittings
   - Fuel lines
   - OEM supplied filters and check valves
2. **PROHEAT fuel and flame detection system.**
   Go to page 4-8 through page 4-22 and perform Regulator, 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 4-45.
   - 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 (see figure 4-27) is a valuable troubleshooting tool used to:

1. Check the coolant flow and direction.
2. Check for air in the system.
3. Check for restrictions caused by the truck systems such as shuttle valves, manual valves, air operated valves.

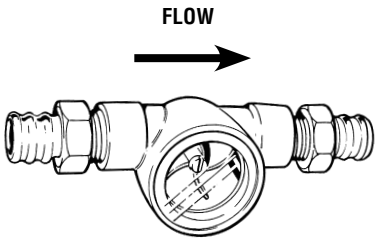


Figure 4-26. Flow Indicator – TK9002

The coolant flow indicator shown in figure 4-26 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.

Check: Coolant Flow

1. **Coolant Lines:** For restrictions and blockages
   Are clamps tight?
2. **Shut-off Valves:** Ensure that shut-off valves are open and functioning properly.
3. **Fittings:** Recommend 1/2" NPT x 3/4" Hose Barb. Minimum size is 1/2" NPT x 5/8" Hose Barb.
   Avoid using 90˚ fittings where possible.
4. **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.
5. **Coolant Pump:** Does the pump function properly? (page 4-36)
6. **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 (85°C) in less than one minute causing a COOLANT FLOW diagnostic code.

NOTICE

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

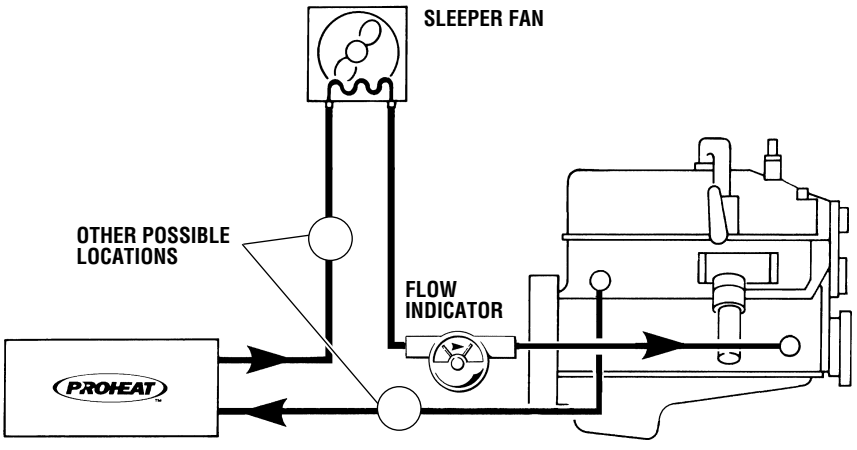


Figure 4-27. Flow Indicator – TK9002

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 and the heat exchanger temperature reaches 280°F +/- 12°F (138°C +/- 11°C).

If the heater is equipped with an Impact Switch, and it is triggered by mechanical shock the PCM will also display code 04 Overheat. Ensure the impact switch (if equipped) is reset by depressing the red button on top of the impact switch.

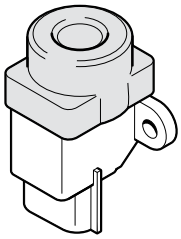


Figure 4-28. Impact Switch

Check: Coolant Flow

1. Is there coolant in the system?
2. 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, carefully 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:

1. Connect a multimeter (adjusted to measure resistance) to the overheat breaker connector. (Figure 4-29.)
   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.

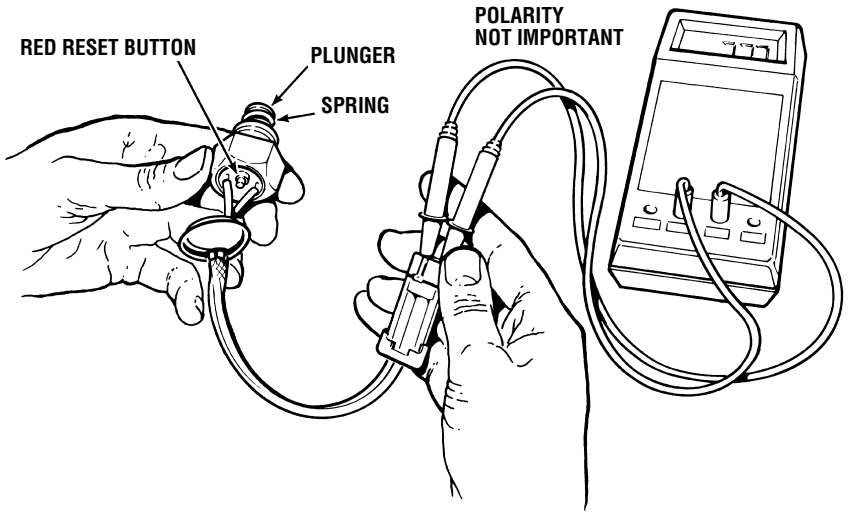


Figure 4-29. Overheat Sensor Test

5 Voltage

A VOLTAGE diagnostic code indicates that the supply voltage to the heater is out of the normal operating range for more then 10 seconds.

Normal voltage ranges:

12 Volt heater – 9.5 to 16.0 Volts

24 Volt heater – 19.5 to 32.0 Volts

Check: **Vehicle Voltage**

1. 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.

2. 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:

- Drop the voltage enough to cause a voltage error.
- 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:

1. Locate the rubber boot on the end of the ignition coil and peel it back to expose the positive and negative terminals.
2. Select the DC Volts range of a multimeter and connect as per figure 4-30. 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 4-30)
3. Read the voltage with the heater running or trying to run.

Normal Voltage Ranges

12 Volt heater – 9.5 to 16.0 Volts

24 Volt heater – 19.5 to 32.0 Volts

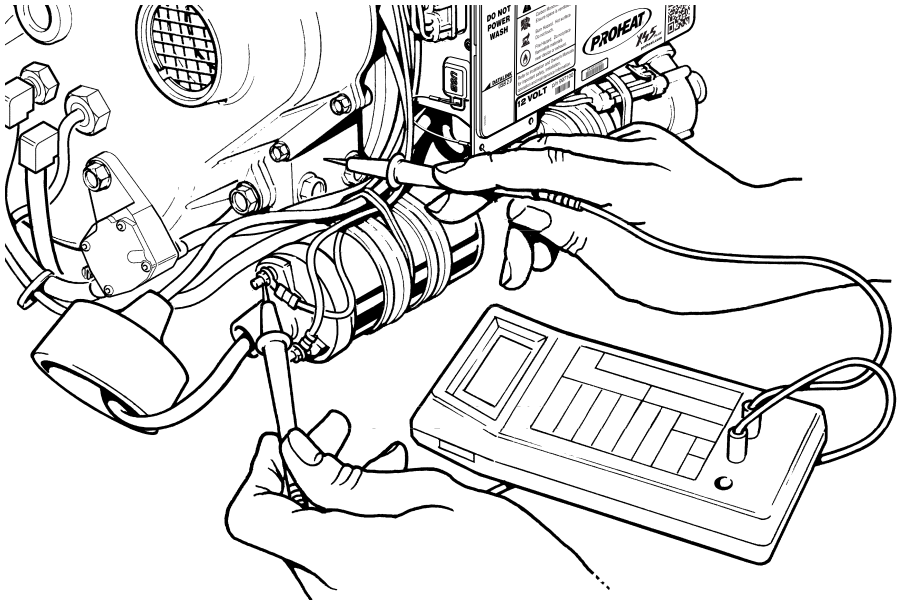


Figure 4-30. Heater Voltage Measurement

Component Faults:

6 – Flame Sensor	11 – Coolant Pump	19 – High Ambient PCM Temperature
7 – Temp Sensor	12 – Blower	
8 – Fuel Pump	13 – Sleeper Fan	21–26 – Outputs 1–9 Faults
9 – Compressor	16 – System Current	
10 – Ignition Coil	18 – CANbus Error	

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.

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.

6 Flame Sensor

A FLAME SENSOR diagnostic code indicates an electrical short circuit in the flame sensor wiring, a flame sensor failure or a flame in Cool Down (Purge).

The PROHEAT was switched on and a flame (signal) was detected in Pre-check.

It will not indicate an open circuit. The flame sensor is an optical device that “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

This code may also be displayed if the sensor “sees” a flame when there should not be a flame in Cool Down (Purge). After 180 seconds in Cool Down (Purge) a flame was still detected, and heater went into another 180 second Cool Down (Purge). At the end of the second Cool Down (Purge) the heater will shut down and enter Lockout mode.

NOTICE

A flame fault in Cool Down (Purge) will cause the heater to preform a second Cool Down (Purge) and then go into Lockout mode. (Requires power to be removed and reapplied to clear the code).

Check: Flame Sensor

- Inspect the flame sensor wiring for a short circuit.
- Inspect the flame sensor lens for damage.
- Test the flame sensor. (See following page for flowchart, Figure 4-31.)

Flame Sensor Test Procedure

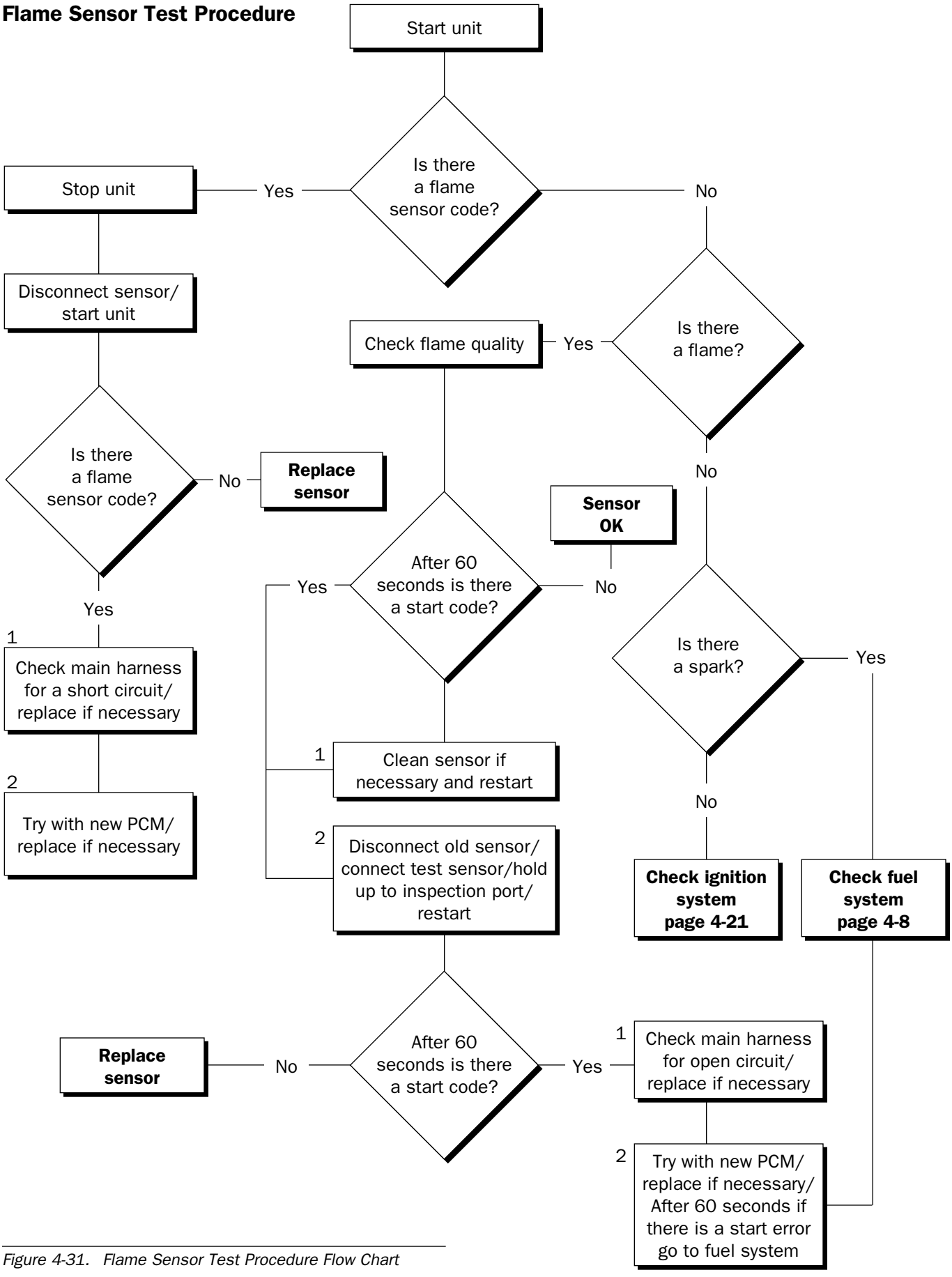


Figure 4-31. Flame Sensor Test Procedure Flow Chart

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)

1. Inspect wiring for short or open circuits.
2. Check resistance of sensor. Is it within range as shown in figure 4-33? If it is within valid range and the PCM still displays code on start up, replace PCM.
3. Test the sensor. (See test procedure below.)

Test Procedure:

1. Connect a multimeter (adjusted to measure resistance) to the temperature sensor as per figure 4-32. The polarity of the sensor connections to the multimeter is not important.
2. Measure the sensor resistance versus temperature under the following conditions:
   - at room temperature
   - in a freezer
   - in boiling water
3. Compare the measured values against the graph (Figure 4-33). If values do not approximately match, then the sensor is defective and must be replaced.

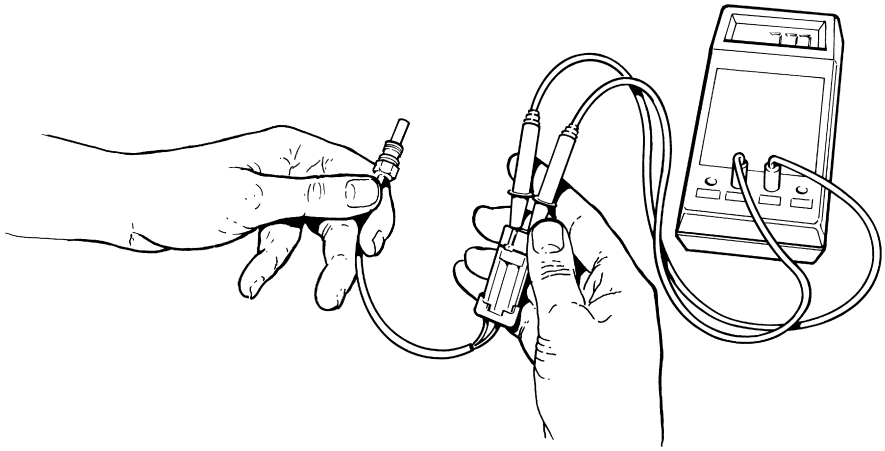


Figure 4-32. Temperature Sensor Test

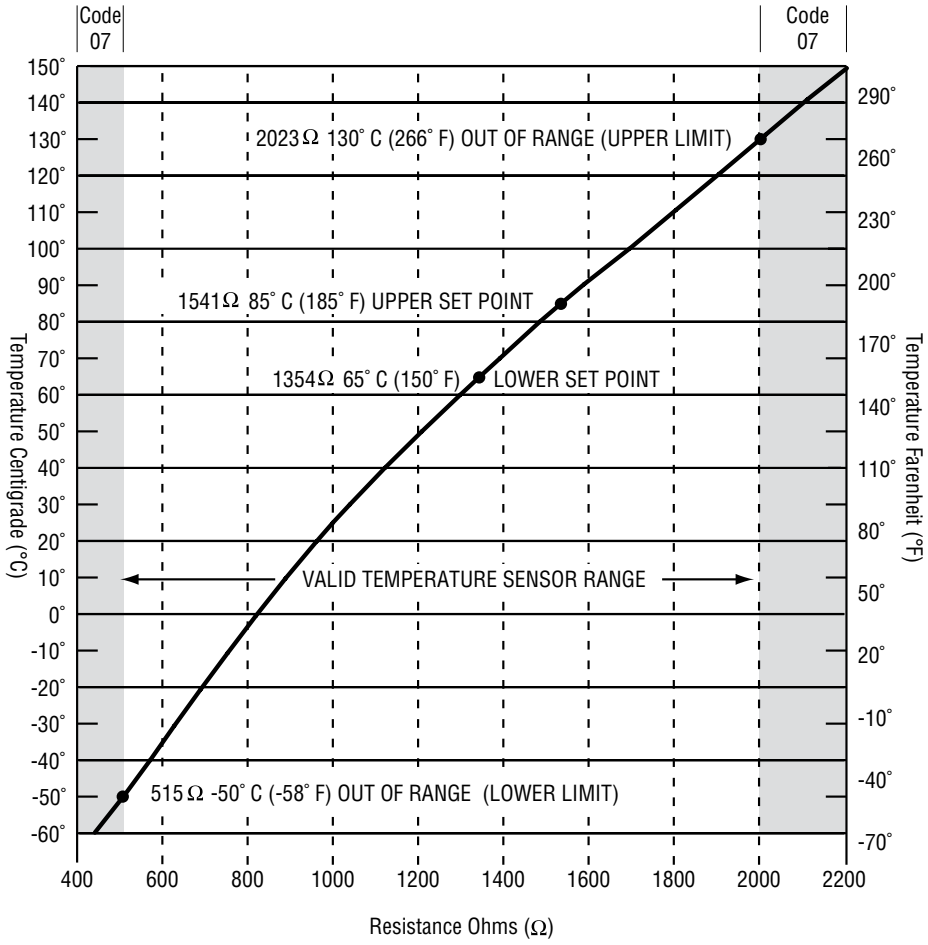


Figure 4-33. Coolant Temperature Sensor Graph

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

8 Fuel Pump

The FUEL PUMP diagnostics code is not used on the X45 Plus and indicates that the wrong configuration number was installed. See “CC” on page 4-6.

9 Compressor

The COMPRESSOR diagnostic code is activated when the PCM detects that the compressor motor is electrically shorted, open, overloaded (software breaker hasn’t tripped), or is damaged (compressor is running when it shouldn’t be “ON”).

Symptom: Air Compressor not running (code indicated)

Check: Air Compressor wiring & function

1. That compressor is connected to harness correctly. (See PROHEAT Wiring Diagram page 1-4)
2. The connector pins for damage or corrosion.
3. Harness for pinched or abraded wires.
4. Test compressor. If it tests OK replace PCM. (See page 4-17, figure 4-18, figure 4-19 and Test Procedure.)

Test Procedure:

1. 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.
2. 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.
3. Measure air compressor current. Use test lead part # 967921K.

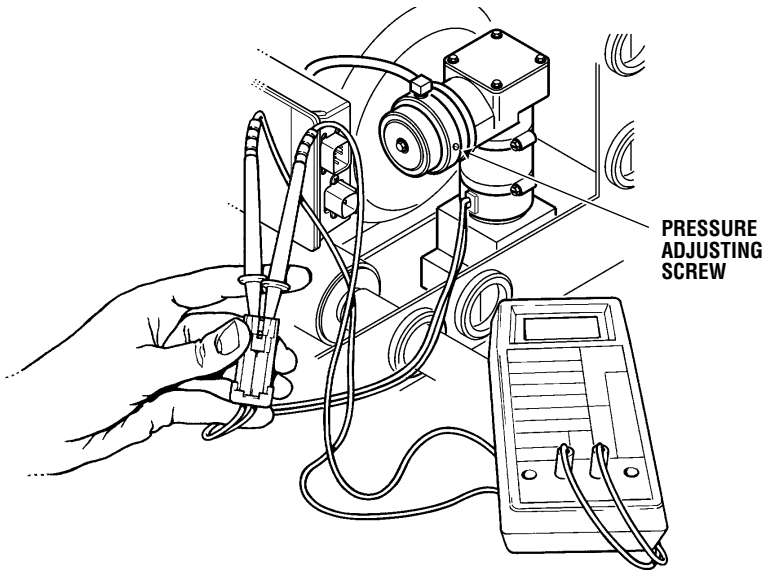


Figure 4-34. Compressor Test

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.

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

Check: Internal Short in Motor

Disconnect compressor/fuel pump motor from internal harness.

To check motor condition:

Spare Compressor Motor is Available – Check:

1. 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:

2. 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:

1. 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 2 and 3.

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 3.

2. 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 3.

3. 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 in good condition, replace PCM.

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

Check: **Air Compressor operation**

1. Harness for pinched or abraded wires. The positive wire must not short to ground.
2. Motor for internal short. (See figure 4-34 and Test Procedure.)
3. Check for seized motor or fuel pump. (See page 4-10, figure 4-8 and figure 4-35 below.)

⚠ 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.

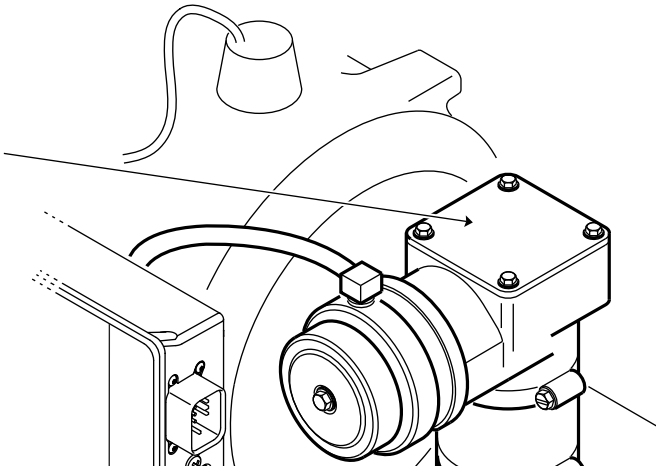


Figure 4-35. Compressor Access Cover

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 4-25. 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

1. Inspect the wiring harness to ensure the ring terminals are secured to the coil. Make sure the polarity is correct.
2. Inspect for broken or abraded wires in the wire harness.
3. Test coil. (Figure 4-36.)
4. 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

1. Inspect the high tension lead between the coil and the electrode.
2. Inspect the ground lead between the second electrode and the heater chassis.
3. Is the electrode gap adjusted correctly? (See page 4-21 for Electrode Gap Detail)

Test Procedure:

1. 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.

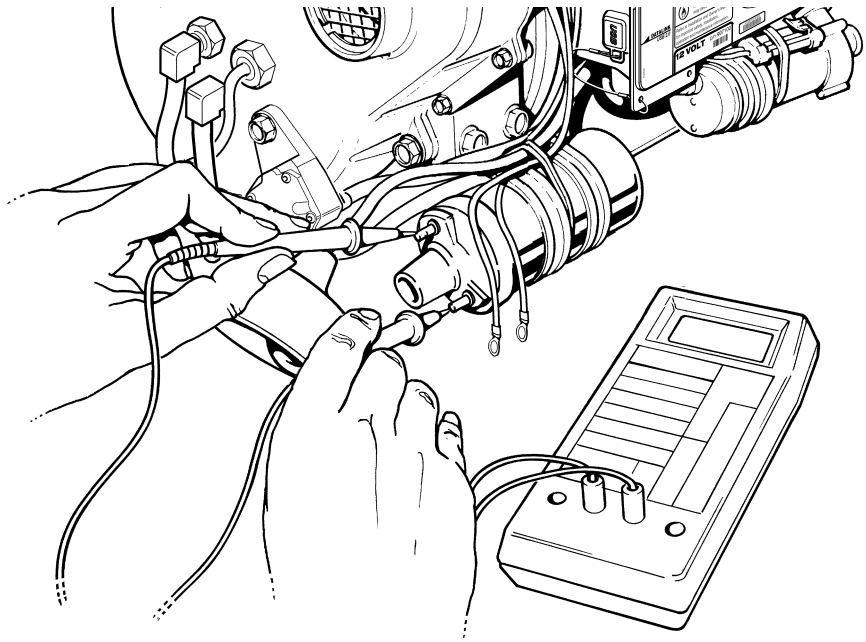
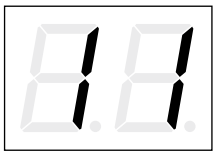


Figure 4-36. Ignition Coil Test

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, an internal short in the motor, or an overload fault detected.

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

1. Connect coolant pump directly to the rated voltage (12/24 Volts) and see if it runs. If not, replace the pump.
2. 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.
3. Measure coolant pump current. Use test lead part # 967921K.

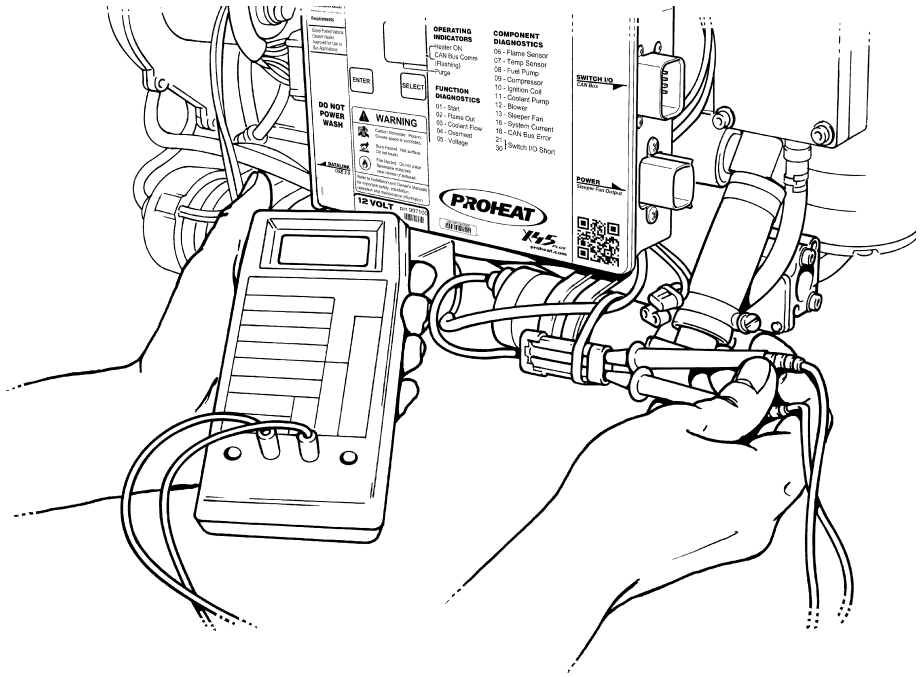


Figure 4-37. Coolant Pump Test

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

1. That coolant pump is connected to harness correctly. (See PROHEAT Wiring Diagram page 1-4)
2. The connector pins for damage or corrosion.
3. Harness for pinched or abraded wires.
4. Test pump. If it tests OK replace PCM. (See figure 4-37 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

Disconnect coolant pump motor from internal harness.

To check motor condition:

Spare Coolant Pump is Available – Check:

1. 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:

2. 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:

1. 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 2 and 3.

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 3.

2. 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 3.

3. 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**

1. Harness for pinched or abraded wires. Positive lead must not short to ground.
2. Check motor for internal short.
(See figure 4-37 and Test Procedure.)

Symptom: **Coolant pump not pumping (no code indicated)**

Check: **Coolant Pump function**

1. If the impeller is turning freely. If not, replace pump.

Symptom: **Coolant pump leaking**

Check: **Leak location**

1. Hose clamps. Tighten if necessary.
2. 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.

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

1. That blower is connected to harness correctly. (See PROHEAT Wiring Diagram page 1-4)
2. The connector pins for damage or corrosion.
3. Harness for pinched or abraded wires.
4. Test blower. If it tests OK replace PCM. (See figure 4-38 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.

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

Check: Internal short in motor

Disconnect blower motor from internal harness.

To check motor condition:

Spare blower is available – check:

1. 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:

2. 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:

1. 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 2 and 3.

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 3.

2. 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 3.

3. 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

1. Harness for pinched or abraded wires. Positive lead must not short to ground.
2. Check motor for internal short. (See figure 4-38 and Test Procedure)

Symptom: Blower turning slowly (no code indicated)

Check: Blower function

1. For fan blade rubbing on housing.
2. For fan blade slipping on motor shaft.

Test Procedure:

1. Connect the blower to a power supply of the rated voltage. Does it turn? If not, replace the blower.
2. 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.
3. Measure blower current. Use test lead part #967921K as described on Service Bulletin #967329 in Appendix.

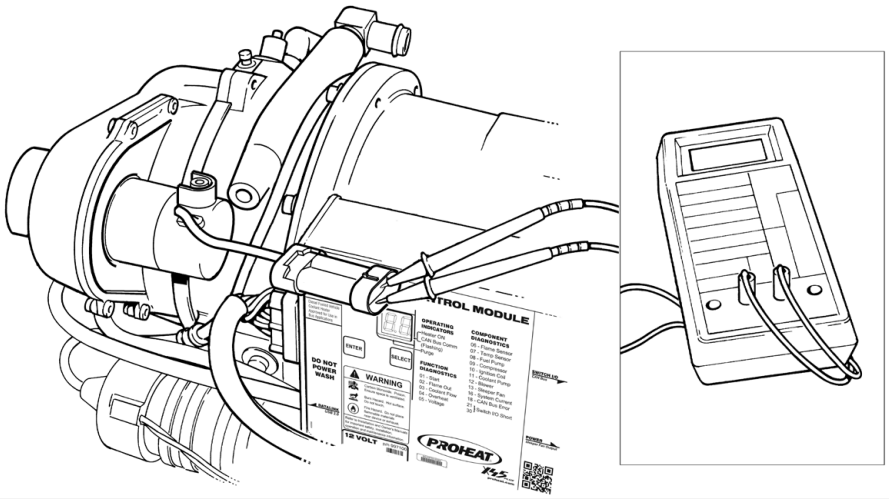


Figure 4-38. Blower Test

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 is a non-critical fault and will not cause the heater to shut down, heat to the engine will be maintained. An open circuit will not display a diagnostic code.

Symptom: Sleeper heater fan not turning (code indicated)

Check: Sleeper Heater system

1. The wiring connections and polarity.
2. 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

1. The wiring connections and polarity.
2. Test sleeper heater fan. (See Test Procedure)

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

Check: Sleeper heater system

1. Air ducting.
2. Use Test Procedure items 5 and 6 to determine if PROHEAT is supplying enough power to drive the sleeper fan.

Test Procedure:

1. Disconnect sleeper fan harness.
2. Restart the PROHEAT, If there is still an error, replace the PCM.
3. Check for correct voltage at the sleeper fan output on the PCM. (See wiring diagram on page 1-4 and page 1-5.)
4. Reconnect sleeper fan harness. Start the PROHEAT.
5. 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.
6. 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 a short circuit fault in the harness or the device being operated by the Hour Meter (Auxiliary Output). This is a non-critical fault and will not cause the heater to shut down, 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

1. The wiring connections and polarity.
2. 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

1. The wiring connections and polarity.
2. Test electrical load. (See Test Procedure)

Test Procedure:

1. Disconnect load/circuit to hour meter (auxiliary output) harness and start heater. If error goes away, check for short circuits in the load/circuit.
2. 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.
3. Check for correct voltage (12 V: 9–14 V, 24 V: 19–30 V) at the hour meter (auxiliary output) harness.
4. Reconnect hour meter (auxiliary output) harness. Start the PROHEAT.
5. Connect electrical load directly to a remote power source of the rated voltage (12/24 Volts). Does the electrical load run?

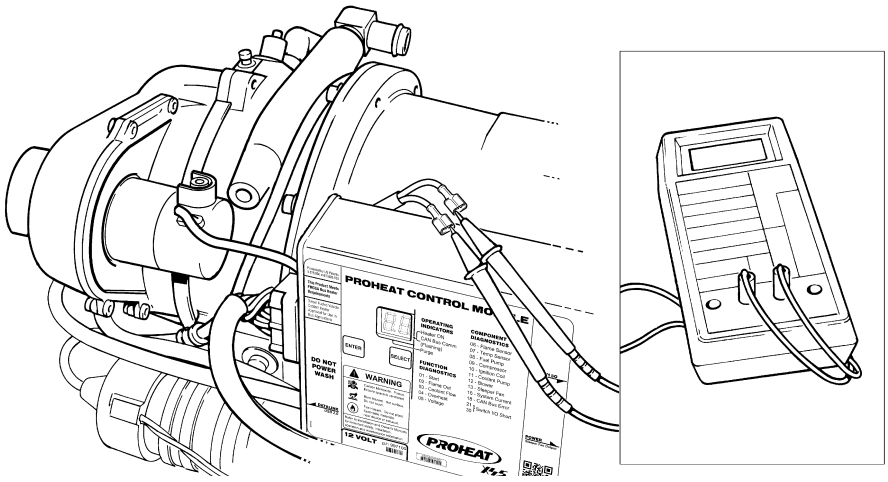


Figure 4-39. Hour Meter (Auxiliary Output) Test

16 System Current

Indicates that the total system current limit of 15 amps was reached as measured by the PCM.

Troubleshoot the system current diagnostic code based on voltage. See page 4-26.

18 CANbus Error

Indicates the heater was switched on via a CANbus input and then lost the CANbus heartbeat message for longer than 2 seconds.

The heater will go to the Cool Down (Purge) mode then turn off until valid CAN communication is restored.

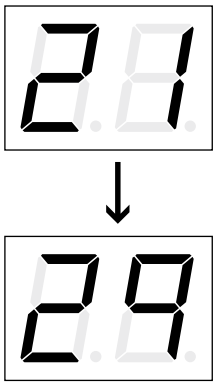
If this diagnostic code displays, contact PROHEAT for more information.

19 High Ambient PCM Temperature

Indicates that the PCM's onboard temperature reaches 203°F (95°C).

This is a non-critical fault and will not cause the heater to shut down.

21–29 Outputs 1–9 Fault



Activated when the PCM detects that any of the configurable output circuits is electrically shorted. This will only be detected whenever the output is powered. This is a non-critical fault and will not cause the heater to shut down. The output fault code refers to a specific hardware pin on the switch/control connector. (See wiring diagram on page 1-4.)

PIN#	DESCRIPTION
21	Autostart Output shorted (Pin 1).
22	Not used.
23	Not used.
24	Not used.
25	Not used.
26	Not used.
27	Accessory Output Shored (Pin 9).
28	Indicator Output Shorted (Pin 14).
29	Not used.

4.2 COMPONENT MECHANICAL OR ELECTRICAL PROBLEMS

4.2.1 FUEL NOZZLE

Go to page 4-20.

4.2.2 FUEL REGULATOR

Go to page 4-9.

4.2.3 AIR COMPRESSOR

Go to page 4-17 and page 4-32.

4.2.4 FUEL PUMP

Go to page 5-8.

4.2.5 IGNITION ELECTRODE

Go to page 4-21.

4.2.6 COOLANT PUMP

Go to page 4-36.

4.2.7 BLOWER

Go to page 4-39.

4.3 OPERATIONAL PROBLEMS

This section describes heater operational problems that are not specifically described in the function or component diagnostic section.

4.3.1 COMPLAINT: Smoking exhaust/smelly exhaust fumes

NOTICE

The heater may puff smoke on start up/shut down for a few seconds.

Normal combustion in full output (ignition off) should be smoke free.

Black Smoke = Too much fuel for the amount of combustion air.

- An increase in the compressor air pressure over the nozzle will add more atomized fuel into the combustion tube; however the combustion air provided by the combustion air blower remains constant resulting in a rich air/fuel mixture and possibly black smoke from the exhaust.
- A restriction in the amount of air through the combustion chamber (restricted air intake, dirty heat exchanger plugged exhaust) will also result in a rich air/fuel mixture as the compressor air pressure (and atomized fuel flow) remains constant.

Check

- Is the Combustion air restricted?
- Do you have the correct nozzle?
- Is the compressor air pressure correct?
- Is the fuel regulator faulty (leaking internally)?

Gray/White Smoke = incomplete combustion of the fuel (bad atomization).

- A restriction in the fuel line, filter, screens, or nozzle fuel passage will reduce the atomized fuel/air flow into the combustion tube: however the combustion air provided by the combustion air blower remains constant resulting in a lean air/fuel mixture and possibly gray/white smoke from the exhaust.
- A decrease in the compressor air pressure over the nozzle will reduce the amount of atomized fuel/air into the combustion tube; however the combustion air provided by the combustion air blower remains constant resulting in a lean air/fuel mixture and possibly gray/white smoke from the exhaust.
- Heater flooded with raw fuel will smoke heavily as it vaporize away. Heater can take up to 10 minutes of running to clear a flood and stop smoking.

Check

- Is it actually smoke or steam?
- Is there air in the fuel?
- Is the heat exchanger and exhaust flooded?
- Do you have the correct nozzle?
- Is the compressor air pressure correct?
- Is the fuel regulator faulty (not opening fully)?

4.3.2 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 4-24).*

4.3.3 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.

4.3.3 COMPLAINT: Backfiring

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

Check

- Fuel level in tank – is the pick-up submerged?
- Air leaks – are all the fuel line clamps tight?
- For severely restricted combustion air blockage at the blower inlet, in the combustion chamber, or in the exhaust system.

5.0 MAINTENANCE

5.1 WEEKLY MAINTENANCE

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

5.2 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, such as 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.

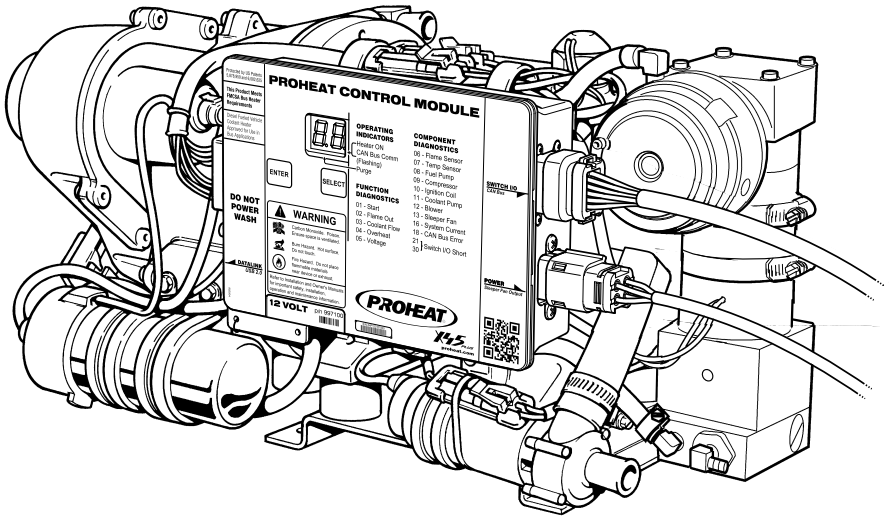


Figure 5-1. PROHEAT X45 Plus Heater

5.2.1 CLEAN HEATER, ENCLOSURE AND AIR INTAKE

⚠ WARNING

DO NOT pressure wash or steam clean.

To clean the heater, enclosure, and air intake:

1. Remove the heater enclosure cover.
2. Clean any accumulated debris or dust from the components.
3. Blow out the compartment with compressed air.
4. Check the combustion air inlet screen for restrictions. Clean as required.
5. Make sure the opening around the exhaust pipe is clear.
6. Visually inspect all the components for wear or damage.

Clean the X45 Plus 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 Plus 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.

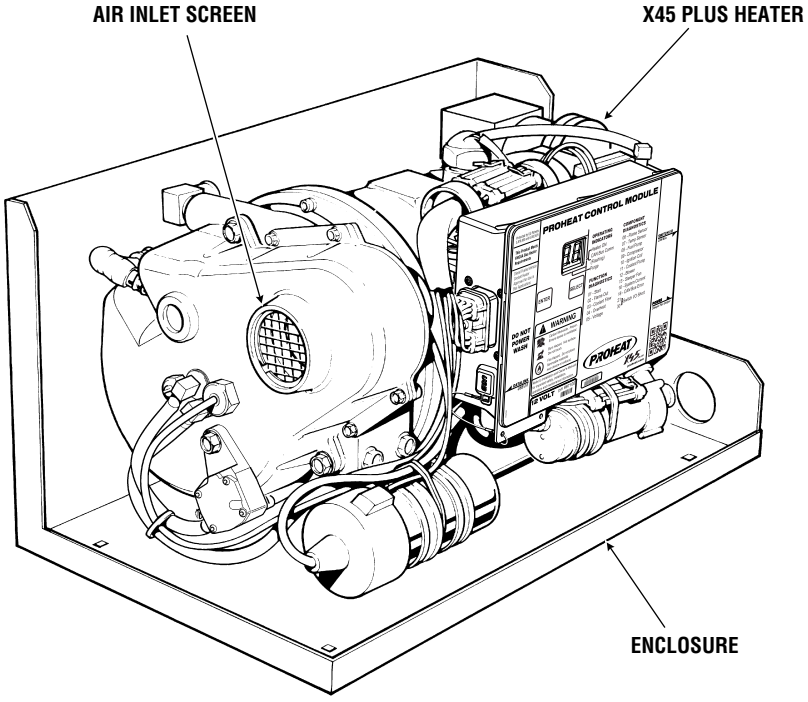


Figure 5-2. X45 Plus Heater and Enclosure

5.2.2 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.

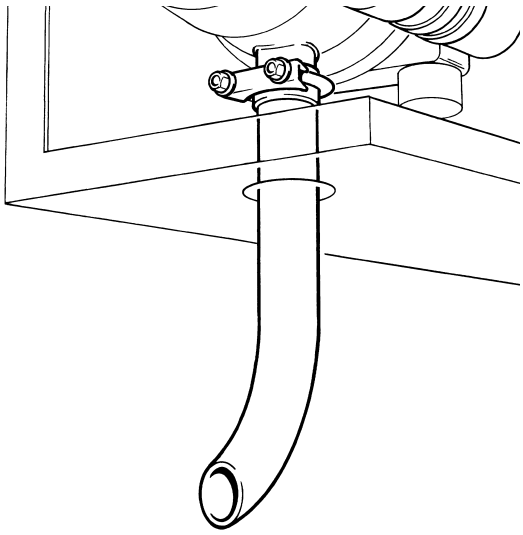


Figure 5-3. Exhaust Pipe

5.2.3 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).

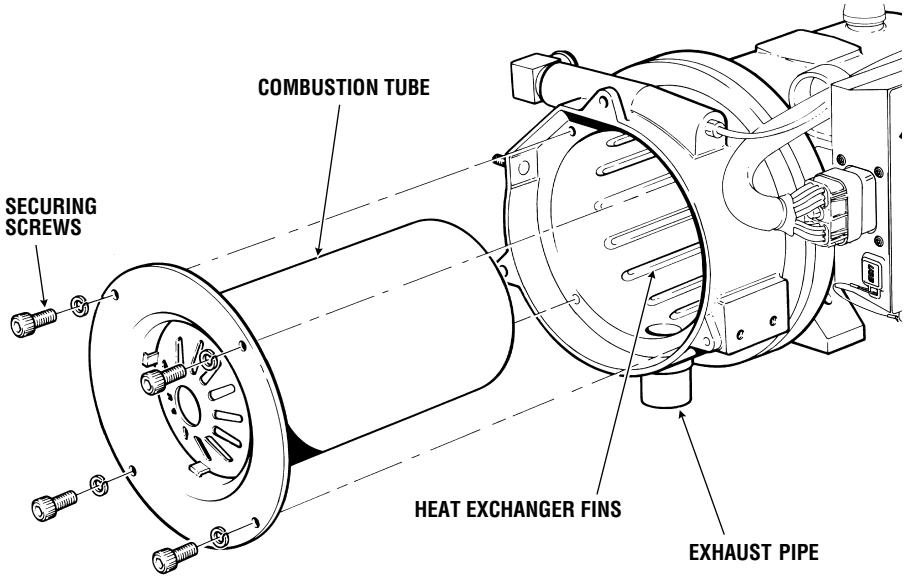


Figure 5-4. Heat Exchanger

5.2.4 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.

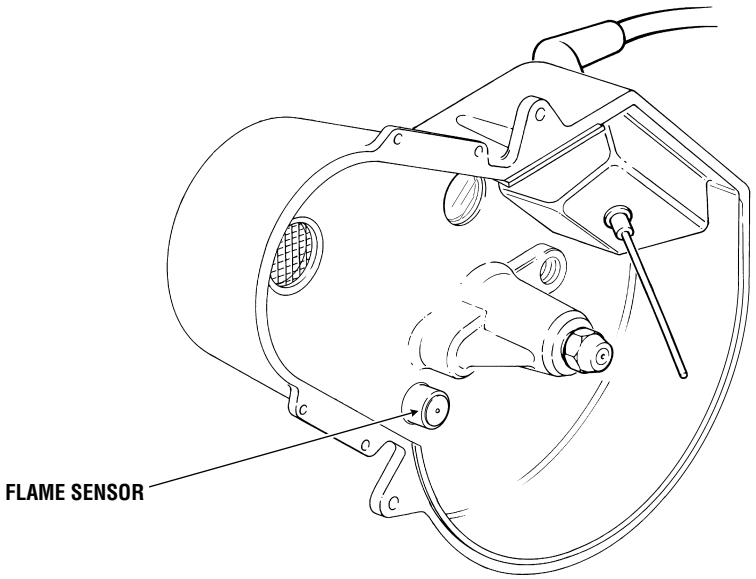


Figure 5-5. Flame sensor

5.2.5 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.

5.2.6 CHECK BATTERIES

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

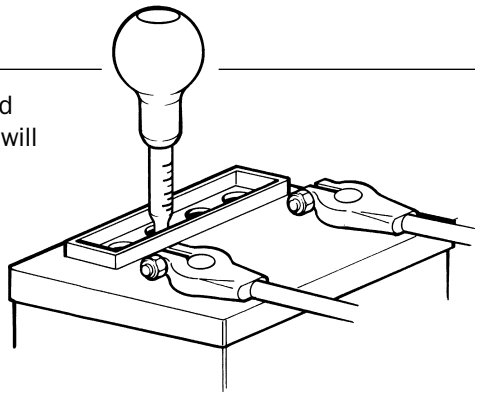


Figure 5-6. Test Battery

5.2.7 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.

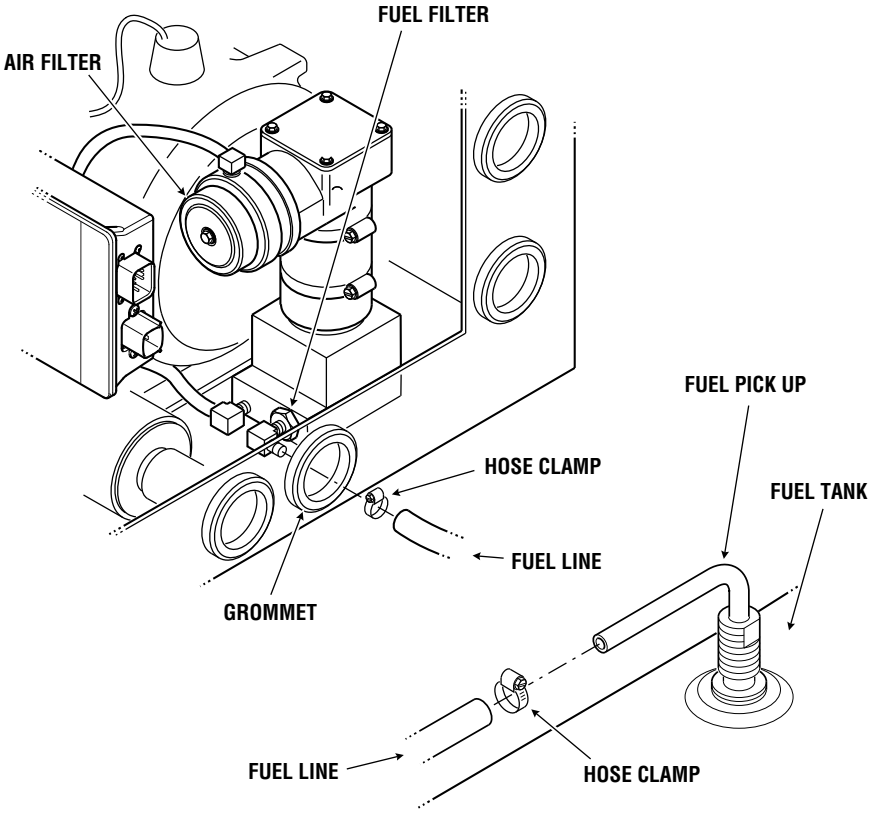


Figure 5-7. Fuel Line Clamp

5.2.8 CHECK FUEL FILTER

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

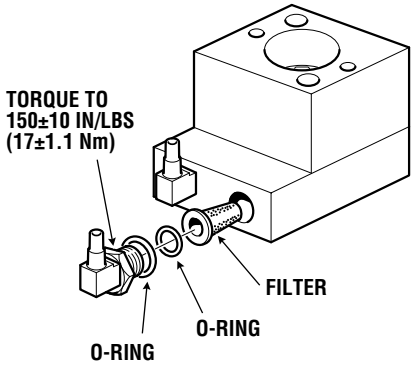


Figure 5-8. Fuel Filter Components

5.2.9 CLEAN NOZZLE

- Remove and install Nozzle as shown on page 4-20. 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.

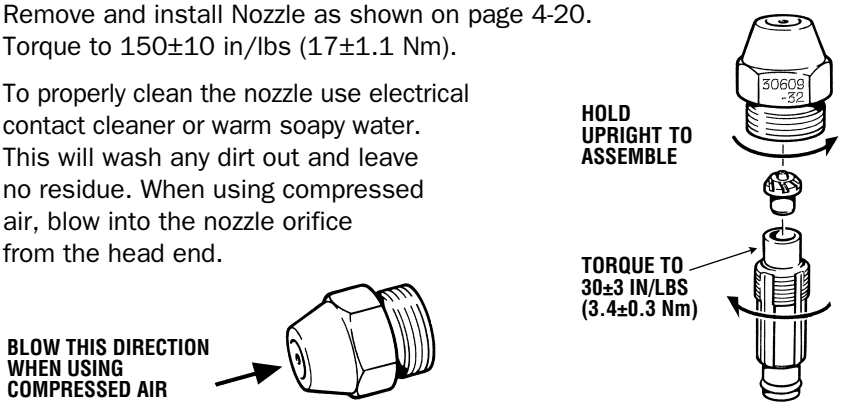


Figure 5-9. Nozzle Components

5.2.10 REPLACE COMPRESSOR AIR FILTER

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

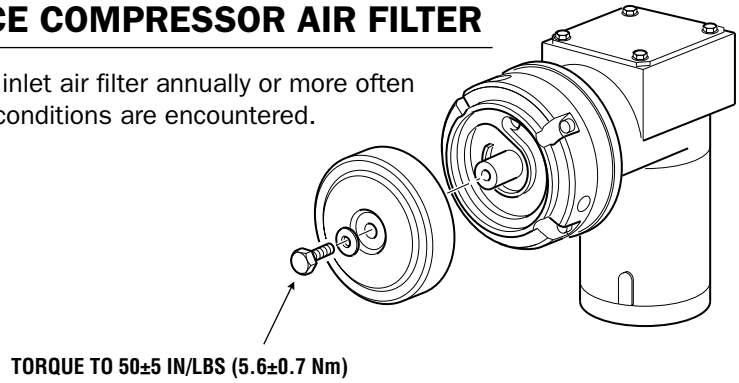


Figure 5-10. Compressor Air Filter

5.2.11 CHECK ELECTRICAL SYSTEM

⚠ CAUTION

Ensure that power is disconnected to the X-45 prior to servicing the ignition lead.

To check the electrical system:

- Check the internal and the external wire harnesses for damage. Replace if required.
- Service the X45 Plus 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.
- Replace the ignition lead every five years or sooner (p/n 930523K).

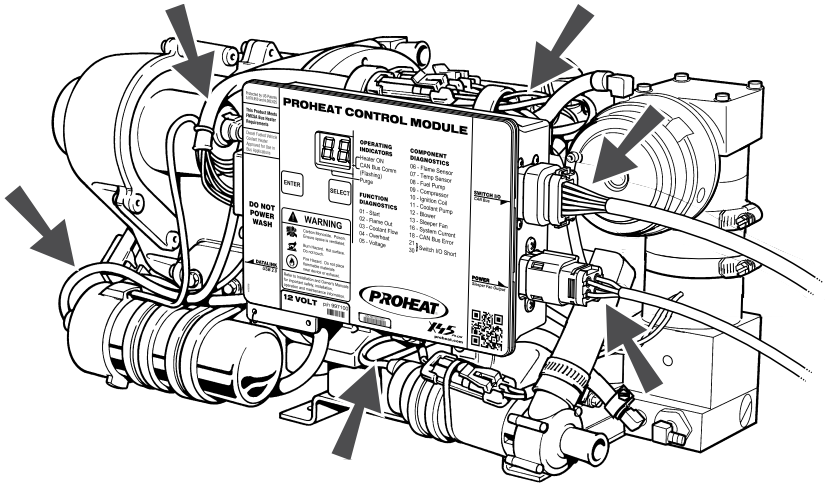


Figure 5-11. Wire Harnesses

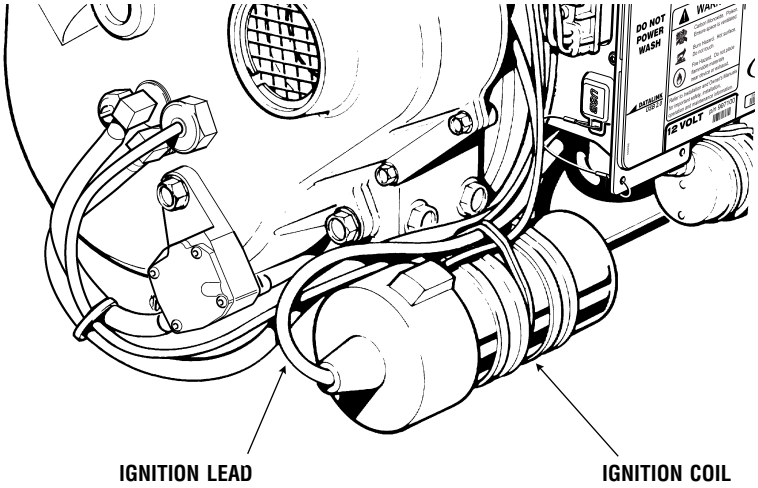


Figure 5-12. Ignition Coil

5.2.12 CHECK AIR PRESSURE

- To check the air pressure, refer to the air compressor pressure test procedure on page 4-17.

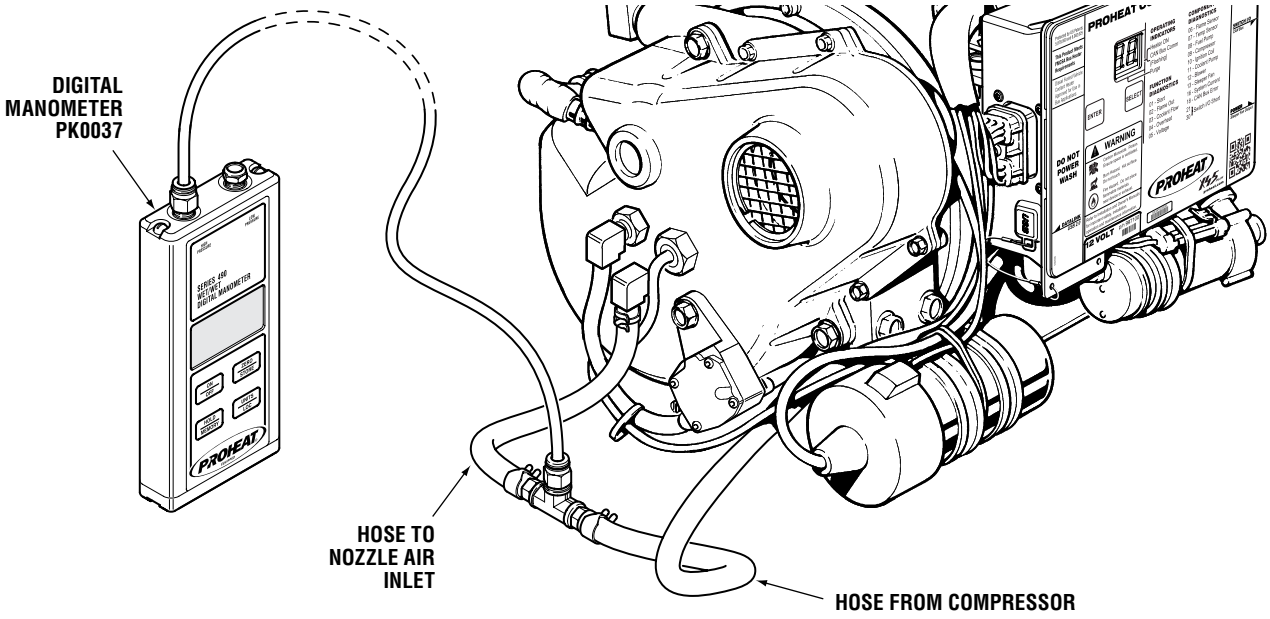


Figure 5-13. Air Compressor Pressure Test Procedure

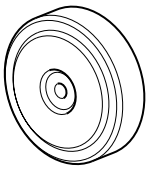
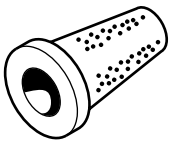
5.2.13 CHECK MODES OF OPERATION – SWITCH, TIMER OR OEM SIGNALS

Check to see that the modes operate as described on page 3-7 to page 3-10.

Operation Test

1. Run the system for at least 15 minutes or until the heater cycles “OFF” and then “ON” again.
2. 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 Plus Fall Service Kit includes: 1 x Air Filter 1 x Fuel Filter 2 x O-Ring
PK0069	1	X45 Plus Major Service Kit includes: 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

6.0 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. PROHEAT heaters 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. PROHEAT heaters which have been modified or use of non-standard parts not approved by PROHEAT.
6. PROHEAT heaters 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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ISO 9001

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