DOMETIC

PROHEAT VARIABLE M-SERIES HEATER

EN

Variable M-Series Heater

Service Manual

Serial numbers
VMH000001 —

[**REVISION B**] Form No. SL9301 | © 2024 Dometic

Table of Contents

1 Important Safety Information

1.1 Explanation of symbols

The symbols below are used throughout this publication to alert you to potential hazards involved with the operation and installation of this product. Observe these warnings and notices carefully. The safety alerts alone cannot eliminate hazards; strict compliance with any special instructions during installation, operation, and maintenance, along with common sense operation, are important measures to prevent hazardous situations.

DANGER!
Safety instruction: Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING!
Safety instruction: Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Safety instruction: Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE!
Indicates a situation that, if not avoided, can result in property damage.

NOTE
Supplementary information for operating the product.

1.2 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 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: 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 traveling 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:

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and reproductive harm.

Wash hands after handling.

2 Technical Specifications

General	
Rating	40,000 to 90,000 BTU/hr. (11.7 to 26.0 kW)
Operating voltage range	10 to 30 VDC
Power consumption	100 W max.
Fuel consumption	0.39 gph @ 40,000 BTU/hr. (1.47 l/hr @ 11.7 kW) 0.86 gph @ 90,000 BTU/hr. (3.26 l/hr @ 26.0 kW)
Coolant flow	12 US gpm (45 lpm)
Coolant temperature (max. at heater)	+185°F (85°C)
Operating temperature range	40°F to +122°F (-40°C to +50°C)
Ignition type	Electronic spark ignition
Heat exchanger capacity	0.5 US gal (2 l)
Dry weight	36.7 lbs (16.7 kg)
Dimensions	23.1 x 9.9 x 9.3 inches (588 x 252 x 237 mm)
Warranty	Two years parts and labour

DANGER!
Do not use gasoline.

Fuel types	
Compatible	Diesel (ULSD #1, #2 and arctic blend), kerosene (K-1), Jjet (A, A-1 and JP-8), renewable diesel, and bio fuels up to B20*

System outputs	
Switch/timer power	Same as voltage Maximum 1 A draw (overload shutoff protection) High-side switched
Indicator light	Same as voltage Maximum 1 A draw (overload shutoff protection) High-side switched

System inputs	
Switch	12 to 24 VDC Standard mode Preheat mode (momentary) Supplemental mode Antifreeze mode Supplemental priority, supplemental max. heat, global low temperature mode
Power	10 to 30 VDC
CAN bus	Meets SAE J1939-11

2.1 Physical

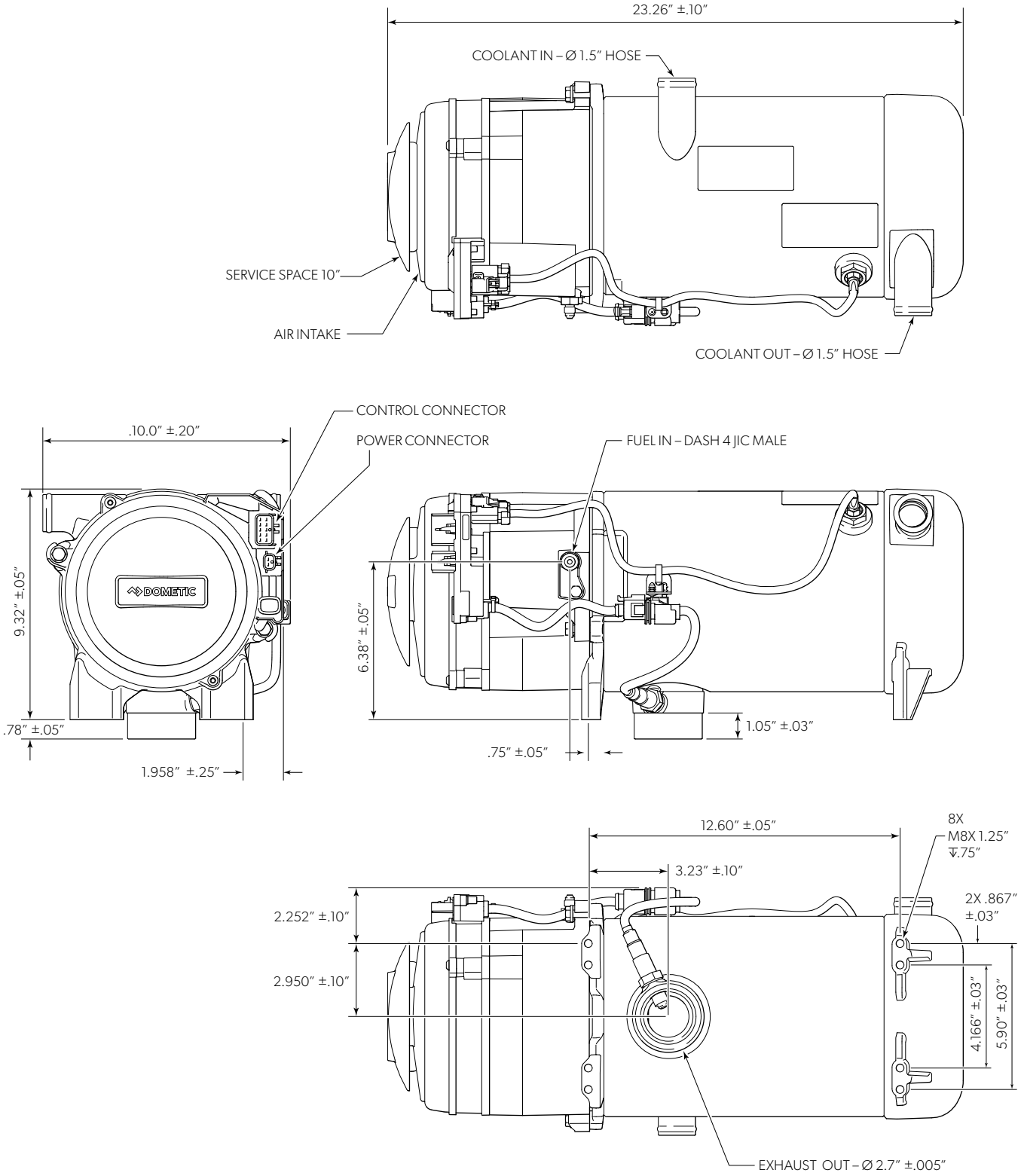


Figure 2-1.

2.2 Electrical

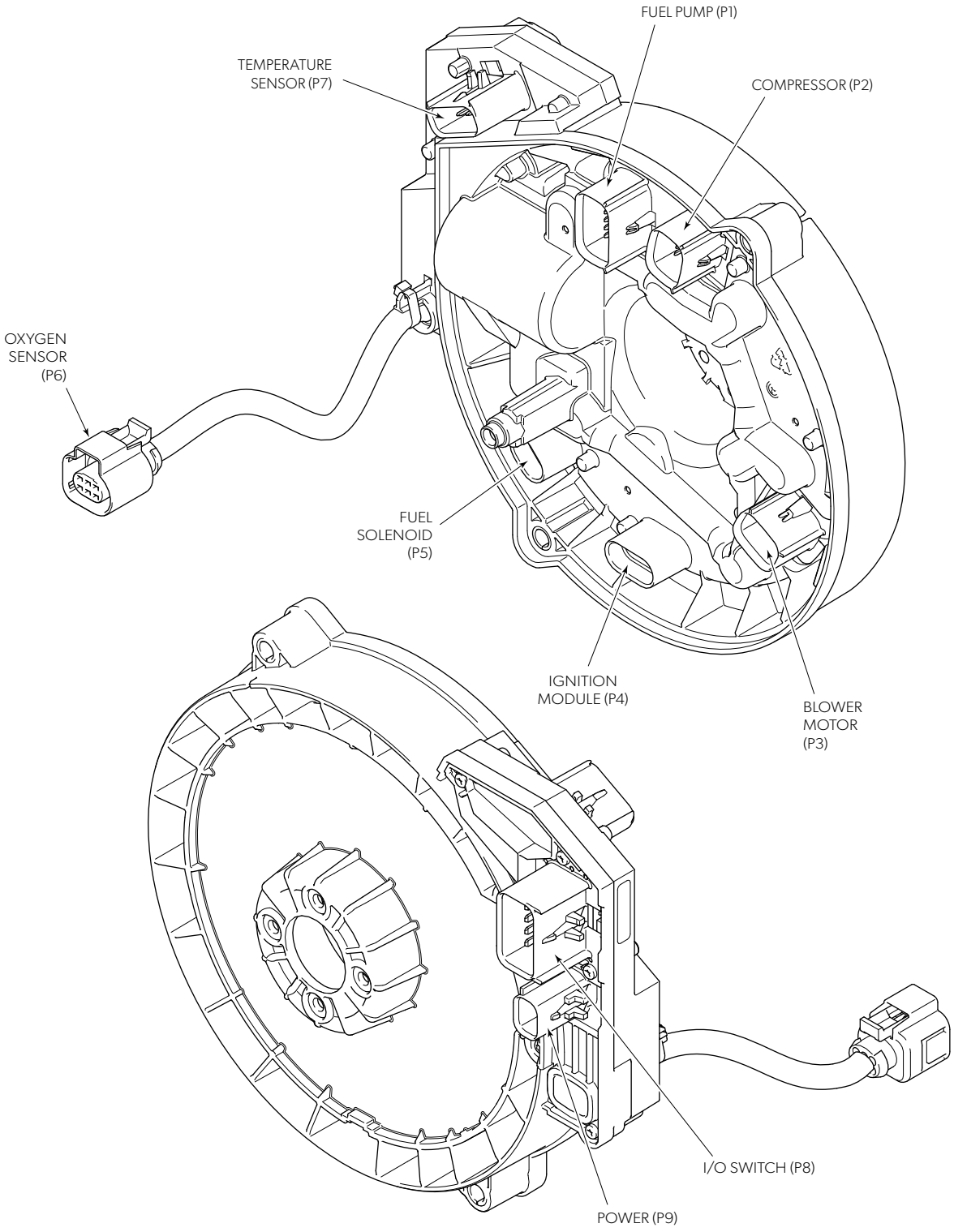
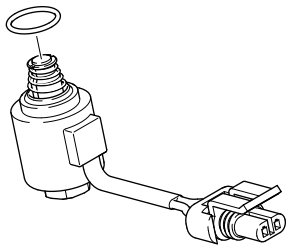


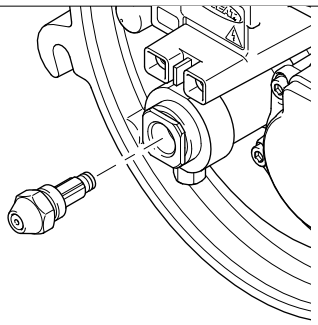
Figure 2-2.

2.3 Torque specifications



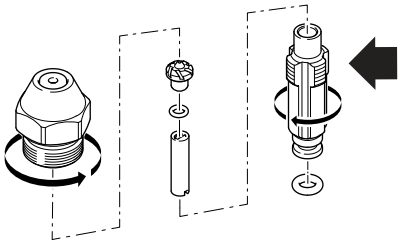
Solenoid valve

- Lubricate O-ring with diesel fuel
- Install solenoid valve by hand
- Ensure poppet and spring remain in place during assembly
- Torque solenoid valve to fuel pump to 25±3 in-lbs



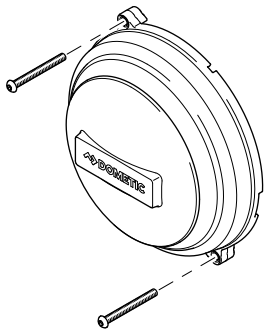
Nozzle

- Lubricate O-ring on nozzle with diesel fuel
- Torque nozzle to nozzle holder to 150±10 in-lbs



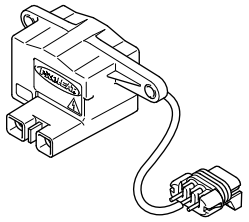
Nozzle assembly

- Torque nozzle to 25-30 in-lbs



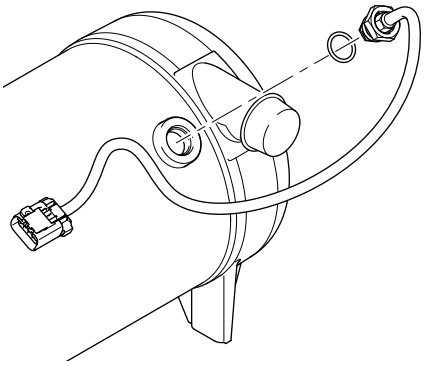
Blower housing

- Torque to 75±5 in-lbs



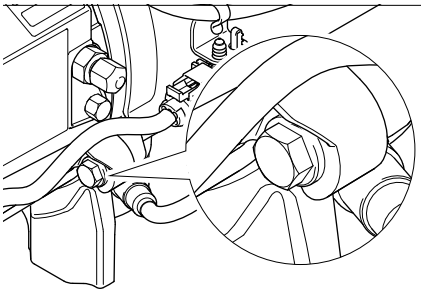
Ignition module

- Torque to 75±5 in-lbs



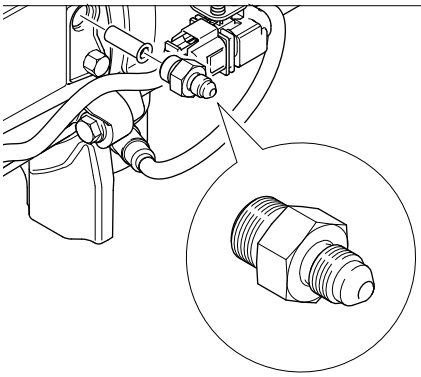
Dual mode temperature sensor

- Torque to 100±10 in-lbs



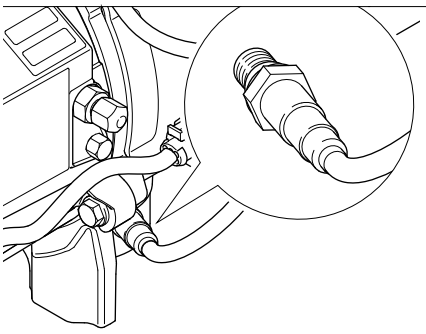
Burner head/heat exchanger

- Torque to 100±10 in-lbs



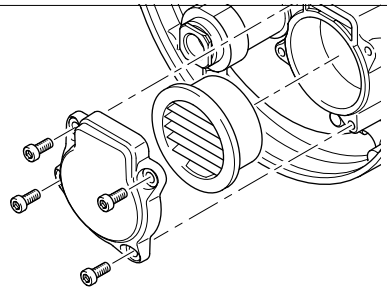
Fuel filter fitting

- Torque to 250±10 in-lbs



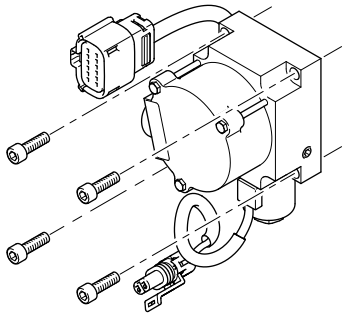
Oxygen sensor

- Torque to 100±10 in-lbs



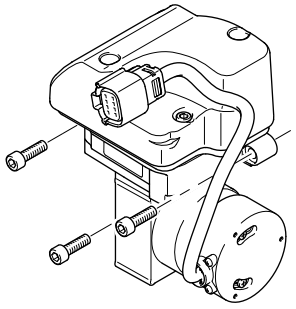
Air filter

- Torque to 27±3 in-lbs



Fuel pump assembly

- Torque to 75±5 in-lbs



Air compressor assembly

- Torque to 75±5 in-lbs

3 Principle of Operation

3.1 Component description

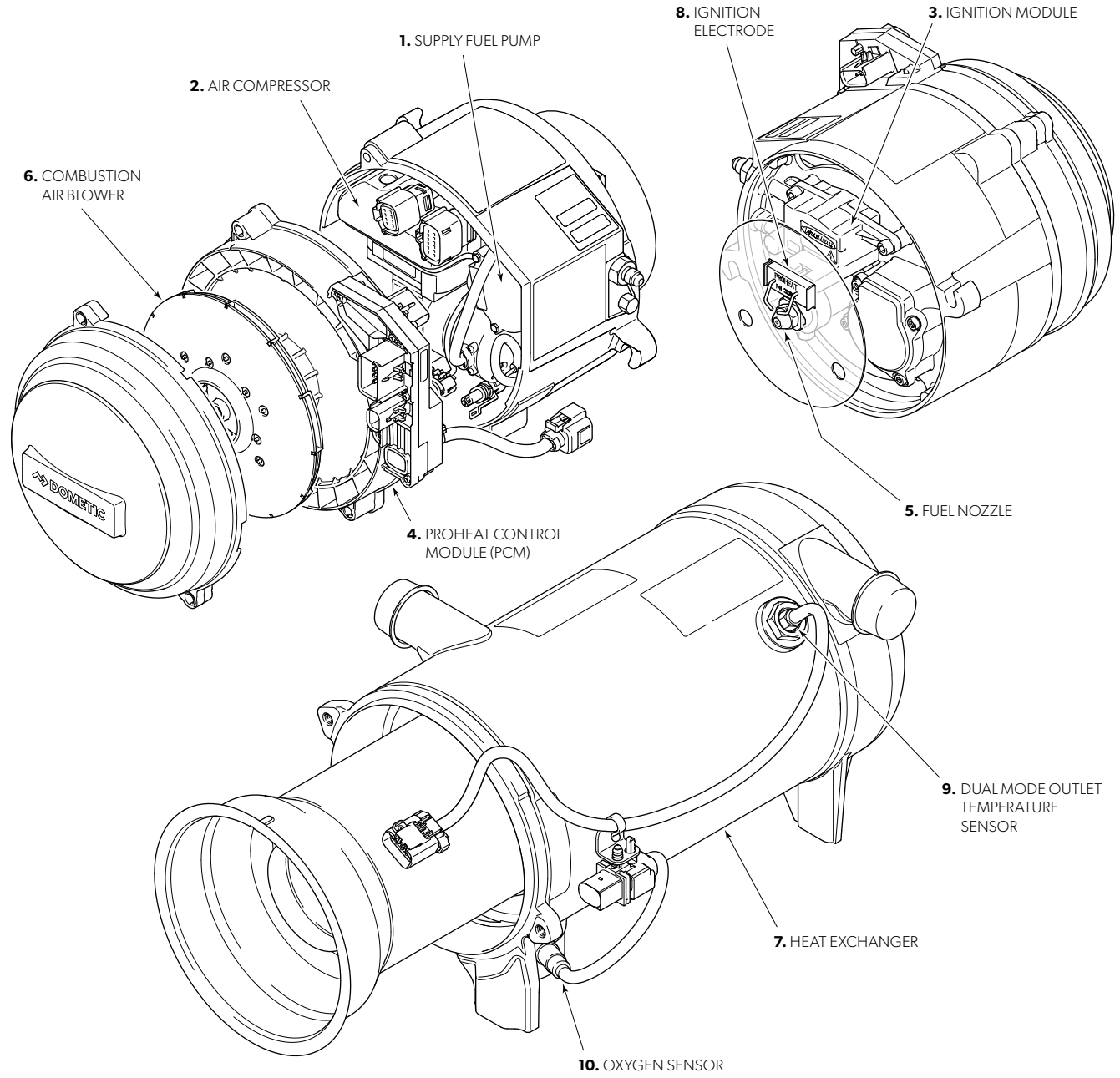


Figure 3-1. Proheat Variable M-Series heater.

1. Supply fuel pump A positive displacement, gear-type pump that draws fuel from the vehicle fuel tank and supplies a metered amount to the fuel nozzle. Fuel is filtered at the fuel pump inlet. Pressure is regulated by means of an internal relief valve.

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

3. Ignition module A spark ignition module supplies high voltage to the ignition electrodes

4. 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 indication function and component problems.

NOTE
See "Modes of Operation section" for a description of the operating modes used.

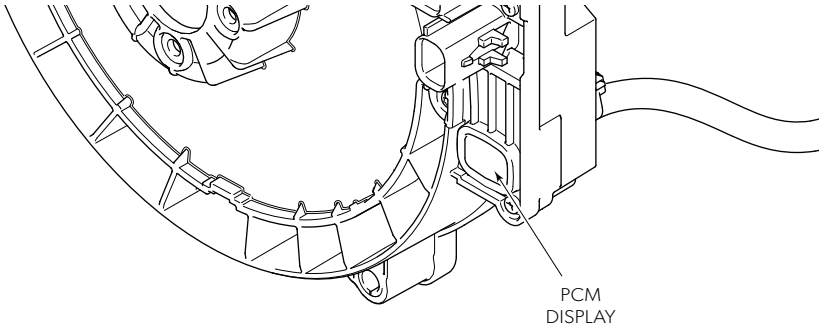


Figure 3-2. LED will light to indicate a problem. Switch or timer indicator light will flash to indicate the diagnostic code (page 4-3).

5. Fuel nozzle

An air/fuel aspirating-type spray nozzle is located inside the burner head. The compressed air flows through the nozzle at high speed creating a venturi effect. This siphons fuel supplied by the fuel pump and combines it with the air, creating an extremely fine mist that is sprayed out of the nozzle into the combustion chamber.

6. Combustion air blower

Uses an impeller-type fan to supply combustion air at low pressure. It is also used to cool and purge the combustion chamber during the shut-down sequence.

7. Heat exchanger

Coolant is circulated through the heat exchanger via the inlet and outlet ports. Heat is transferred from the heat exchanger fins through the inner wall of the heat exchanger and into the coolant. The exhaust gases are directed out through the exhaust port.

8. Ignition electrode

The electrode is located near the nozzle just out of the air/fuel mixture path. During the ignition sequence, the spark jumps a gap between the electrodes, igniting the air/fuel mixture, and is then turned off. Spark duration is up to 60 seconds.

9. Dual mode outlet temperature sensor

Measures the coolant temperature near the outlet port of the heat exchanger and sends this information to the PCM. The dual mode sensor contains both digital and analog sensing elements for more accurate and reliable measurements. The sensor also touches the inner heat exchanger surface to measure the heat exchanger temperature for an overheat condition.

WARNING!
The dual mode temperature sensor must be properly installed in the heat exchanger at all times for overheat protection.

10. Oxygen sensor

Located in the exhaust outlet of the heat exchanger. Provide continuous feedback to the PCM.

11. 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 blinking red light indicates that a diagnostic code is being displayed on the PCM (see figure 3-3).

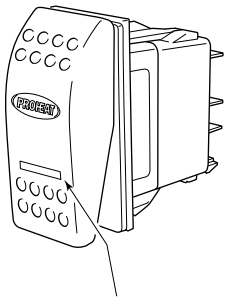


Figure 3-3. On/Off rocker switch.

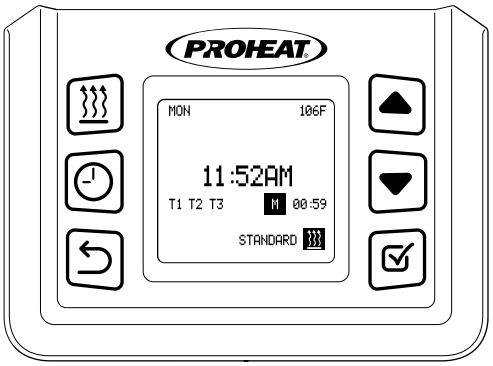


Figure 3-4. Optional Proheat Function Controller (PFC).

12. Optional Proheat Function Controller (PFC)

CAN bus enabled, multifunction controller that includes multiple programmable timers, error code reading and system programming.

NOTE
An On/Off switch or a PFC should be used, not both.

3.2 Theory of operation

1. Fuel supply system

The purpose of the fuel pump is to deliver a metered amount of clean, air-free fuel to the nozzle.

As the fuel pump motor turns, it drives a positive displacement gear type pump. The fuel pump draws (under vacuum) fuel from the fuel tank through the fuel line. The fuel then enters a filter screen located inside the burner head after the fuel inlet fitting. The fuel then enters the fuel pump and is pressurized. The fuel enters the nozzle via the fuel solenoid valve.

2. Air compressor

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

As the compressor motor turns, it drives a diaphragm type compressor. The compressor draws fresh air through an air filter located inside the burner head. It is then compressed and delivered to the nozzle in the burner head via internal passages.

3. Fuel control system (feedback)

The purpose of the fuel control system is to maintain optimal combustion chamber conditions.

An oxygen sensor located in the exhaust outlet of the heat exchanger provides continuous feedback to the PCM. The PCM uses this data to continuously meter the fuel/air ratio in the combustion chamber by way of adjusting the fuel pump motor speed.

The fuel is always matched to the available oxygen in the combustion chamber.

4. Nozzle

The purpose of the nozzle is to supply combustible fuel to the combustion chamber.

The compressed air (by way of the compressor's internal passage) travels over the body of the nozzle. As it reaches the end of the nozzle, it passed through a restriction. This creates a negative pressure or venturi effect.

This negative pressure extends back through the center of the nozzle all the way to the fuel solenoid valve. The compressed air and fuel are then mixed at the end of the nozzle into a very fine mist of fuel and air that is sprayed into the combustion chamber in the shape of a cone.

NOTE
The compressed air flowing over the nozzle is not sufficient for clean combustion.

5. Combustion air system

The purpose of the combustion air system is to deliver a metered amount of air to the combustion tube (chamber). 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 is sometimes used to draw air from a clean source. The air is then directed into the combustion tube. The combustion tube is shaped in such a way that it causes the air to swirl into the combustion chamber. 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° 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 enter the exhaust system and are read by the oxygen sensor, then are directed away from the vehicle.

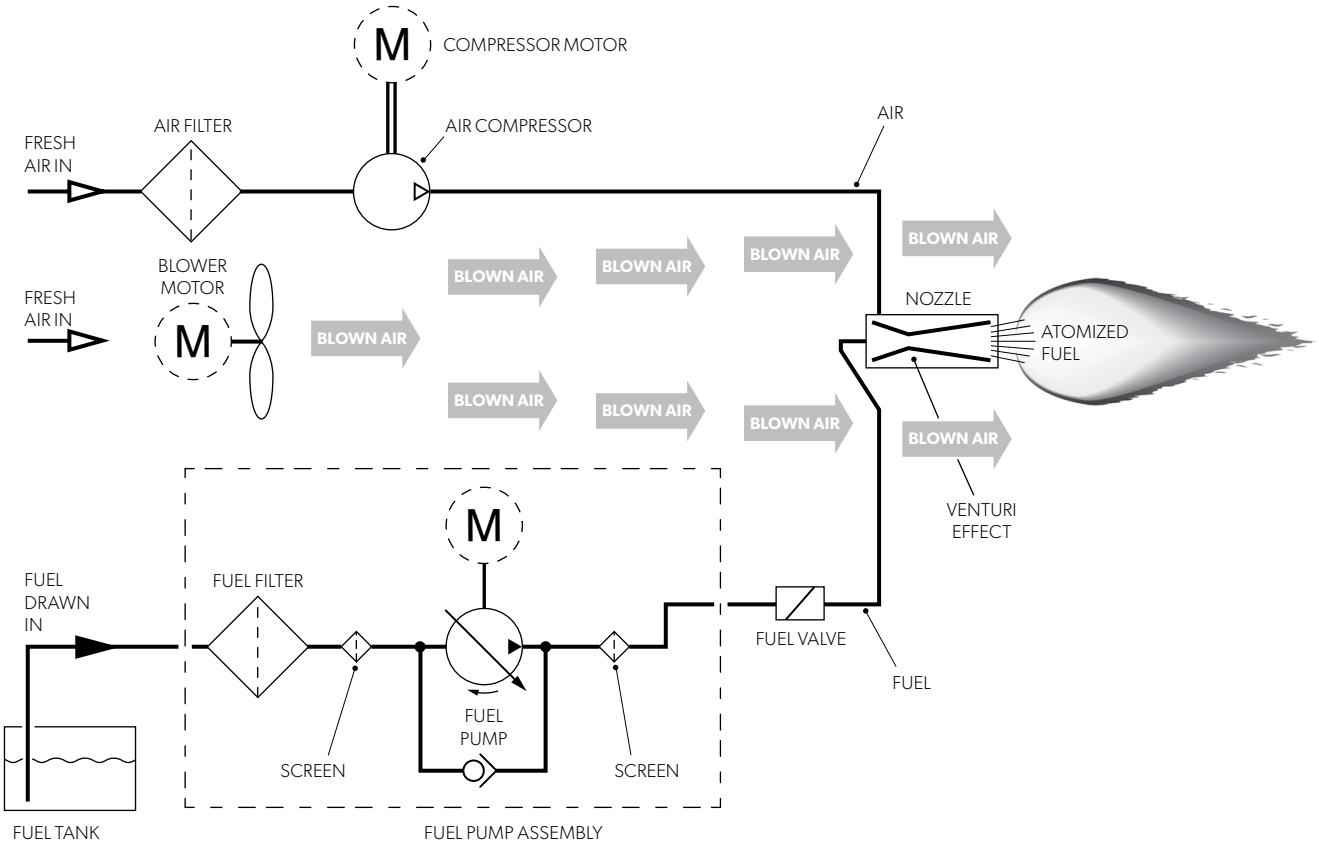


Figure 3-5. Fuel delivery theory of operation.

3.3 Modes of operation

The Proheat Variable M-Series has five modes of operation: standard, supplemental, preheat, and anti-freeze. For a general description of the modes, see heater modes starting below.

Combo Mode

- normal operation of the Proheat

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 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

* Optional I/O programing required for these mode features.

3.3.1 Combo mode

When used in "Combo Mode" with an E-Series heater, the Variable M-Series heater will control the E-Series heater as required

3.3.2 Standard mode

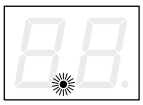
1. Switch "ON" standard mode signal — On/Off switch lamp, timer or OEM indicator (installation options) will light green. In addition, the PCM ON Indicator will light. If the coolant temperature is below 150°F (65°C) the Proheat enters Pre-check. If the coolant temperature is above 150°F (65°C) the Proheat 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 Pre-Ignition.

3. Pre-ignition — Fuel valve starts to cycle, followed by the heated oxygen sensor warm-up phase. The blower starts to turn followed by the compressor.

4. Ignition — The ignition spark is turned on and then the blower and compressor speed is increased. Once the heater senses a good flame, the Proheat goes to full output and turns the Ignition off.

5. 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), this is indicated on the Proheat Control Module (PCM).



6. 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.

7. 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 Pre-check and repeat steps 2 to 7. The Proheat will continue to repeat steps 2 to 5 until it is switched "OFF."

8. 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."

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 and Repair manual)
- the Proheat is operating at full output when it is shut "OFF"

3.3.3 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.

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 30 seconds 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.

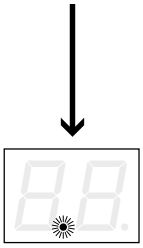
4. Pre-check The PCM performs a short diagnostic cycle. This takes a few seconds to check components for proper ranges, checking for the presence of a flame, short-circuits, and open circuits. If there are no errors indicated, the Proheat goes to Pre-ignition.

5. Pre-ignition Fuel valve starts to cycle, followed by the heated oxygen sensor warm-up phase. The blower starts to turn followed by the compressor.

6. Ignition The ignition spark is turned on and then the blower and compressor speed is increased. Once the heater enters closed loop and senses 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 185˚F (85°C)*† at the heater outlet. The Proheat shuts the flame off and goes to Cool down (purge), this is indicated on the Proheat Control Module (PCM).

** Factory Setting.* *† In modulation the temperature may rise 9°F (5°C) past the setting.*



8. 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 8.

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

9. Remove supplemental signal for five seconds

The "ON" light and the heater indicator turn off after five 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,".

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 and Repair manual)
- the Proheat is operating at full output when it is 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).

3.3.4 Optional preheat mode

1. Activate preheat signal

Push the preheat button and the PCM "ON" LED light will turn on. The Proheat goes to Pre-check.

2. 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 Pre-ignition.

3. Pre-ignition

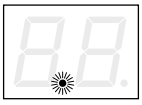
Fuel valve starts to cycle, followed by the heated oxygen sensor warm-up phase. The blower starts to turn followed by the compressor.

4. Ignition

The ignition spark is turned on and then the blower and compressor speed is increased. Once the heater enters closed loop and senses a good flame, the Proheat goes to full output and turns the Ignition off.

5. 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).



6. 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.

** Factory Setting.* *† In modulation the temperature may rise 9°F (5°C) past the setting.*

7. 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 Pre-check and repeats steps 2 to 7. The Proheat will continue to repeat this cycle until it is switched off, or will switch "OFF" automatically after 90 minutes.

8. 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.

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 and Repair manual)
- the Proheat is operating at full output when it is shut "OFF"

3.3.5 Optional anti-freeze mode

1. Switch "ON" anti-freeze mode signal

The "ON" light and heater indicator will turn "ON" after receiving the signal.

2. Anti-freeze Standby

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

3. Pre-run

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. 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.

6. Pre-ignition

Fuel valve starts to cycle, followed by the heated oxygen sensor warm-up phase. The blower starts to turn followed by the compressor.

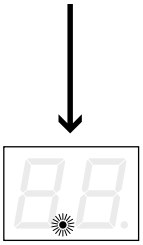
7. Ignition

The ignition spark is turned on and then the blower and compressor speed is increased. Once the heater enters closed loop and senses a good flame, the Proheat goes to full output and turns the Ignition off.

8. Full output

The Proheat runs at full output until the coolant temperature reaches 68˚F (20°C)*† at the heater outlet. The Proheat shuts the flame off and goes to Cool down (purge), this is indicated on the Proheat Control Module (PCM).

** Factory Setting.* *† In modulation the temperature may rise 9°F (5°C) past the setting.*



9. 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 9 until switched off.

10. 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.

NOTE

The Proheat will Cool down (purge) for 3 reasons:

- the coolant reaches 68˚F (20˚C)*†
- there is a function or component problem (See troubleshooting and repair manual)
- the Proheat is operating at full output when it is shut "OFF"

** Factory Setting.* *† In modulation the temperature may rise 9°F (5°C) past the setting.*

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4 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 are indicated by means of a blinking diagnostic 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 blinking diagnostic code (e.g., blown fuse, smoking exhaust, backfiring, or low heat output. Go to page 4-37.)

4.1 Troubleshooting a problem

1. Locate the Proheat and visually check for any problems with wiring harnesses, fuel leaks, coolant leaks, exhaust pipe damage, and environmental conditions.
2. Inspect the display of the Proheat Control Module (PCM) for the error code.
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.

- 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 continuously. The Proheat will try again once the switch is turned "OFF" and then "ON" again.
- If the Proheat runs but is not performing or operating correctly, consult the operational problems, section 4.6 on page 4-37.

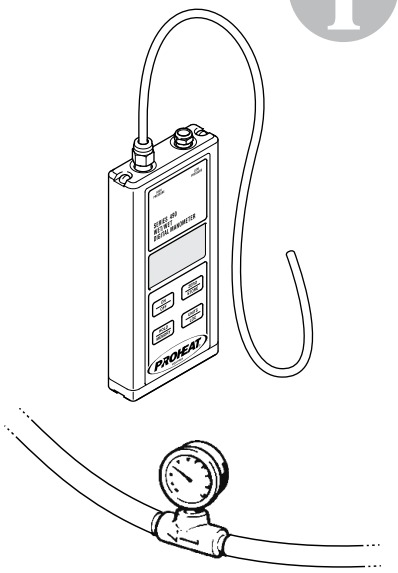


Figure 4-1. Troubleshooting tools.

Troubleshooting and repair tools required

- Digital air compressor test gauge (Proheat P/N PK0036). Allows the service technician to check compressor pressure in order to ensure correct fuel delivery.

The analog air pressure gauge PK0067 can also be used.

4.2 Operation indicators, function and component diagnostics

7 Segment Display — 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.

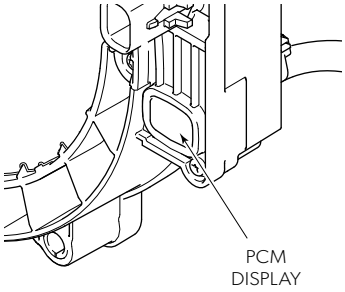
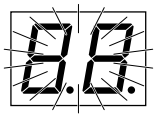


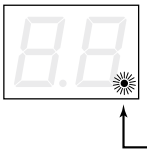
Figure 4-2. 7 Segment display.

Power Up



The power up indicator communicates that the Proheat power has been supplied. All segments of the LED momentarily blink "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/CAN



The ON indicator code communicates:

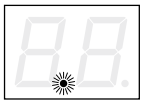
On solid – Heater is switched on via analog switch inputs and is operating normally.

Off then two blinks then off again – Heater is connected to CAN Bus network and is communicating on the network but is not switched on.

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

WARNING!
The "ON" LED indicates that the heater can start at any time.
Refer to page 3-5 to page 3-9.

Cool Down



The Proheat will be in the Cool down (purge) state as defined in Modes of Operation (see page 3-6).

Diagnostic codes:

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 blink. (See page 3-5 for a complete list of operation states and error codes.)

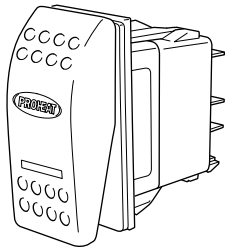
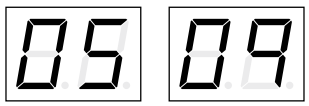


Figure 4-3. Remote on/off rocker switch.



If multiple errors occur, multiple codes will be displayed. For example, if a 5 and 9 error occurs together, the PCM display will display 5 and then 9.

NOTICE! LOCKOUT MODE
After 6 consecutive start faults (code 01) or on the first occurrence of Overheat (code 04) the Variable M-Series PCM will go into Lockout mode, Power to the Variable M-Series PCM must be removed and reapplied to exit Lockout mode.

	Operating State	Display Code No.	Description
Function Diagnostics	Configuration	CC	Configuration error
	Start	1-1	Start O_2 low
		1-2	Start O_2 high
		1-3	Start optical flame low
	Flame out	2-1	Flame out O_2 low
		2-2	Flame out O_2 high
		2-3	Flame out optical flame low
		2-4	Flame out fuel pump RPM low
		2-5	Flame out unstable
	Coolant flow	3-1	Coolant flow
	Overheat	4-1	Overheat — coolant
	Voltage	5-1	Under voltage
		5-2	Over voltage
		5-3	Surge voltage
	Flame	6-1	Flame fault

	Operating State	Display Code No.	Description
Component Diagnostics	Temperature sensor	7-1	Outlet analog temperature sensor short circuit
		7-2	Outlet analog temperature sensor open circuit
		7-3	Outlet digital temperature sensor comm failure
		7-4	Outlet temperature sensors reading mismatch
	Fuel pump and valve	8-1	Fuel pump driver fault/short circuit
		8-2	Fuel pump overload
		8-3	Fuel pump open circuit
		8-4	Fuel pump speed
		8-5	Fuel pump damaged
		8-6	Fuel pump calibration failed
		8-7	Fuel valve short circuit
		8-8	Fuel valve open circuit
		8-9	Fuel valve uncommanded
	Compressor	9-1	Compressor driver fault/short circuit
		9-2	Compressor overload
		9-3	Compressor open
		9-4	Compressor speed
		9-5	Compressor fault
	Ignition module	10-1	Ignition module short circuit
		10-3	Ignition module open circuit
	Blower motor	12-1	Blower driver fault/short circuit
		12-2	Blower overload
		12-3	Blower open
		12-4	Blower speed
		12-5	Blower fault

Table 4-1. Function display panel detail and error flash codes.

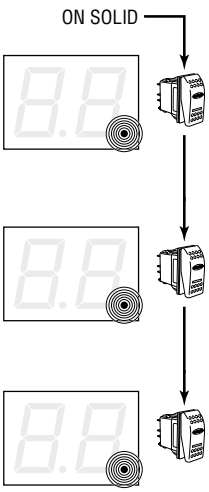
Component Diagnostics

Operating State	Display Code No.	Description
System current	16-1 16-2	System current short circuit System current overload
Oxygen sensor	17-1 17-2 17-3 17-4	O_2 Sensor fault O_2 Sensor out of range O_2 Sensor response O_2 Sensor near end of life
CAN bus	18-1	CAN bus error
PCM temp	19-1	High PCM temperature
Output 1	21-1	Output 1 short circuit (J1-1)
Output 2	22-1	Output 2 short circuit (J1-2)
Output 3	23-1	Output 3 short circuit (J1-3)
Output 4	24-1	Output 4 short circuit (J1-4)
Output 5	25-1	Output 5 short circuit (J1-5)
Output 6	26-1	Output 6 short circuit (J1-6)
Impact switch	33-1	Impact switch active
PCM hardware	34-1 34-2	PCM fault Crash dump saved
PCM software	37-1	Software mismatch

Table 4-1 continued. Function display panel detail and error flash codes.

4.3 Example Proheat behavior error Code 01-1

The following is an example of an Variable M-Series 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 other modes). This sequence of events occurs for codes 01 through 18. Codes 19 through 26 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 PCM cover status LED, PCM segment "ON" LED, toggle switch, T-II timer red manual light or OEM indicator will light. The Proheat goes to precheck.

2. Pre-check

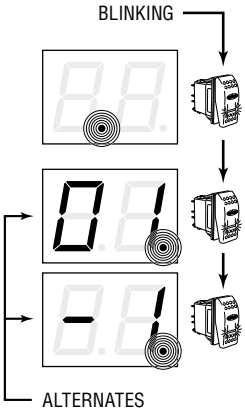
The PCM performs a short diagnostic cycle. This takes several seconds checking components for proper ranges, checking for the presence of a flame, short-circuits and open circuits. If there are no errors indicated, the Proheat goes to Pre-ignition.

3. Pre-ignition

The fuel valve starts to cycle, followed by the heated oxygen sensor warm-up phase. The blower starts to turn followed by the compressor and fuel pump.

4. Ignition

The ignition spark is turned on and then the blower and compressor speed is increased. Once the heater enters closed loop and senses a good flame, the Proheat goes to full output and turns the ignition off.



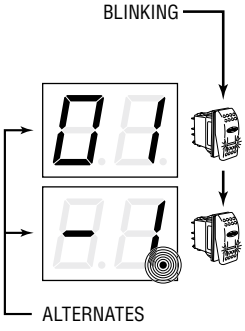
5. Error detection – purge

If the oxygen sensor does not detect 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 01-1 will be displayed. The PCM cover status LED, toggle switch, and timer red manual light or OEM indicator light will blink. After 3 minutes, the blower stops and the Proheat attempts to start again.

6. Steps 1 to 4 are repeated

The Proheat always restarts after one error detection. After the 3-minute Cool down (purge), the Proheat will go through Pre-check, Pre-ignition, Ignition and the error detection – Cool down (purge) cycle one more time.



7. Hold state

After two consecutive code 01 errors, the Proheat goes into a hold state. No further start attempts will be made. Code 01–1 will be displayed continuously and the PCM display "ON" light will turn "OFF."

The PCM cover status LED, toggle switch, T-II timer red manual light or OEM indicator light will continue to blink.

NOTE
To restart the heater, turn the toggle switch "OFF" and back "ON."

4.4 Function diagnostics

Function errors:

• Start • Flame Out • Coolant Flow • Overheat • 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.

Boot Loader

The Boot Loader is displayed if the PCM is powered up and is still in the factory programing mode.

- No heater operation will occur until PCM has been programed
- No response to Analog inputs or CAN commands
- No analog outputs will occur

Contact Proheat for further assistance.

Configuration

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

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

Contact Proheat for further assistance.

1 Start

Indicates that a Flame was not detected during the full 30 second ignition period.

The PCM can detect three types of no starts.

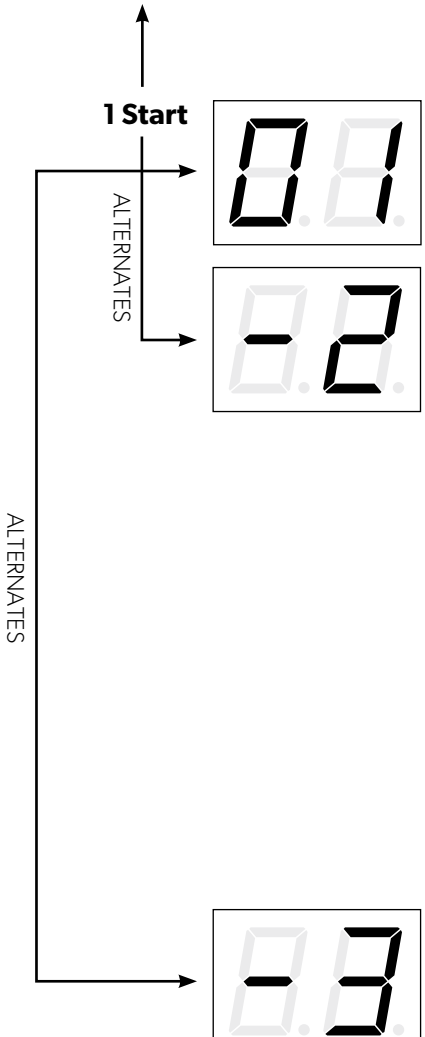
- 01-1, O_2 Low — Lack of combustion air
- 01-2, O_2 High — Lack of fuel
- 01-3, Optical flame not detected — O_2 values look normal however there is no flame detected by the optical flame sensor

ALTERNATES

ALTERNATES

01-1, O2 Low — Troubleshoot based on:

1. Combustion air supply
   - Check combustion air intake for damage or restrictions
   - Check combustion air blower for damage
   - Combustion chamber – dirty or clogged
   - Exhaust pipe — dirty, clogged, or damaged
2. Fuel valve
   - Faulty fuel valve causing internal leak
3. Ignition system
   - Weak or no sxpark (may cause the heater to flood with raw fuel)
4. Oxygen sensor
   - Fuel soaked oxygen sensor (flooded heater)
   - Faulty oxygen sensor



01-2, O_2 High — Troubleshoot based on:

1. Weak or no spark
   - If weak or no spark fuel vapor will be seen coming out from the exhaust
     See Ignition system on page 4-14.
2. Fuel supply to the Proheat
   Go to page 4-8 and perform fuel system check.
   - Check combustion air intake for damage or restrictions
   - Check combustion air blower for damage
   - Combustion chamber — dirty or clogged
   - Exhaust pipe — dirty, clogged, or damaged
3. Proheat fuel delivery system
   - Fuel supply pump
   - Air compressor — pressure
   - Fuel pump — plugged or faulty
   - Nozzle — dirty or clogged
   - Oxygen sensor — dirty

01-3, Optical flame not detected:

1. Combustion air supply
   - Check combustion air intake for damage or restrictions.
   - Check combustion air blower for damage
   - Combustion chamber — dirty or clogged
   - Exhaust pipe — dirty, clogged, or damaged
2. Optical flame sensor
   - Check for obstructions on the flame eye and flame shield
   - Go to page 4-15 for optical sensor check

NOTICE!
After 6 consecutive start faults the Variable M-Series PCM will go into Lockout Mode. Power to the Variable M-Series PCM must be removed and reapplied to exit Lockout mode.

Fuel system schematic

The Proheat Variable M-series fuel system operates on a venturi-style atomizing nozzle technology. It operates similarly to a compressed air paint sprayer.

As shown in figure 4-4, 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 valve. The fuel valve then meters the fuel available to the nozzle. Compressed air flowing through the nozzle creates a venturi or suction effect that siphons fuel from the fuel valve.

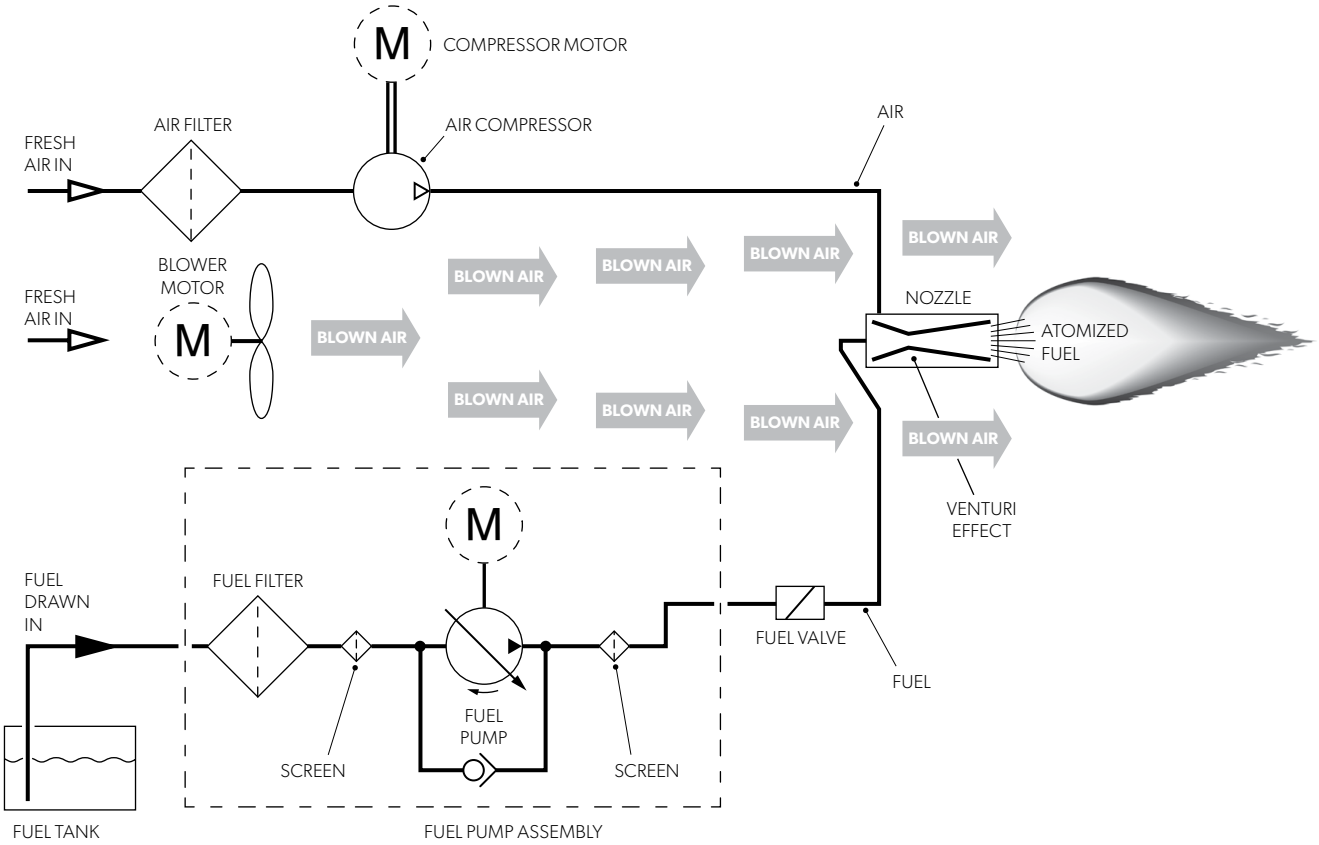


Figure 4-4. Fuel system schematic.

START
Fuel supply

Check:

See theory of operation on page 3-3 for fuel system schematic and description.

a) Vehicle fuel level and/or for fuel gelling during cold weather.
b) Air leaks and/or restrictions in the fuel supply lines to the Proheat.
c) The Proheat operation when supplying fuel from a direct source.

Check fuel system

Test procedure — Supplying fuel from a remote source:

1. Remove the fuel line from the fuel inlet at the Proheat fuel pump.
2. Using a length of fuel line connected from the Proheat fuel inlet to a direct source of clean fuel, switch the Proheat on and operate for at least one complete cycle. Observe the operation.

   If the Proheat functions correctly, the fault is in the vehicle fuel system. Check fuel lines, connections and routing back to fuel tank. Consult OEM for service requirements.

   If a Start diagnostic code is indicated, the problem is in the Proheat.

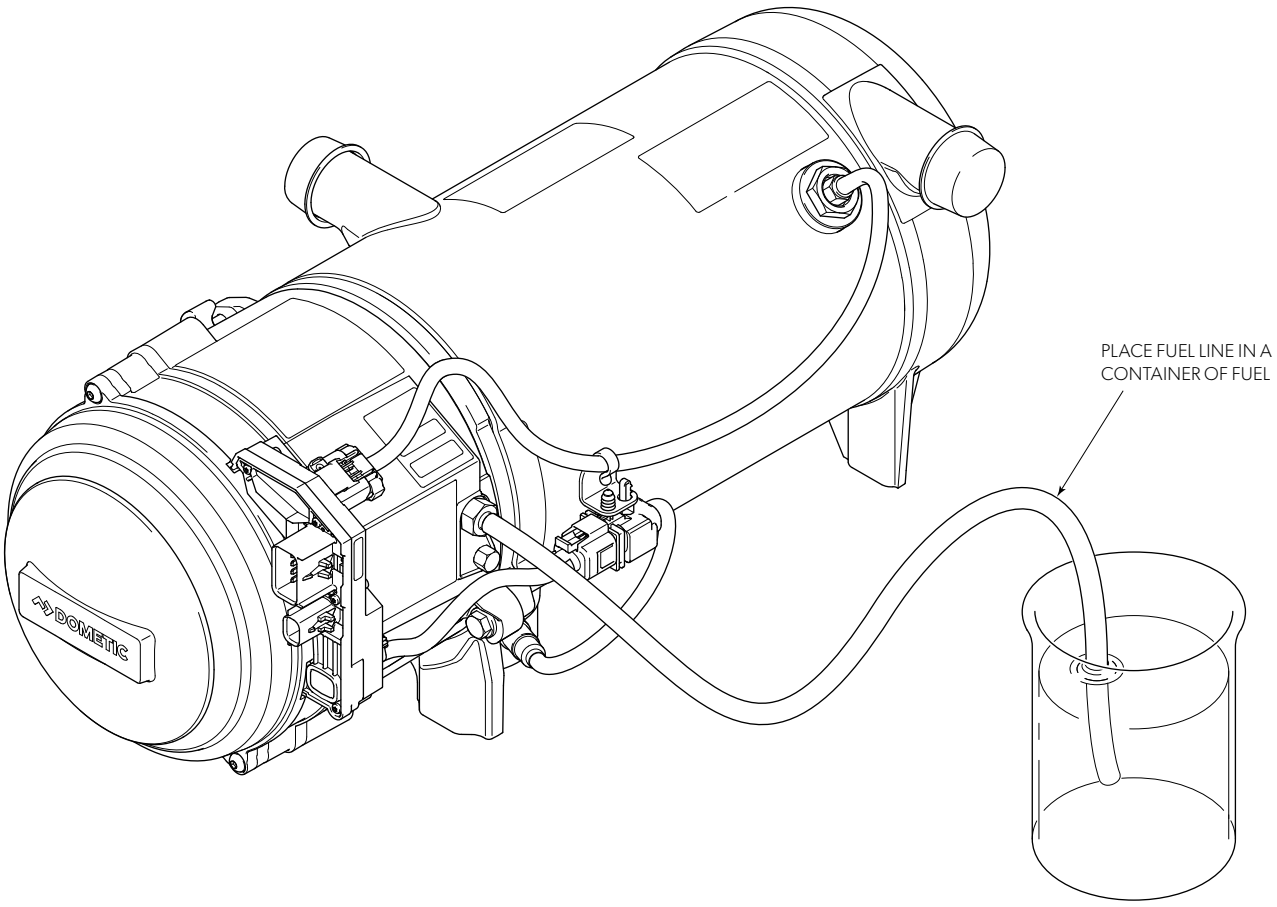


Figure 4-5. Remote fuel supply.

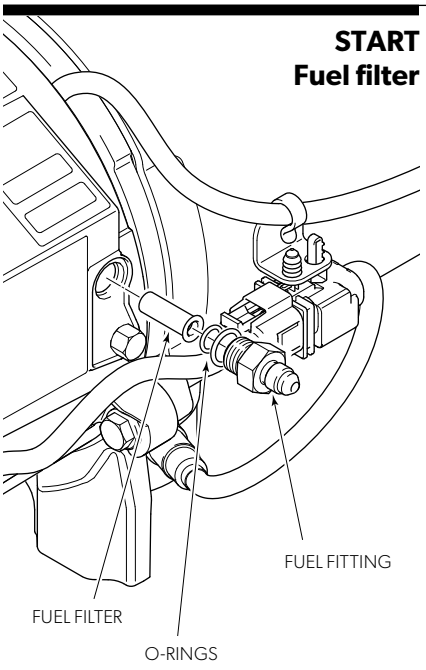


Figure 4-6. Variable M-Series fuel filter.

START
Fuel filter

Check:

a) Disconnect the fuel supply line at the Proheat.
b) Remove the fuel filter adapter and fuel inlet fitting located in the burner head.
c) Remove O-ring and filter. Inspect for contamination and/or restrictions. Clean filter using electrical contact cleaner or warm soapy water. Replace if necessary.
d) Inspect the O-rings for contamination and/or damage. Clean O-rings with a cloth or replace as necessary.
e) Inspect and clean the filter cavity and O-ring seat as necessary using contact cleaner.
f) Reinstall filter, O-rings and inlet adapter. Tighten the adapter until it bottoms out against the face.
g) Reconnect the fuel supply line.
h) Switch the Proheat on and operate for at least one complete cycle. Observe the operation.

START
Fuel nozzle

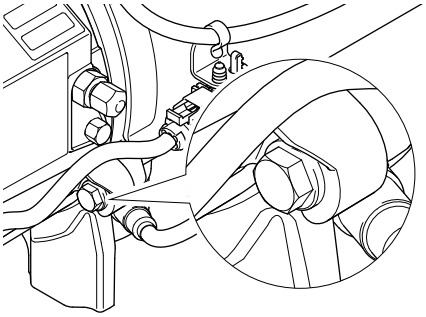


Figure 4-7. Burner head removal.

Check:

a) For fuel nozzle and O-ring damage and/or contamination.
b) For correct fuel nozzle. (Refer to parts manual.)

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

a) Disconnect all harnesses at the PCM.
b) Disconnect the fuel lines.
c) Remove the four burner head bolts, and remove burner head.
d) Remove fuel nozzle. Verify the fuel nozzle number ensuring it is the correct fuel nozzle for the Variable M-Series. Disassemble, inspect, clean, and reassemble fuel nozzle.

Fuel nozzle disassembly, inspection, cleaning and reassembly.

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

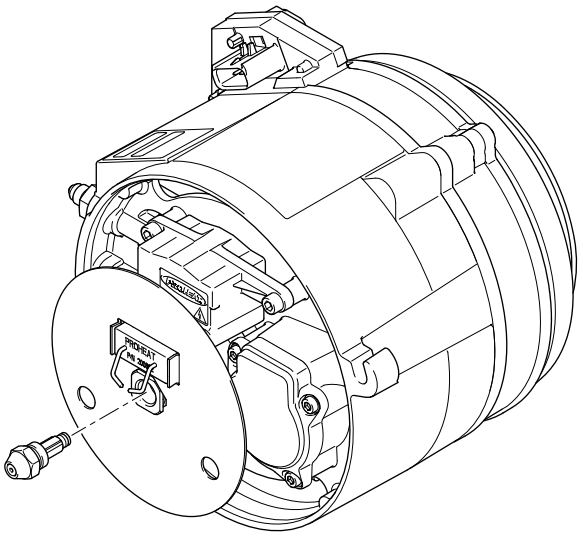


Figure 4-8. Nozzle removal.

f) Inspect the fuel nozzle cavity and clean as necessary using electrical contact cleaner or warm soapy water.
g) Reinstall the fuel nozzle using diesel fuel to lubricate O-ring.
h) Reinstall the burner head by mounting it against the heat exchanger face and installing the three mounting bolts.
i) Tighten mounting bolts. See section 1.3 for torque.
j) Reconnect the electrical harnesses and fuel lines.
k) Switch the Proheat on and operate for at least one complete cycle. Observe the operation.

NOTICE!
Fuel nozzle parts are a matched set and not interchangeable.

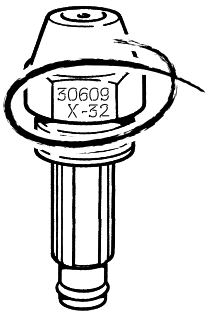


Figure 4-9. Nozzle number location.

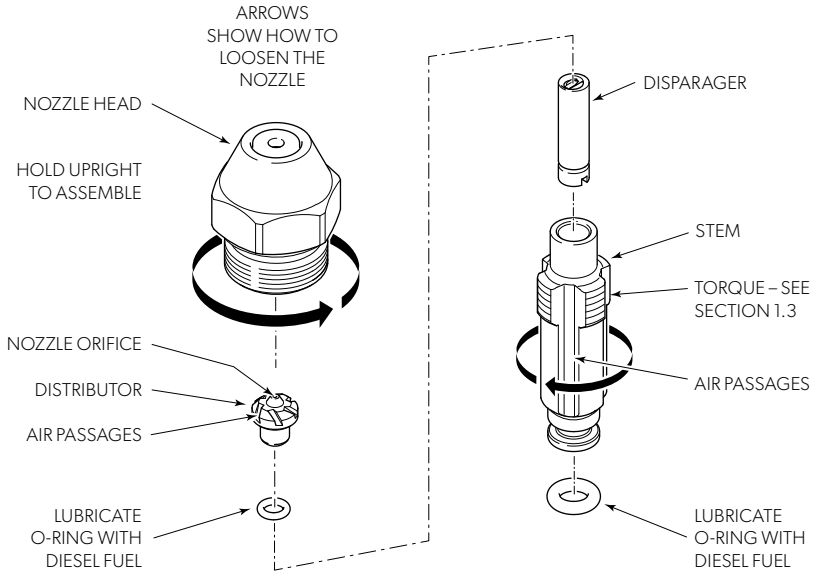


Figure 4-10. Fuel nozzle assembly.

NOTICE!
Do not use a tip cleaner in the fuel orifice.

START
Air compressor

Check:

a) Air compressor pressure and operation.
Before checking air pressure, remove and clean the fuel nozzle.

Air compressor filter check:

a) Disconnect all harnesses from the PCM.
b) Disconnect fuel supply line.
c) Loosen and back out the Burner Head mounting (2) bolts five to six turns allowing enough room to rotate the burner head 15° counter-clockwise and remove.
d) Remove air filter housing (4) screws.
e) Remove air compressor filter. Inspect for contamination and replace if necessary. Ensure filter is seated properly and reinstall cover.

Test procedure — Air pressure check:

Ensure nozzle is clean (see page 5-5) and the air compressor filter is clean (see page 5-5) before proceeding with air compressor check:

a) Disconnect all harnesses from the PCM.
b) Disconnect fuel supply line.
c) Loosen and back out the Burner Head mounting (2) bolts five to six turns allowing enough room to rotate the burner head 15° counter-clockwise and remove.

d) Remove the plug to the air pressure measurement port.

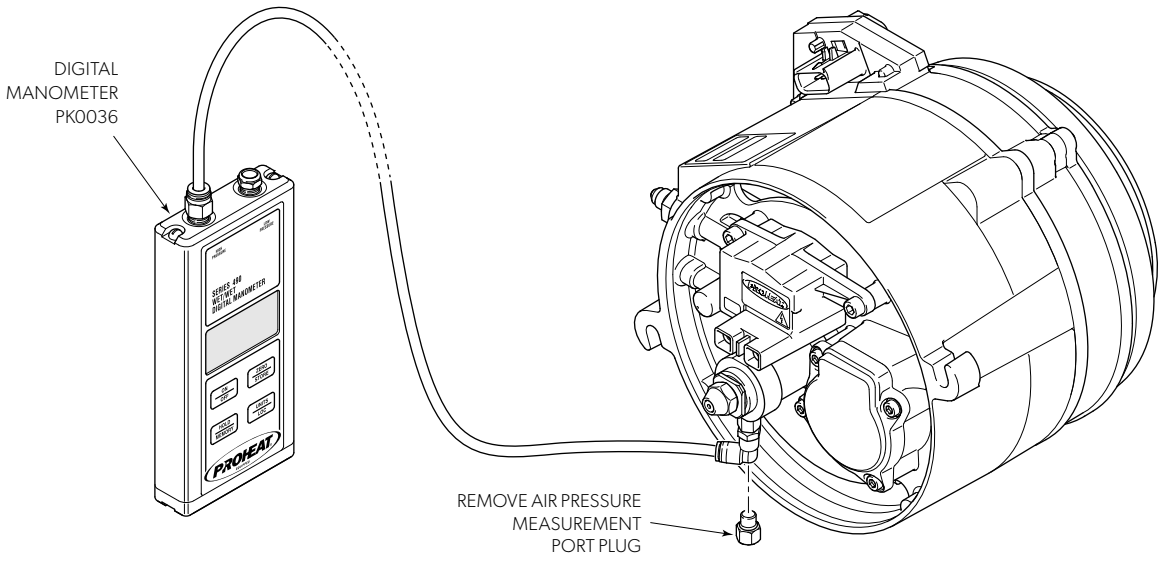


Figure 4-11.

e) Thread in the pressure gauge and torque to 25±3 in-lbs as shown in figure 4-11.
f) Reconnect the power and switch harnesses.

NOTE
The temperature sensor must be disconnected from the PCM for the to enter Ignition check mode.

g) Switch the heater on to standard mode for one full minute, then observe the air pressure. Expected range: 2.6 to 3.0 psi.
h) If the pressure is not within the above range and the air compressor filter and fuel nozzle are clean, replace the compressor. See www.proheat.com for the latest parts manual for more information.
i) Turn the heater off. Wait until the Cool down (purge) mode is complete (approximately 3 minutes).
j) Remove pressure gauge. Lubricate air measurement port plug O-ring with diesel fuel and reinstall plug. Torque to 25±3 in-lbs.

START
Fuel supply pump

Check:

a) Fuel supply pump pressure and operation.
Check fuel system supply (page 4-8) before checking fuel pressure.

Test procedure — Fuel pressure check:

a) Remove the fuel supply test port plug located beside the fuel inlet fitting.

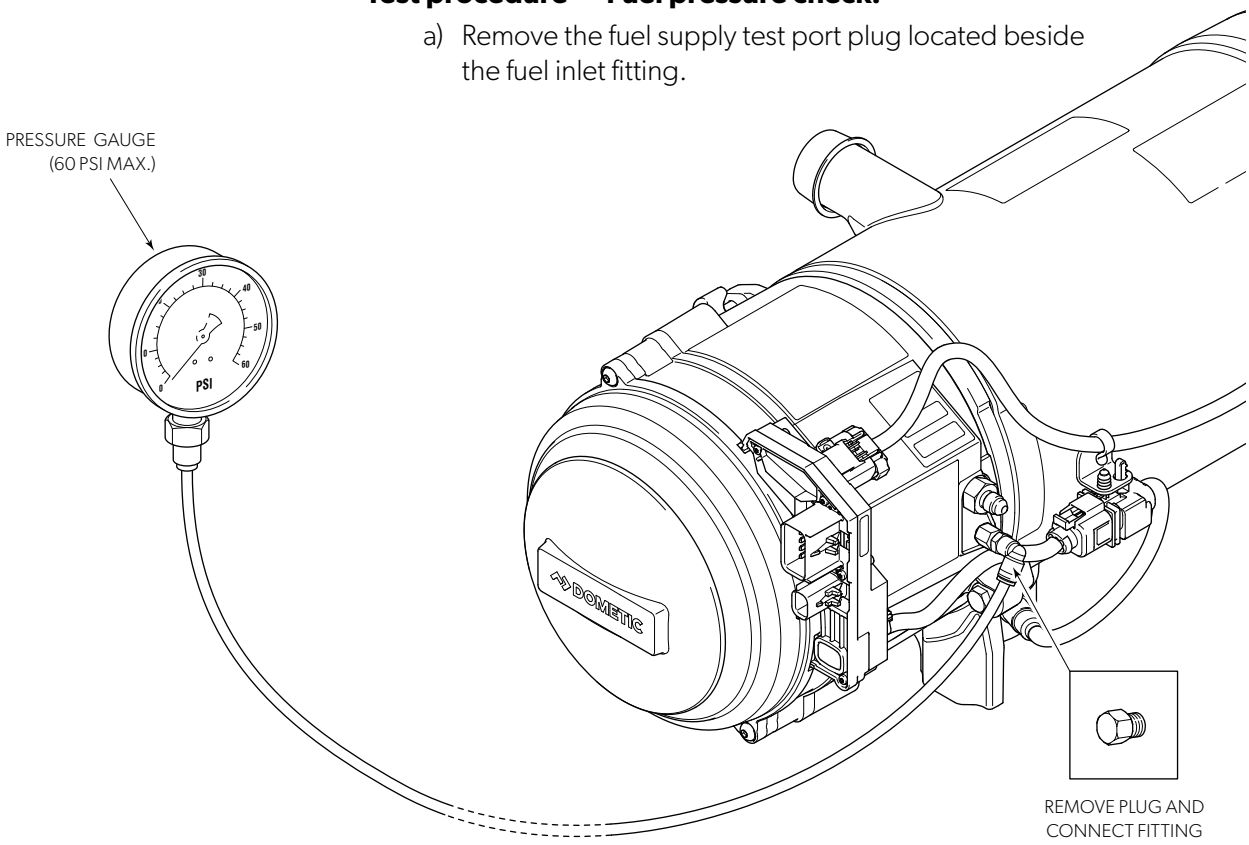


Figure 4-12.

b) Thread in the pressure gauge and torque to 25±3 in-lbs as shown in figure 4-12.
c) Switch the Proheat on and read the fuel pressure:
VM-series range 6 to 28 psi.
If the fuel pressure is below the lower limit and the fuel supply has been verified, replace the flange/fuel pump assembly.
If the fuel pressure is above the upper limit psi, clean or replace the fuel nozzle.
If the fuel pressure reads OK, review the ignition system troubleshooting.
d) Turn heater off. Wait until Cool down (purge) mode is complete (approximately 3 minutes).
e) Remove pressure gauge. Lubricate fuel measurement port plug o-ring with diesel fuel and reinstall plug. Torque to 25±3 in-lbs.

START
Ignition system

Check:

a) Ignition operation using Ignition check mode.
b) Ignition electrode check.

Test procedure — Ignition module spark check:

a) Disconnect all harnesses from the PCM.
b) Disconnect fuel supply line.
c) Loosen and back out the Burner Head mounting (2) bolts five to six turns allowing enough room to rotate the Burner Head 15° counter-clockwise and remove.
d) Check electrodes for carbon bridging and/or damage. Replace if necessary.
e) Reconnect power and switch harnesses only.

NOTE
The temperature sensor must be disconnected from the PCM for the to enter Ignition check mode.

f) Switch the Proheat on and observe the spark across the electrode tips. Spark will continue for five seconds.

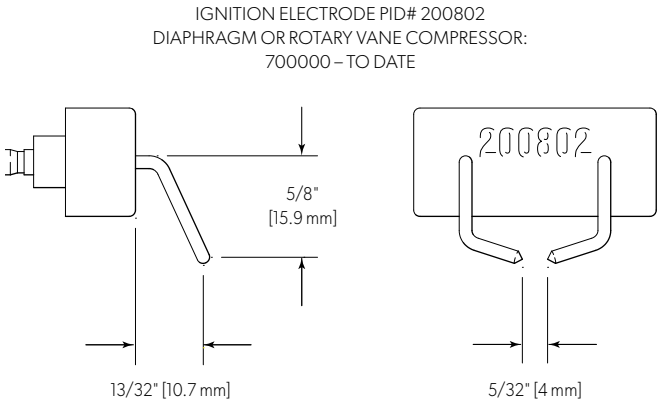


Figure 4-13.

START
Oxygen sensor and optical flame sensor

Check:

a) Inspect the oxygen sensor for damage.
b) Operation of the optical flame sensor.

Test procedure — Oxygen sensor

The Variable M-Series uses a five-wire heated wide-band oxygen sensor.

Testing of the oxygen sensor is beyond the scope of this manual and the sensor itself is non-repairable.

If you suspect an oxygen sensor issue, first perform a visual inspection of the sensor harness.

a) Inspect the PCM connector for damage and/or corrosion. Inspect the oxygen sensor harness and connector for damage and/or corrosion.
   If no damage or corrosion is found, replace the oxygen sensor.

Oxygen sensor replacement procedure:

a) Disconnect the power and switch harness from the PCM.
b) Disconnect the oxygen sensor from the PCM.

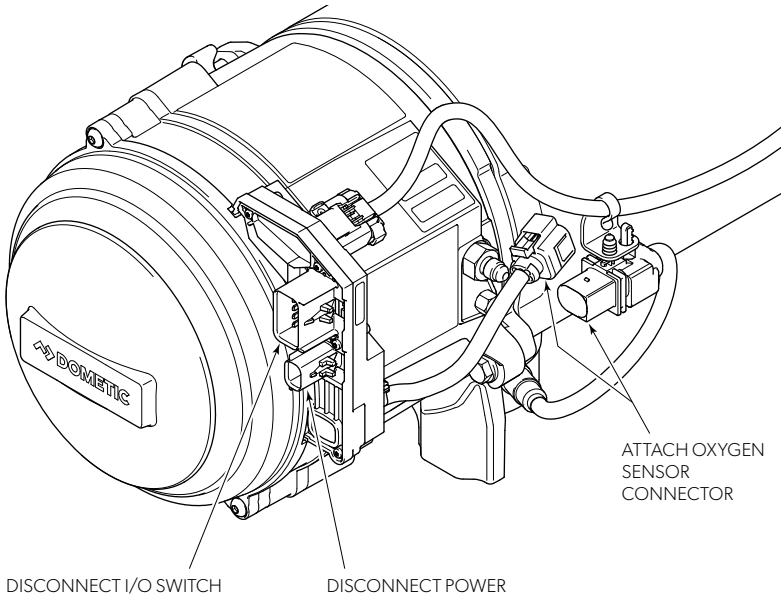


Figure 4-14.

c) Replace the oxygen sensor – Do not connect the new oxygen sensor harness to the PCM at this time.
d) With the power, switch and oxygen sensor harnesses still disconnected from the PCM, connect only the power harness for 30 seconds and then remove the power harness from the PCM.

NOTE
Viewing the heater event log with either the PFC or Datalink, you will now see an event called "Oxygen Sensor Replaced". This will also reset code 17-4.

Test procedure — Optical flame sensor

a) Disconnect all harnesses from the PCM.
b) Disconnect fuel supply line.
c) Loosen and back out the Burner Head mounting (2) bolts five to six turns allowing enough room to rotate the Burner Head 15° counter-clockwise and remove
d) Inspect the flame sensor and flame shield for contamination. Clean if necessary using electrical contact cleaner and a soft cloth.
e) Reconnect power and switch harnesses only.

NOTE
The temperature sensor must be unplugged to enter Ignition check mode (during the Ignition check mode the electrodes will spark for five seconds, then the heater will enter Cool down mode (purge) with the compressor running for 3 minutes).

f) During Cool down mode, direct a strobe light set at 1,500 rpm (25 Hz) at the optical flame sensor.
The Cool down mode will end immediately if the light is detected by the light sensor and the PCM display will show "LL". The "LL" will appear and disappear when light is applied and removed until the PCM is power cycled.

NOTE
The optical flame sensor is based on frequency and flashlights (such as a flashlight on a cell phone) will not register a "flame". If a strobe light is not available, a cell phone can be used with an app to flash the phone's LED light between 1,000 and 2,000 rpm.

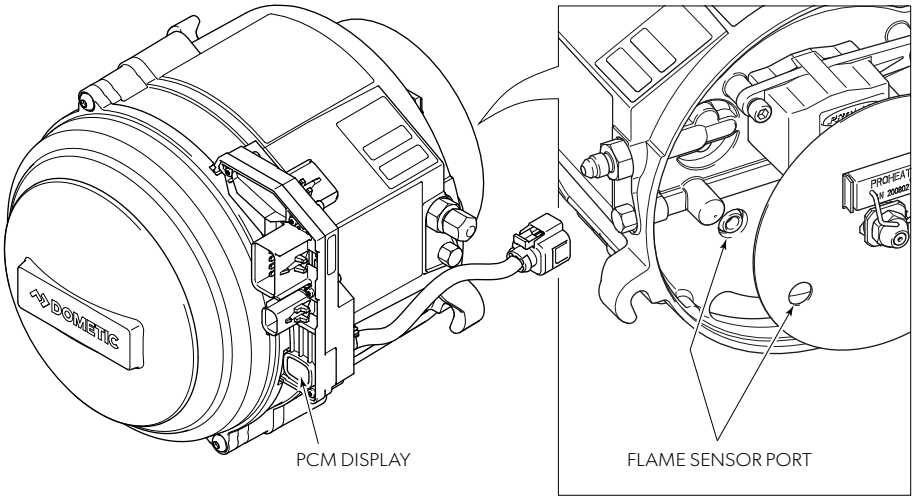


Figure 4-15.

2 Flame out

Indicates that a flame was detected but it could not be maintained or after being established the flame went out before reaching the cycle off temperature of 185°F (85°C) and could not be re-lit.

- 02-1, O_2 low – Lack of combustion air (too rich).
- 02-2, O_2 High – Lack of fuel (too lean).
- 02-3, O_2 values look normal.
- 02-4, Fuel valve below low range – O_2 value still low when the fuel valve was commanded below the lower limit (too rich).
- 02-5, Unstable flame – Flame went out five times in a heating cycle.

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 fault is most often with the fuel supply system or combustion air supply.

ALTERNATES

ALTERNATES

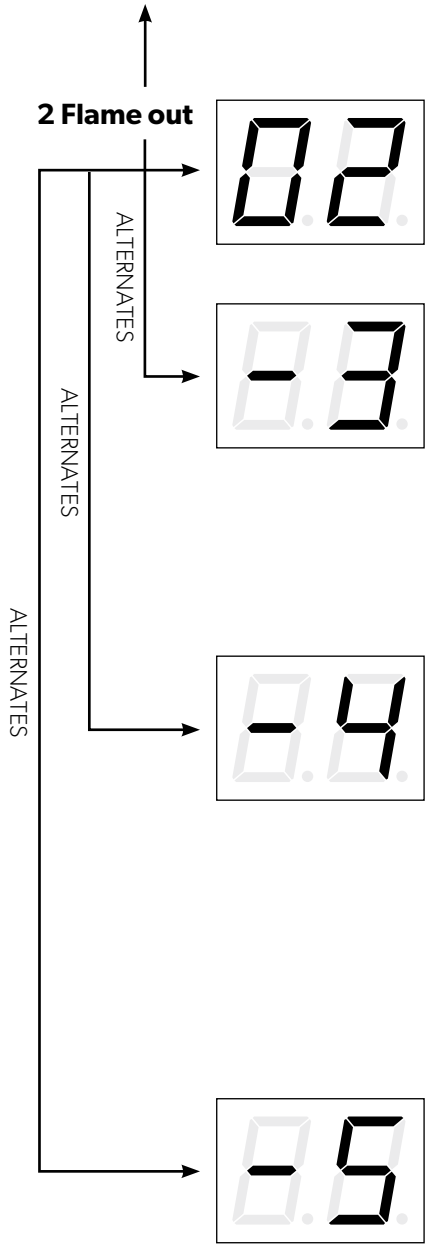
ALTERNATES

02-1, O_2 Low — Troubleshoot the combustion air supply based on:

1. **Combustion air supply.**
   - Check combustion air intake for damage or restrictions.
   - Check combustion air blower for damage.
   - Combustion chamber – dirty or clogged.
   - Exhaust pipe – dirty, clogged, or damaged.

02-2, O_2 High — Troubleshoot the fuel system 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 oxygen detection system.**
   - Fuel supply sump.
   - Air compressor — pressure.
   - Fuel pump — faulty.
   - Nozzle — dirty or clogged.
   - Oxygen sensor — dirty faulty.



02-3, Optical Flame not detected — troubleshoot based on:

1. **Combustion air supply.**
   - Check combustion air intake for damage or restrictions.
   - Check combustion air blower for damage.
   - Combustion chamber – dirty or clogged.
   - Exhaust pipe — dirty, clogged or damaged.
2. **Optical light sensor (PCM).**
   - Dirty or faulty. Go to page 4-15 to perform optical flame sensor check.

02-4, Fuel pump low.

1. **Combustion air supply.**
   - Check combustion air intake for damage or restrictions.
   - Check combustion air blower for damage.
   - Combustion chamber – dirty or clogged.
   - Exhaust pipe — dirty, clogged, or damaged.
2. **Fuel pump.**
   - Internal leak.
3. **Oxygen sensor.**
   - Dirty or faulty.

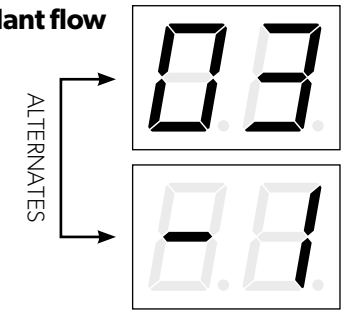
02-5, Unstable flame — The flame has gone out and been re-lit more than five times in a cycle.

The heater is functioning but the flame is unstable.

Troubleshoot 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 oxygen detection system.**
   - Fuel supply pump.
   - Air compressor — pressure.
   - Nozzle — dirty or clogged.
   - Oxygen sensor — dirty faulty.

3 Coolant flow



Indicates that the coolant temperature in the Proheat reached 185˚F (85˚C) within 60 seconds from the beginning of ignition. There is coolant in the system but its flow rate is too low.
An in-line flow indicator (see figure 4-16) 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.

The coolant flow indicator shown in figure 4-16 is a service tool used to troubleshoot and test for possible flow and air problems in the coolant flow path. Flow direction during heater operation or during engine operation can then be observed.

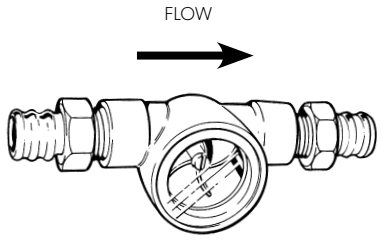


Figure 4-16. Inline flow indicator — TK9002.

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?
6. **Coolant system capacity:** The coolant system must contain at least 12 US gallons (45 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.

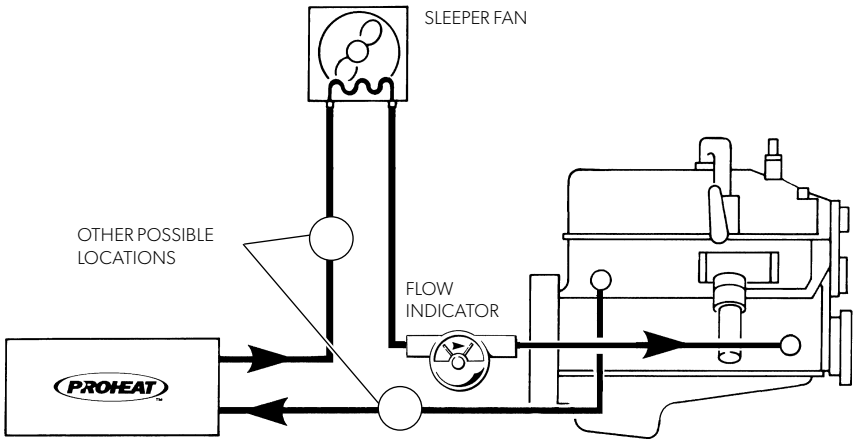
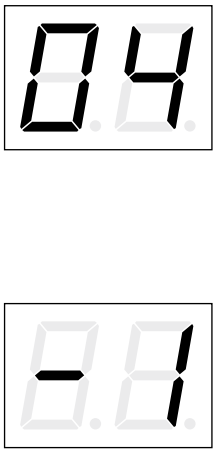


Figure 4-17. Flow indicator — TK9002.

4 Overheat



Indicates that the heat exchanger is above the normal operating range for one second.

An overheat code will immediately put the heater in lockout mode (requires power to the PCM to be removed and reapplied).

The PCM will detect overheats even if the heater is not switched on.

The PCM can detect overheats

• 04-1, Dual mode coolant outlet temperature above 257°F (125°C).

04-1, Coolant overheat — troubleshoot based on:

Indicates that the outlet temperature sensor detected an inner heat exchanger surface temperature of 257°F (125°C).

1. **Lack of coolant, air or flow problems in the coolant system.**
   - Go to page 4-19, Steps 1 and 2.
2. **Faulty outlet temperature sensor.**
   - Go to page 4-24.
3. **Faulty PCM temperature sensor circuit.**
   - Replace PCM.

An Overheat will put the heater in Lockout Mode (requires power to the PCM to be removed and reapplied) on the first occurrence of an overheat

CAUTION!
Repeatedly resetting the Proheat without resolving the overheat diagnostic code will damage the heat exchanger.

5 Voltage

ALTERNATES

ALTERNATES

A voltage diagnostic code indicates that the supply voltage to the heater is out of the normal operating range. In Pre-check the code is displayed immediately. If the heater was operating the condition must last for more then 10 seconds before a code is displayed.

The PCM can detect three types of voltage

- 05-1, Voltage low
  12V below 9.5 volts
  24V below 18.0 volts
- 05-2, Voltage high
  above 32 volts
- 05-3, Voltage Surge
  above 40 volts

05-1, Voltage low — troubleshoot based on:

1. **Low voltage.**
   - Voltage supply is below the rated requirement.
   - Poor or faulty electrical connections.
   - Voltage supply source is OK. Voltage drop due to high amperage load while the Proheat is operating or trying to operate.

NOTICE!
When the Variable M-Series is first connected to battery power it senses the available system voltage. If the batteries are not fully charged when you first connect power to the Variable M-Series you may get a false voltage codes.

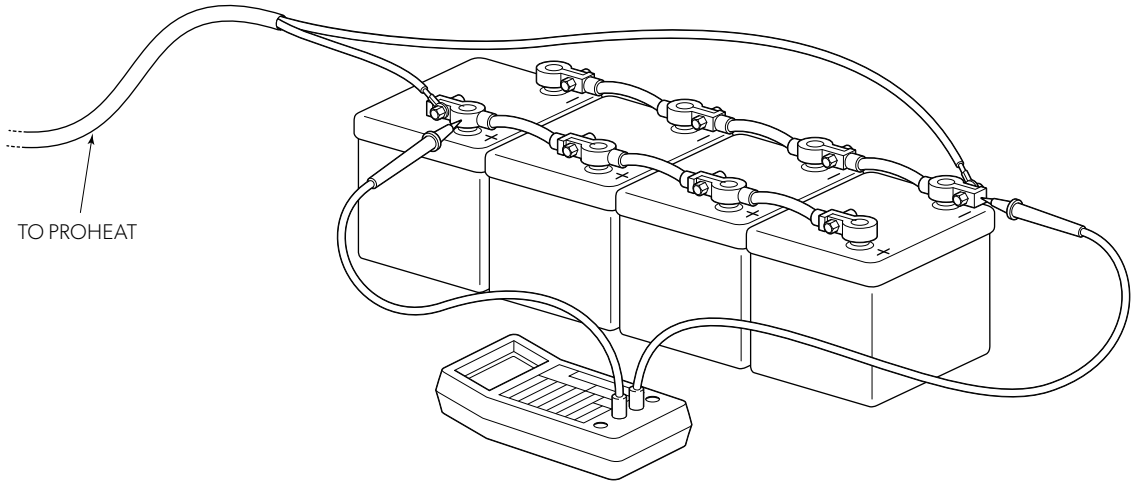


Figure 4-18. Heater voltage measurement.

Test Procedure — Low voltage:

a) Inspect the wiring harnesses and connections for corrosion and proper fit. Clean if necessary.

b) Using a multimeter set for voltage, measure across the positive and negative battery terminals or at the supply source.
If the voltage is below the required voltage, service the batteries and/or charging system as per OEM supplier recommendations. If the voltage level is within the operating range, cycle power to the Proheat for 30 seconds and test run again.

5 Voltage

ALTERNATES

ALTERNATES

PCM — Locate the P8 I/O switch connector under the PCM cover, back probe and measure voltage at pins 4 (power) and 7 (ground).

Perform this with the Proheat off and then switched on.

If the voltage is within the operating range and a Voltage diagnostic code is still indicated, reset the PCM's auto voltage selection by disconnecting battery power for 30 seconds then reconnecting.

If the voltage falls below the required voltage when the heater tries to start check the wiring from the supply source to the Proheat PCM for voltage drop.

05-2, Voltage High — troubleshoot based on:

1. **High voltage.**
   - Voltage supply is above the rated requirement while the engine is running.
   - PCM sensed the wrong voltage at power up.
   - Poor or faulty electrical connections.

Test procedure — high voltage:

a) Inspect the wiring harnesses and connections for corrosion and proper fit. Clean if necessary.

b) Using a multimeter set for voltage, measure across the positive and negative battery terminals or at the supply source.
Then start the vehicles engine. If the voltage level is within the operating range, reset the heater's auto voltage selection by removing the power fuse for 30 seconds. Service the batteries and/or charging system as per OEM supplier recommendations. If the voltage level is within the operating range, cycle power to the Proheat for 30 seconds and test run again.

c) Check the vehicle charging system. Consult the OEM for testing procedure.

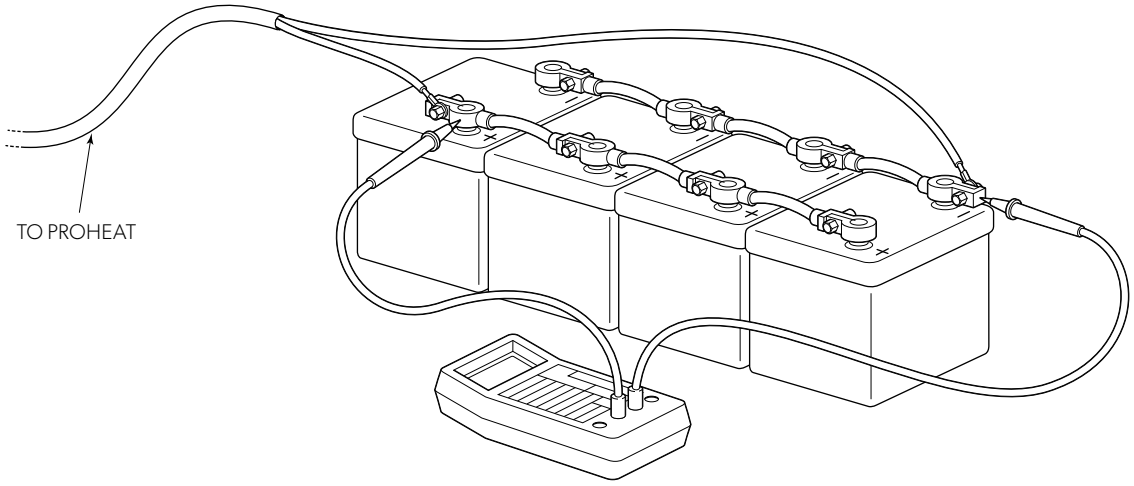
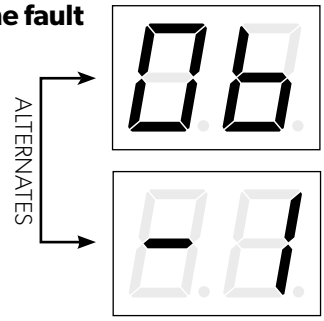


Figure 4-19. Heater voltage measurement.

05-3, Voltage surge — troubleshoot based on:

1. **Voltage surge.**
   - Using a multimeter set for voltage, measure across the positive and negative battery terminals or at the supply source. Start the vehicles engine and measure the voltage. If voltage is below 40 Volts and the code keeps recurring call Proheat for further assistance.

6 Flame fault



Flame fault diagnostic code 6 the optical flame sensor detected an unexpected flame.

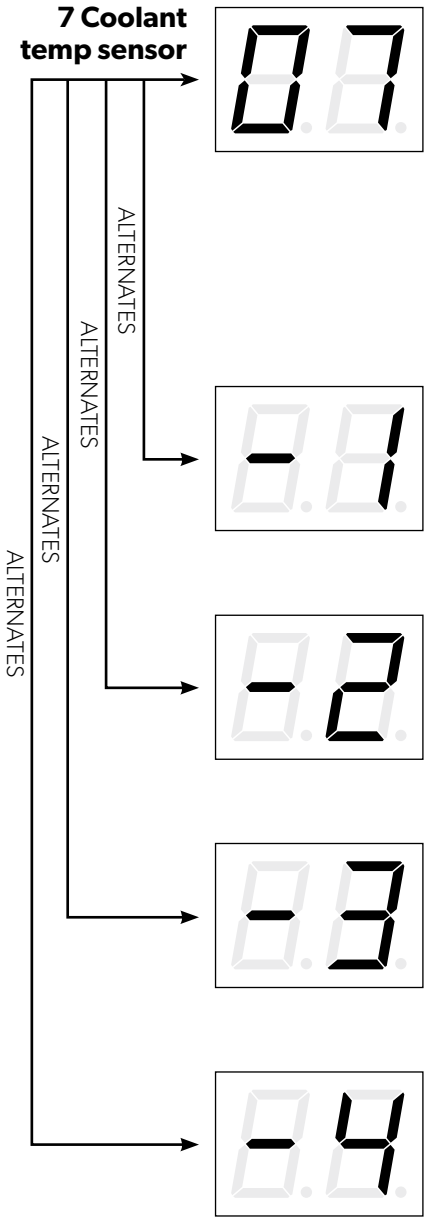
06-1, indicates that:

1. The Proheat reached its cycle off temperature and entered Cool down (purge). After 20 seconds a flame was still detected by the optical flame sensor, or
2. The Proheat was switched on and a flame was detected in Pre-check.

Test procedure — Compressor and PCM test.

a) Glowing carbon deposits inside the combustion tube. Go to section 7.2.3 and perform annual maintenance procedure.
b) Verify function of the fuel pump and valve – Go to page 4-26.
c) Verify function of the optical flame sensor – Go to page 4-15.

4.5 Component diagnostics



The dual mode coolant outlet temperature sensor contains both digital and analog sensing elements a diagnostic code 7 indicates the PCM has detected one of four possible faults with the dual mode outlet sensor.

- 07-1, Range low.
- 07-2, Range high.
- 07-3, No communication.
- 07-4, Temperature mismatch.

Testing of the dual mode temperature sensor is beyond the scope of this manual and the sensor itself is non reparable.

07-1, Analog outlet temperature sensor below range.

Inspect the PCM connector for damage and corrosion. Inspect the dual mode temperature sensor harness and connector for damage and corrosion. If no damage or corrosion is found, replace dual mode temperature sensor.

07-2, Analog outlet temperature sensor above range.

Inspect the PCM connector for damage and corrosion. Inspect the dual mode temperature sensor harness and connector for damage and corrosion. If no damage or corrosion is found, replace dual mode temperature sensor.

07-3, Digital outlet temperature sensor not communicating.

Inspect the PCM connector for damage and corrosion. Inspect the Dual Mode Temperature sensor harness and connector for damage and corrosion. If no damage or corrosion is found, replace dual mode temperature sensor.

07-4, Analog/digital temperature sensor mismatch — troubleshoot the dual mode temp sensor based on:

1. **Coolant flow.**
   - Go to page 4-19.

If the Coolant flow is correct and the 07-4 mismatch code is still indicated Inspect the PCM connector for damage and corrosion. Inspect the dual mode temperature sensor harness and connector for damage and corrosion. If no damage or corrosion is found, replace dual mode temperature sensor.

2. **Temperature sensor replacement.**
   a) Isolate the coolant system at the Proheat inlet and outlet ports for minimal coolant loss using valves in the system or hose clamps.
   b) Remove main sensor mount using a 1" wrench.
   c) Reinstall the new sensor. Ensure that the O-ring and O-ring seat are clean. Install the sensor until it bottoms out on the mounting boss.

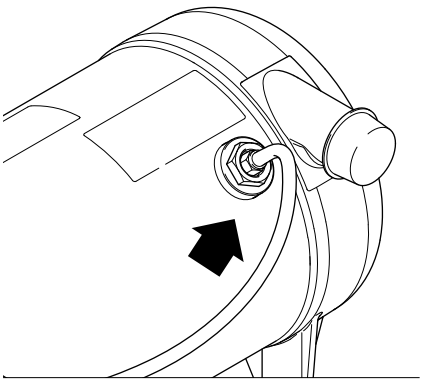


Figure 4-20. Temperature sensor.

NOTICE!
Before diagnosing fuel pump ensure:
1. The system voltage is within the specified range (see 4-21)
2. Ensure the heater has an adequate supply of clean liquid diesel (4-8)

8 Fuel pump

Fuel pump diagnostic code 8 indicates the PCM has detected one of nine possible faults with the fuel pump.

- 08-1, Fuel pump driver fault /shorted.
- 08-2, Fuel pump overload (software breaker tripped).
- 08-3, Fuel pump open.
- 08-4, Fuel pump speed out of range.
- 08-5, Fuel pump damaged.
- 08-6, Fuel pump calibration failure.
- 08-7, Fuel solenoid valve shorted.
- 08-8, Fuel solenoid valve open.
- 08-9, Fuel solenoid valve uncommanded open.

Testing of the fuel pump is beyond the scope of this manual and the pump itself is non-repairable.

ALTERNATES

08-1, Indicates a fuel pump motor driver fault or that the motor is drawing very high current.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, with the harness still disconnected switch the heater on.

a) If code 08-1 is still displayed, replace the PCM.
b) If code 08-3 is displayed, replace the flange/fuel pump assembly.

ALTERNATES

08-2, Indicates the fuel pump motor is drawing very high current and has tripped the 15A software breaker.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, reconnect the harness and switch the heater on.

a) If the fault persists, replace the flange/fuel pump assembly.
b) If replacing the flange/fuel pump assembly does not eliminate the fault, replace the PCM.

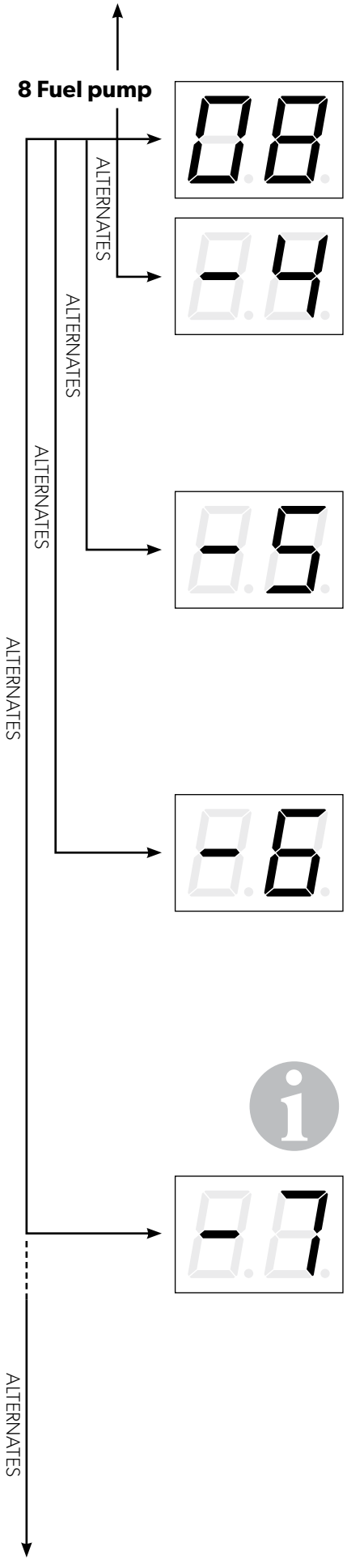
ALTERNATES

08-3, Indicates the fuel pump speed was 0 rpm for four seconds.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, reconnect the harness and switch the heater on.

a) If the fault persists, replace the flange/fuel pump assembly.
b) If replacing the flange/fuel pump assembly does not eliminate the fault, replace the PCM.



08-4, Indicates the fuel pump speed is out of range.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. If none is found, reconnect the harness and switch the heater on.

a) If the fault persists, replace the flange/fuel pump assembly.
b) If replacing the flange/fuel pump assembly does not eliminate the fault, replace the PCM.

08-5, Indicates the fuel pump or PCM damaged.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, reconnect the harness and switch the heater on.

a) If the fault persists, replace the flange/fuel pump assembly.
b) If replacing the flange/fuel pump assembly does not eliminate the fault, replace the PCM.

08-6, Indicates the fuel pump failed to calibrate.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. If none is found, reconnect the harness and switch the heater on.

a) If the fault persists, replace the flange/fuel pump assembly.
b) If replacing the flange/fuel pump assembly does not eliminate the fault, replace the PCM.

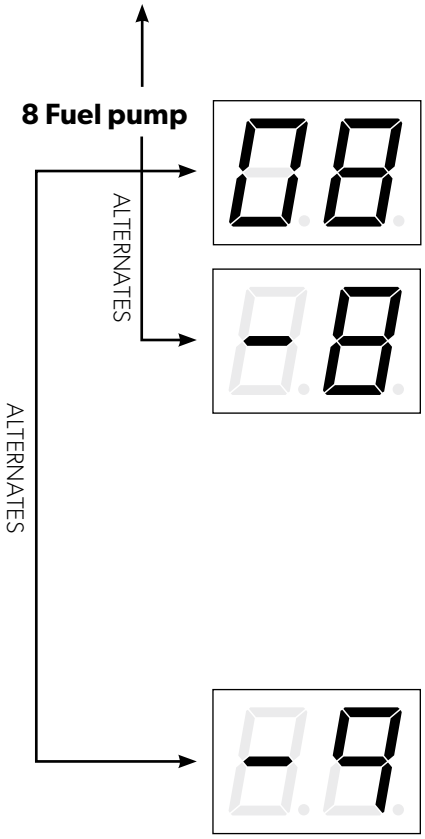
NOTE
The fuel pump will fail to calibrate if the diesel fuel in the system has gelled in cold temperatures

08-7, Indicates the fuel solenoid valve is drawing high current.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel solenoid from the PCM (P5) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, with the harness still disconnected switch the heater on.

a) If code 08-7 is still displayed, replace the PCM.
b) If code 08-8 is displayed, switch the heater off. Using a multimeter set to read Ohms, measure the resistance across the two pins.
If the coil measure between 35 and 45 Ohms, the coil is OK — replace the PCM.
If the coil does not measure between 35 and 45 Ohms, replace the flange/fuel pump assembly.



08-8, Indicates the fuel solenoid valve is drawing no current.

Test procedure — Fuel pump motor and PCM test.

Disconnect the fuel pump motor from the PCM (P1) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. Using a multimeter set to read Ohms, measure the resistance across the two pins.

a) If the coil measure between 35 and 45 Ohms, the coil is OK — replace the PCM.
b) If the coil does not measure between 35 and 45 Ohms, replace the flange/fuel pump assembly.

08-9, Indicates the PCM is damaged.

a) Replace PCM.
b) Return damaged PCM to Proheat.

9 Compressor

ALTERNATES

ALTERNATES

ALTERNATES

ALTERNATES

Compressor diagnostic code 9 indicates the PCM has detected one of five possible faults with the compressor..

- 09-1, Compressor shorted.
- 09-2, Compressor overload (software breaker tripped).
- 09-3, Compressor open.
- 09-4, Compressor speed out of range.
- 09-5, Compressor damaged.

Testing of the compressor is beyond the scope of this manual and the compressor itself is non-repairable.

09-1, Indicates a compressor motor is drawing very high current.

Test procedure — Compressor and PCM test.

Disconnect the compressor motor from the PCM (P2) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, with the harness still disconnected switch the heater on.

a) If code 09-1 is still displayed, replace the PCM.
b) If code 09-3 is displayed, replace the compressor assembly.

09-2, Indicates the Compressor Motor is drawing high current and has tripped the software breaker.

Test procedure — Compressor and PCM test.

Disconnect the compressor motor from the PCM (P2) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the compressor flywheel by hand to and feel for mechanical binding.

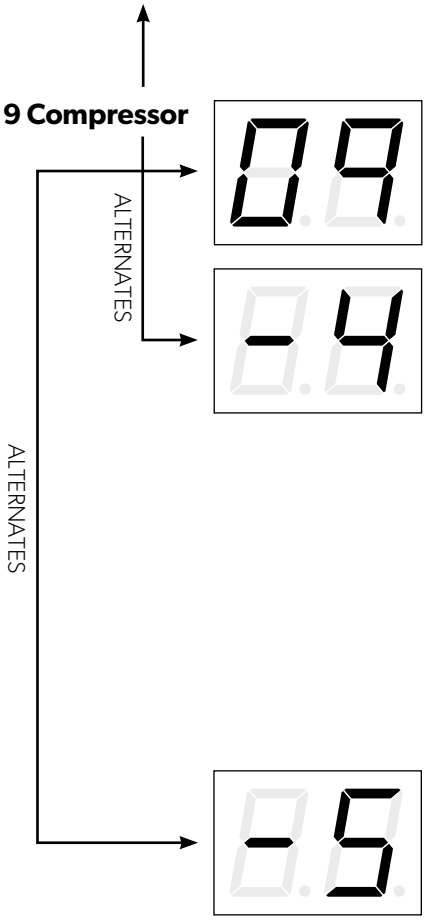
a) If the compressor does not turn freely, replace the compressor.
b) If the compressor turns freely, reconnect the compressor (P2) and switch the heater on.
   i If the fault persists, replace the compressor
   ii If replacing the compressor does not eliminate the fault, replace the PCM.

09-3, Indicates the compressor speed was 0 rpm for four seconds.

Test procedure — Compressor and PCM test.

Disconnect the compressor motor from the PCM (P2) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, reconnect the harness and switch the heater on.

a) If the fault persists, replace the compressor assembly.
b) If replacing the compressor does not eliminate the fault, replace the PCM.



09-4, Indicates the compressor speed is out of range.

Test procedure — Compressor and PCM test.

Disconnect the compressor motor from the PCM (P2) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the compressor flywheel by hand to and feel for mechanical binding.

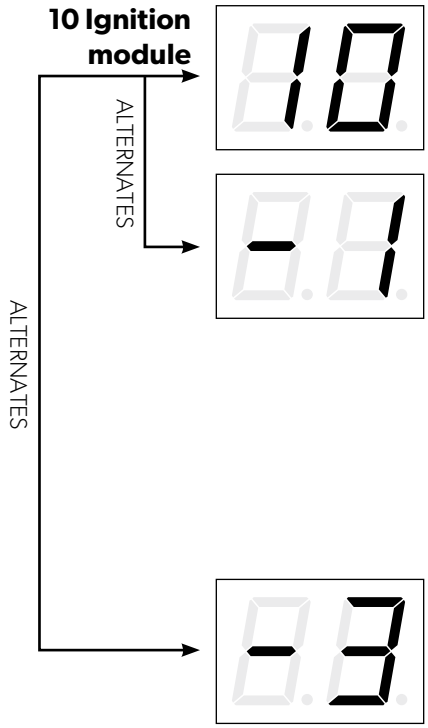
a) If the compressor does not turn freely, replace the compressor.
b) If the compressor turns freely, reconnect the compressor (P2) and switch the heater on.
   i If the fault persists, replace the compressor
   ii If replacing the compressor does not eliminate the fault, replace the PCM.

09-5, Indicates the compressor or PCM damaged.

Test procedure — Compressor and PCM test.

Disconnect the compressor motor from the PCM (P2) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the compressor flywheel by hand to and feel for mechanical binding.

a) If the compressor does not turn freely, replace the compressor.
b) If the compressor turns freely, reconnect the compressor (P2) and switch the heater on.
   i If the fault persists, replace the compressor
   ii If replacing the compressor does not eliminate the fault, replace the PCM.



Ignition module diagnostic code 10 Indicates the PCM has detected one of two possible faults with the ignition module.

- 10-1, Ignition module shorted
- 10-3, Ignition open

10-1, Ignition module shorted.

Indicates the ignition module is drawing very high amperage.

Test procedure — Ignition module and PCM test:

Disconnect the P3 ignition module harness from the PCM. Inspect the PCM connector for damage and corrosion. Inspect the ignition module harness and connector for damage and corrosion. If none is found, with the harness still disconnected switch the heater ON

a) If code 10-1 is still displayed, replace the PCM.

b) If code 10-3 is displayed replace the ignition module.

10-3, Ignition module open.

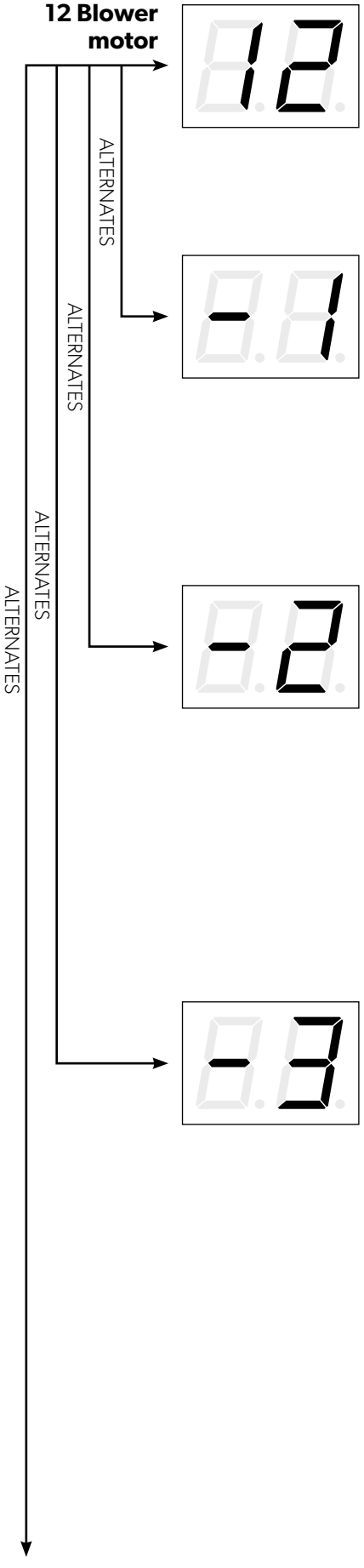
Indicates the ignition module was not detected in Pre-check.

Test procedure — Ignition module and PCM test:

Disconnect the P3 ignition module harness from the PCM. Inspect the PCM connector for damage and corrosion. Inspect the ignition module harness and connector for damage and corrosion. If none is found the module is faulty, replace the ignition module.

WARNING!

The Proheat chassis is grounded from the PCM. Ensure the ground is securely connected. Failure to ensure a proper ground may result in electrical shock.



Blower diagnostic code 12 indicates the PCM has detected one of five possible faults with the blower motor.

- 12-1, Blower driver fault/shorted.
- 12-2, Blower overload (software breaker tripped).
- 12-3, Blower open.
- 12-4, Blower speed out of range.
- 12-5, Blower damaged.

12-1, Indicates a blower motor driver fault or that the motor is drawing very high current.

Test procedure — Blower and PCM test.

Disconnect the blower motor from the PCM (P3) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found, with the harness still disconnected switch the heater on.

a) If code 12-1 is still displayed, replace the PCM.
b) If code 12-3 is displayed, replace the blower assembly.

12-2, Indicates the blower motor is drawing very high current and has tripped the 15A software breaker.

Test procedure — Blower and PCM test.

Disconnect the blower motor from the PCM (P3) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the blower blade by hand to and feel for mechanical binding.

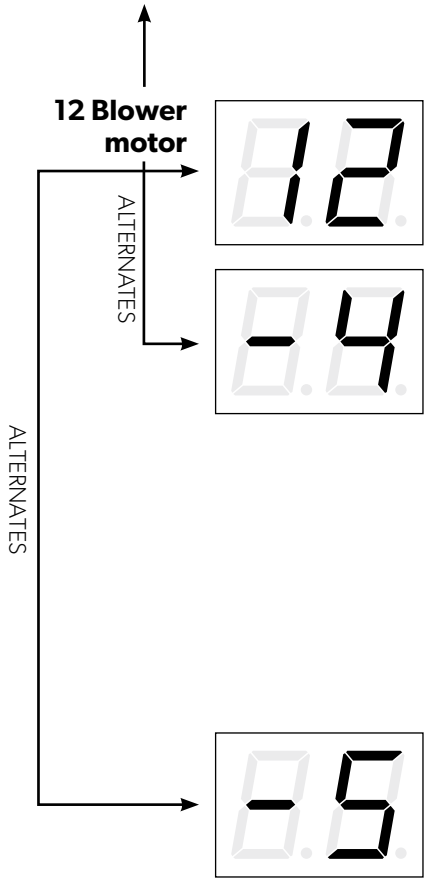
a) If the blower blade does not turn freely, replace the blower/PCM assembly.
b) If the blower blade turns freely, reconnect the blower motor (P3) and switch the heater on.
– If the fault persists, replace the blower/PCM assembly.

12-3, Indicates the blower speed was 0 rpm for four seconds.

Test procedure — Blower and PCM test.

Disconnect the blower motor from the PCM (P3) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the blower blade by hand to and feel for mechanical binding.

a) If the blower blade does not turn freely, replace the blower/PCM assembly.
b) If the blower blade turns freely, reconnect the blower motor (P3) and switch the heater on.
– If the fault persists, replace the blower/PCM assembly.



12-4, Indicates the blower speed is out of range.

Test procedure — Blower and PCM test.

Disconnect the blower motor from the PCM (P3) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the blower blade by hand to and feel for mechanical binding.

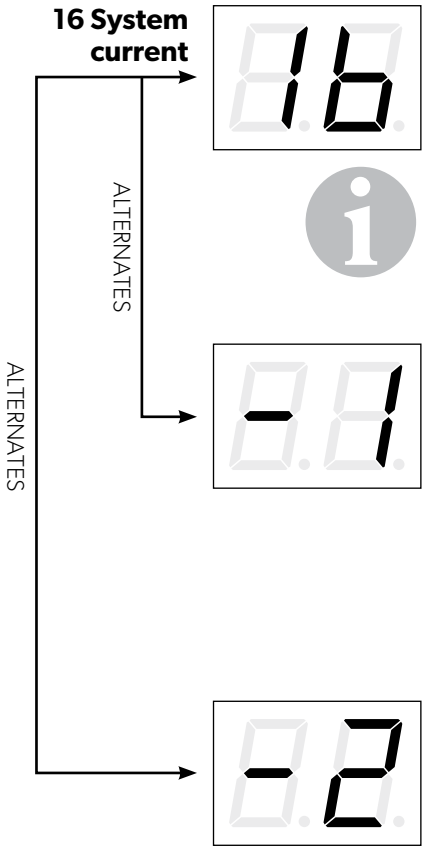
a) If the blower blade does not turn freely, replace the blower/PCM assembly.
b) If the blower blade turns freely, reconnect the blower motor (P3) and switch the heater on.
   – If the fault persists, replace the blower/PCM assembly.

12-5, Indicates the blower or PCM damaged.

Test procedure — Blower motor and PCM test.

Disconnect the blower motor from the PCM (P3) and inspect wires and connector for damage and/or corrosion. Inspect the PCM connector and pins for damage and/or corrosion. If none is found; turn the blower blade by hand to and feel for mechanical binding.

a) If the blower blade does not turn freely, replace the blower/PCM assembly.
b) If the blower blade turns freely, reconnect the blower motor (P3) and switch the heater on.
   – If the fault persists, replace the blower/PCM assembly.



The system current diagnostics code 16 Indicates the PCM has detected one of two possible faults with the total system current.

- 16-1, System current shorted.
- 16-2, System current overload (software breaker tripped).

NOTE

In an attempt to lower the system current, the auxiliary output is turned off for the remainder of the current cycle. Troubleshoot the system current diagnostic code based on voltage: page 4-21.

16-1, System current shorted.

Indicates the system current is drawing very high amperage.

Test Procedure — Component and PCM test:

Disconnect all the harnesses from the PCM. Inspect the PCM connectors for damage and corrosion. Inspect the harnesses and connector for damage and corrosion. If none is found measure the total system current using a clamp on Amp meter.

a) If the amp draw measures below 25A, replace the PCM.

16-2, System current overload.

Indicates the system current is drawing high amperage and has tripped the 25 amp breaker. This could be an electrical or mechanical problem with a component.

Test Procedure — Component and PCM test:

Disconnect all the harnesses from the PCM. Inspect the PCM connectors for damage and corrosion. Inspect the harnesses and connector for damage and corrosion. If none is found measure the total system current using a clamp on Amp meter.

a) If code 16-2 is still displayed, check all the motors for mechanical interference, replace as needed.

b) If code 16-2 is still displayed replace PCM.

17 Oxygen sensor

The oxygen sensor diagnostic code 17 Indicates the PCM has detected one of four possible faults with the oxygen sensor.

- 17-1, Oxygen sensor fault.
- 17-2, Oxygen sensor out of range fault.
- 17-3, Oxygen sensor response.
- 17-4, Oxygen sensor warning.

ALTERNATES

17-1, Oxygen sensor — Function code

Indicates the oxygen sensor has invalid readings.

Test procedure — Component and PCM test:

a) Remove burner head

b) Disconnect the oxygen sensor harness from the PCM. Inspect the PCM connector for damage and corrosion. Inspect the oxygen sensor harnesses and connector for damage and corrosion. If none is found replace oxygen sensor. See procedure on page 4-15.

ALTERNATES

17-2, Oxygen sensor — Function code

Indicates the oxygen sensor O_2 is out of range in Pre-ignition.

The heater will go through a full Cool down (purge).

Test procedure — Inspection:

a) Remove burner head

b) Disconnect the oxygen sensor harness from the PCM Inspect the PCM connector for damage and corrosion. Inspect the oxygen sensor harnesses and connector for damage and corrosion.

c) Check blower fan, combustion air Intake, combustion chamber and exhaust for restrictions.

d) If none is found replace oxygen sensor. See procedure on page 4-15.

ALTERNATES

17-3 Oxygen sensor — Function code

Indicates the oxygen sensor O_2 reading is not dropping when the exhaust temperature reading is climbing.

The heater will go through a full Cool down (purge).

a) Remove burner head

b) Disconnect the oxygen sensor harness from the PCM, inspect the PCM connector for damage and corrosion. Inspect the oxygen sensor harnesses and connector for damage and corrosion.

c) If none is found replace oxygen sensor. See procedure on page 4-15.

ALTERNATES

17-4, Oxygen sensor — Warning code

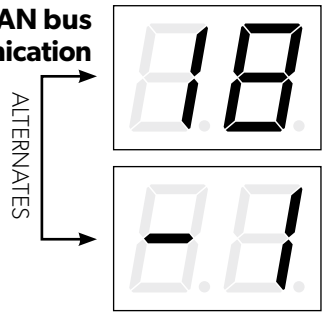
Indicates the oxygen sensor O_2 is near the end of its life.

The heater will continue to operate normally for some time.

Repair Procedure — Replace oxygen sensor and reset code 17-4:

a) See procedure on page 4-15.

18 CAN bus communication



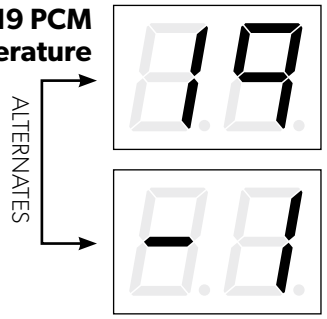
Indicates the heater was switched on via a CAN input and then lost the CAN bus heartbeat message for longer than two seconds. The heater will go to the Cool down (purge) mode then turn off until valid CAN communication is restored.

18-1, CAN bus heartbeat.

Test procedure — PCM test:

a) Disconnect the switch I/O harness from the PCM Inspect the PCM connector for damage and corrosion. Inspect the CAN harnesses and connector for damage and corrosion. If none is found and code persists contact Proheat for more information.

19 PCM temperature



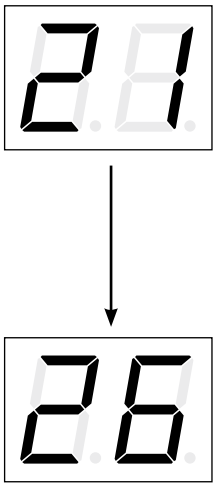
Indicates that the PCM's onboard temperature sensor reached 212°F (100°C). This is a non-critical fault and will not cause the heater to shut down.

19-1, PCM Temperature high.

Test procedure — PCM test:

a) Allow the PCM to Cool down. Inspect the heater installation for the cause of the high ambient temperature. If none is found and code persists contact Proheat for more information.

21 through 26 output 1-6



Indicates the PCM detected that one 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.

21-1, Pin 1 on the I/O switch harness

22-1, Pin 2 on the I/O switch harness

23-1, Pin 3 on the I/O switch harness

24-1, Pin 4 on the I/O switch harness

25-1, Pin 5 on the I/O switch harness

26-1, Pin 6 on the I/O switch harness

Test Procedure — PCM test:

a) Disconnect the switch I/O harness from the PCM Inspect the PCM connector for damage and corrosion. Inspect the corresponding harnesses and connector for damage and corrosion. Check wire for short to ground using a multimeter. If no short is found remove the wire from the cavity, reconnect the I/O switch harness. If the same code persists replace PCM.

33 Impact switch

The impact switch has been triggered. Reset the impact switch.

34 PCM hardware

ALTERNATES

Indicates an electrical issue with the PCM's battery supply power.

34-1, Hardware failure — Troubleshoot based on voltage:

Test procedure — PCM power harness test:

a) Disconnect the P6 Power harness from the PCM for 30 seconds.

b) Reconnect harness and switch heater on.
If code persists call Proheat for further assistance.

37 PCM software

PCM Software diagnostic code 37 indicates an internal software error.

Visit proheat.com to download the latest version of Datalink to update the PCM to the latest software.

4.6 Operation problems with no codes displayed

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

Complaint: Smoking exhaust/smelly exhaust fumes

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

Check:

- Is the combustion air restricted?
- Do you have the correct nozzle?
- Is the compressor air pressure correct?
- Is the fuel pump faulty (leaking internally)?
- Is the O_2 sensor faulty?

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.

Gray/white smoke = Incomplete combustion of the fuel (bad atomization).

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 pump faulty (not opening fully)?
- Is the O_2 sensor faulty?

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 4-19).

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.

Complaint: Backfiring

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

- 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.
- Fuel line ID wrong. Please ensure only the Proheat supplied fuel line is used with the Variable M-Series.

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5 Maintenance

5.1 Weekly maintenance

Visually inspect the Proheat, mounting brackets, fuel line, harnesses, coolant lines and exhaust system for damage, loose parts and leakage.

Run the Proheat 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.

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.

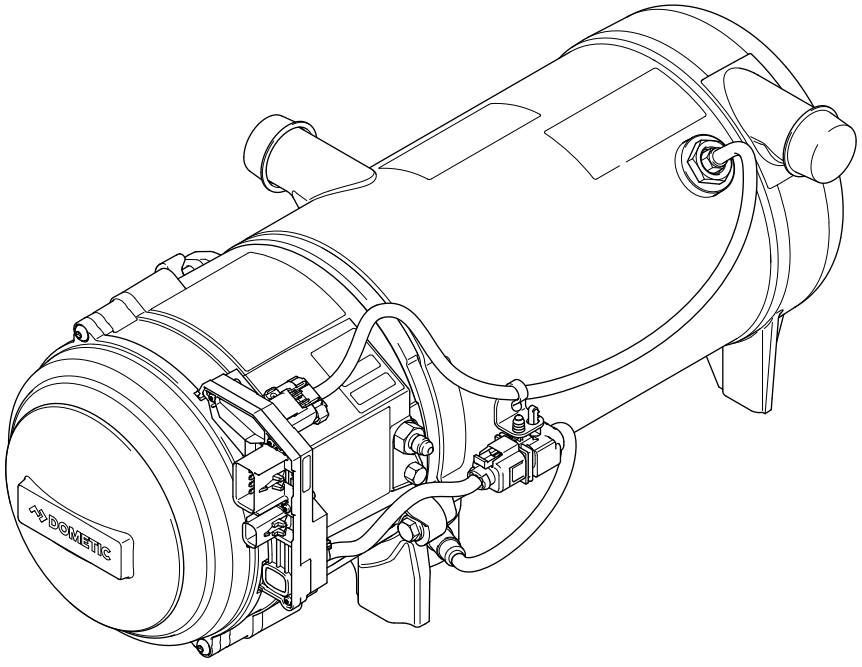


Figure 5-1. Proheat Variable M-Series heater.

5.2.1 Clean heater, enclosure and air intake

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 Variable M-Series using the following procedure:

1. Protect yourself from burns and only touch a heater after it has cooled to room temperature.
2. Clean the Variable M-Series 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.

WARNING!
Do not pressure wash or steam clean.

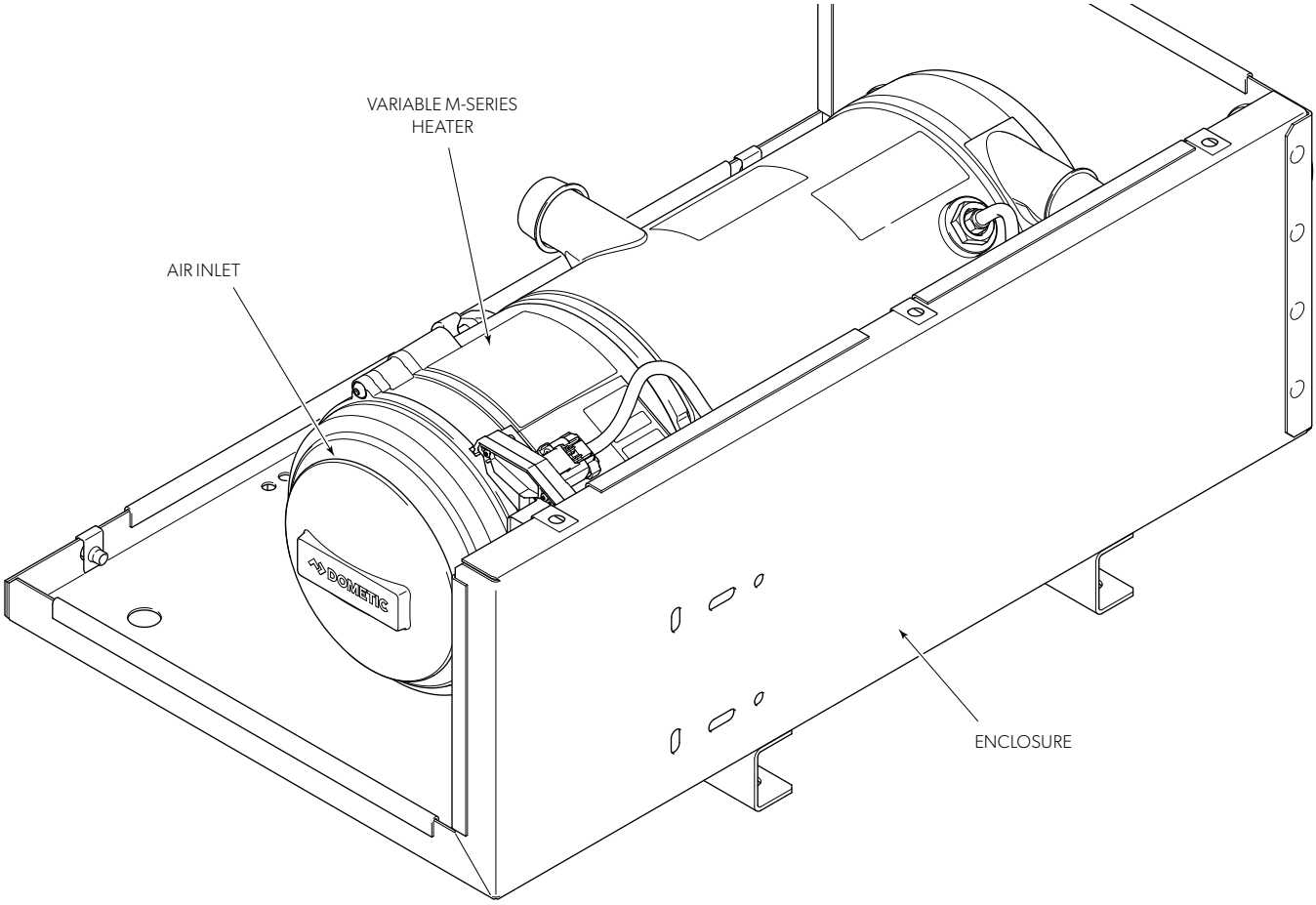


Figure 5-2. Proheat Variable M-Series heater and enclosure.

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.

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 burner head 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 100±10 in-lbs (11.3±1.1 Nm).

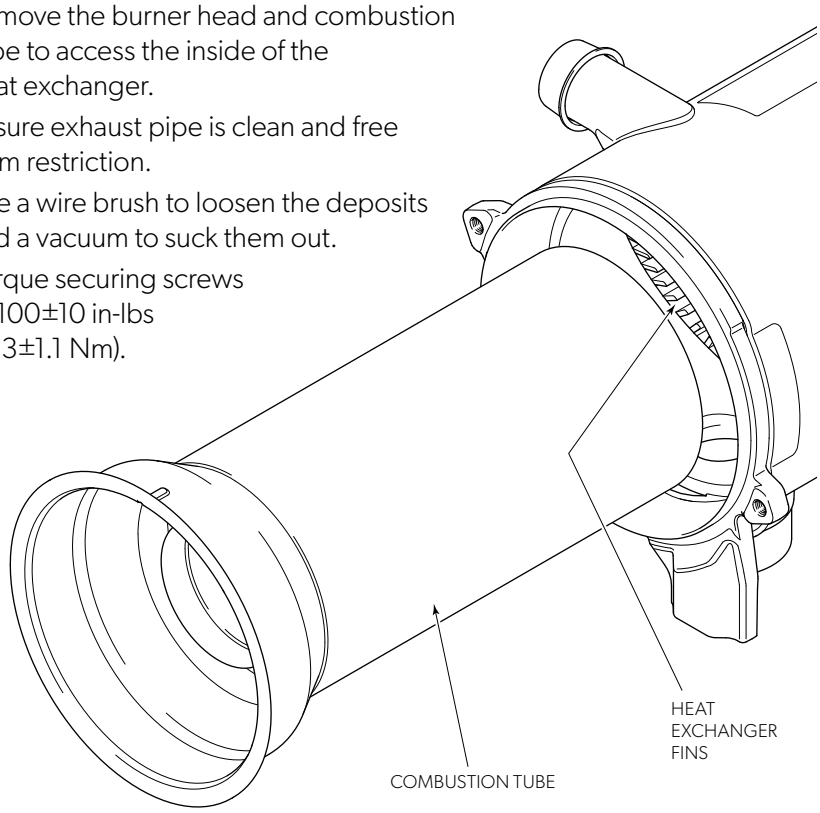


Figure 5-3. Heat exchanger.

5.2.4 Check cooling system

- Check all heater hoses and connections for signs of leakage or damage.
- Repair or replace as required.

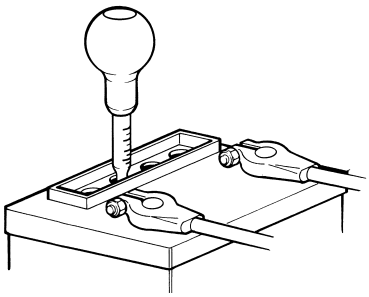


Figure 5-4. Test Battery.

5.2.5 Check batteries

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

5.2.6 Check fuel system

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

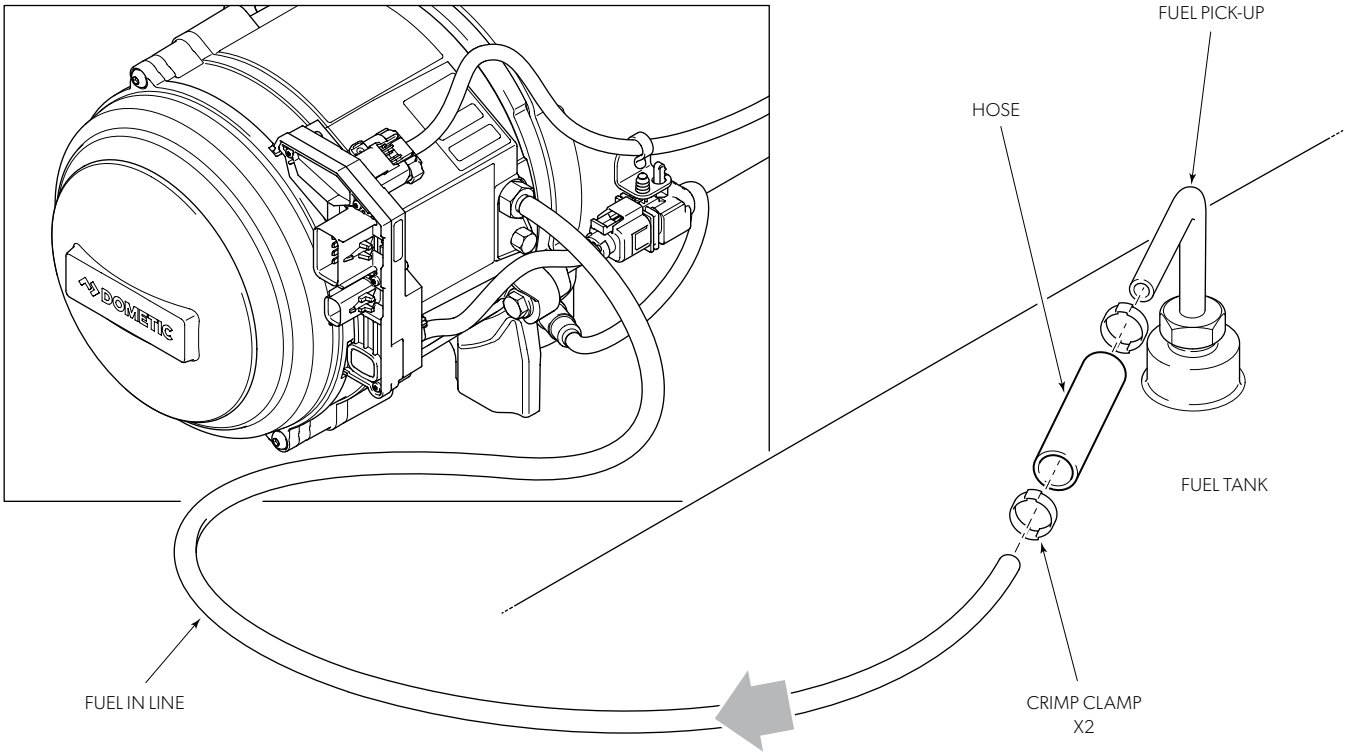


Figure 5-5. Fuel lines.

5.2.7 Check fuel filter

- Remove and inspect filter. Clean or replace as necessary.
- Lubricate O-rings with diesel.
- Torque fuel fitting to 150±10 in/lbs (17±1.1 Nm).

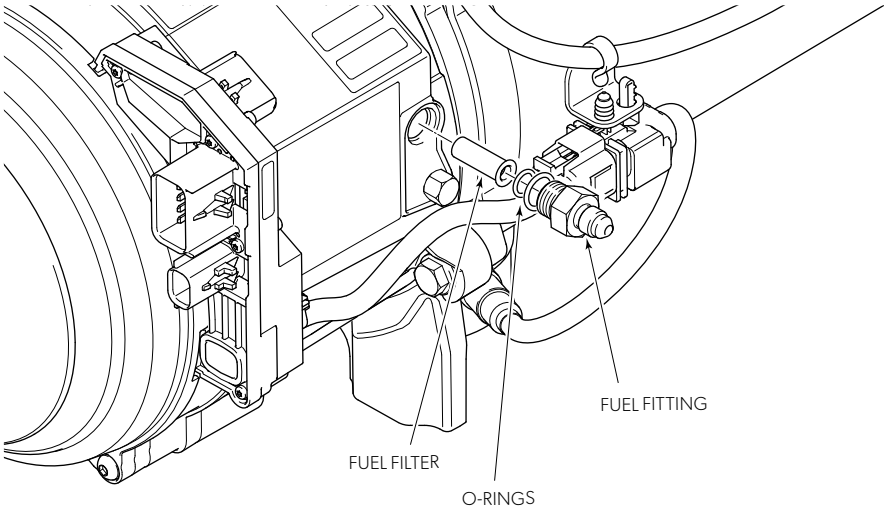


Figure 5-6. Fuel filter components

5.2.8 Check nozzle

- Remove and install Nozzle as shown on page 5-6 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.

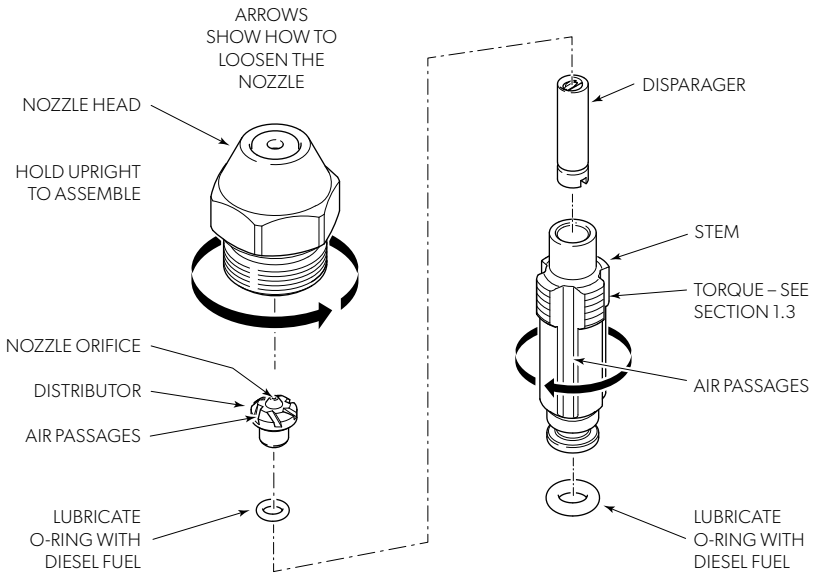


Figure 5-7. Fuel nozzle components.

5.2.9 Replace compressor air filter

- Replace inlet air filter annually or more often if dusty conditions are encountered.
- Torque securing screws to 27±3 in/lbs (3.0±0.3 Nm).

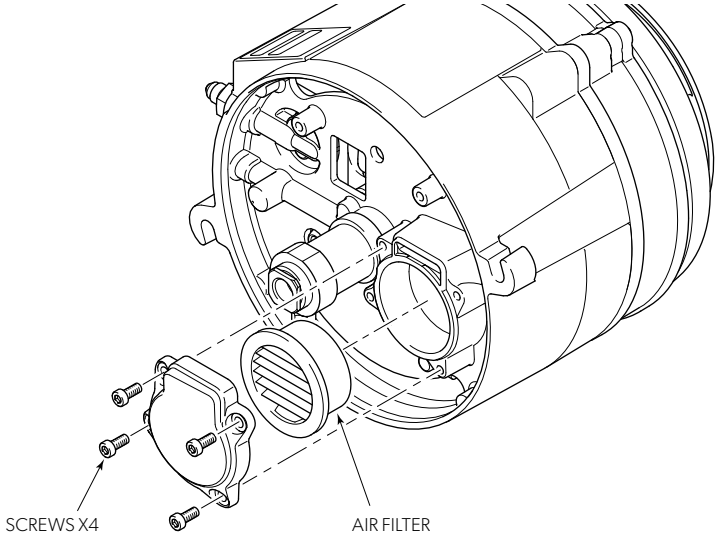


Figure 5-8. Compressor air filter.

5.2.10 Check electrical system

To check the electrical system:

- Check the internal and the external wire harnesses for damage. Replace if required.

CAUTION!
Ensure that power is disconnected to the Variable M-Series prior to servicing the ignition lead.

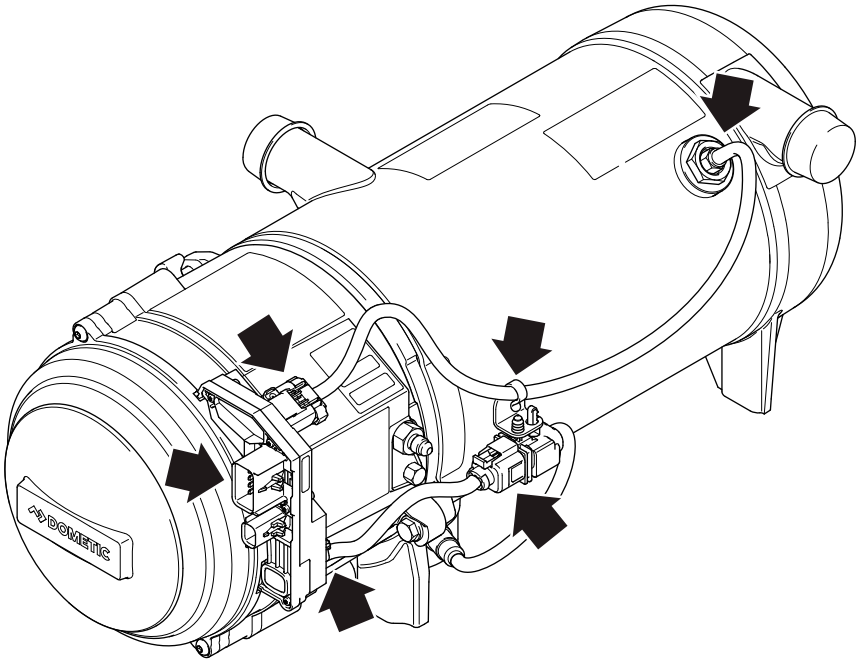


Figure 5-9. Proheat Variable M-Series heater.

5.2.11 Check air pressure

- To check the air pressure, refer to the air compressor pressure test procedure on page 4-11.

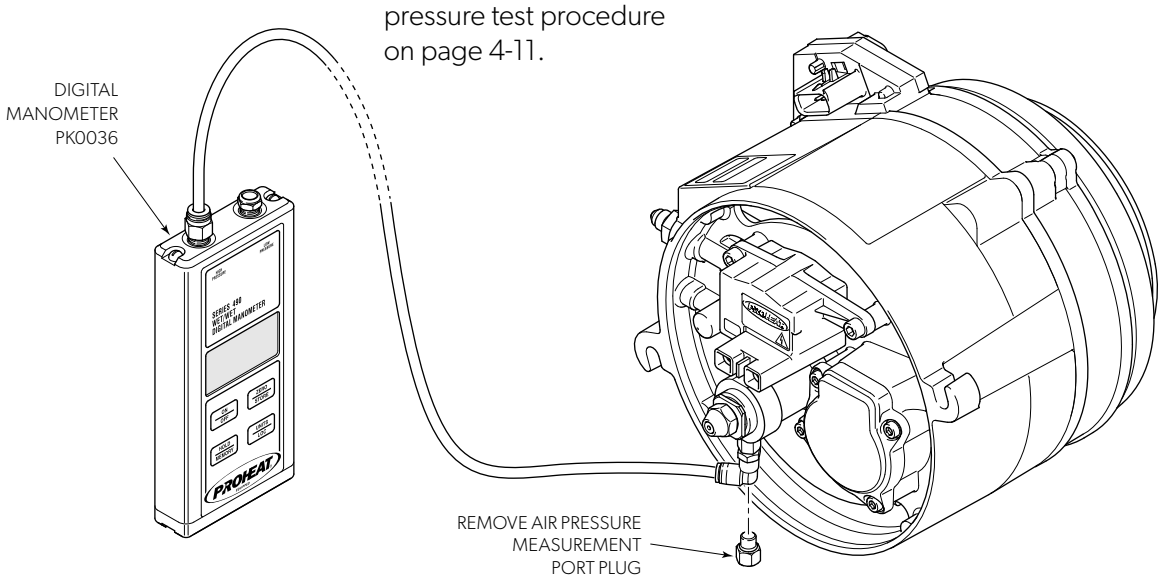


Figure 5-10. Air compressor pressure test procedure.

EN

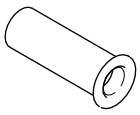
5.2.12 Check modes of operation – switch, timer or OEM signals

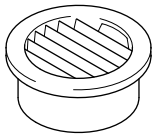
Check to see that the modes operate as described on page 3-5 to page 3-5.

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
149481K	1	Fuel filter, Variable M-series 

PART #	QTY	DESCRIPTION
953420K	1	Air filter, Variable M-series 

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6 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.

Notes

Notes

Mobile living made easy.

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