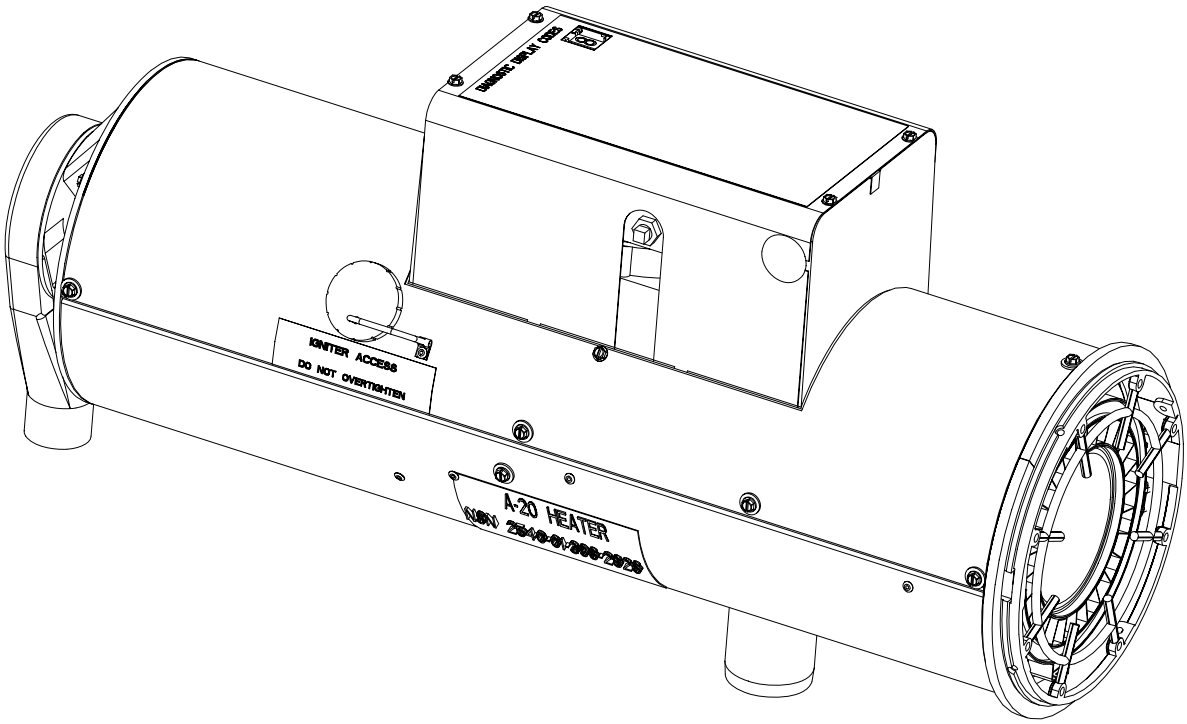
TM 9-2540-207-14&P

TECHNICAL MANUAL

OPERATOR, FIELD, AND SUSTAINMENT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) FOR HEATER, VEHICULAR COMPARTMENT

NSN 2540-01-396-2826
MODEL: A20



HEADQUARTERS, DEPARTMENT OF THE ARMY

31 July 2007

Revision 3

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WARNING SUMMARY

Failure to follow these safety precautions could result in serious injury or death to personnel and/or property damage. Refer to FM 4-25.11 for first aid information.

WARNING

Carbon monoxide is a colorless, odorless gas, and if inhaled can be lethal. Never operate a heater indoors without venting the exhaust out of the test area or vehicle. The heater consumes oxygen and produces carbon monoxide gas, which is vented through the exhaust. Adequate exhaust ducting must be provided to avoid carbon monoxide leakage and poisoning of personnel.

WARNING

Should the heater not start within three (3) consecutive attempts, refer to the Troubleshooting guide in Section 6 of this manual. **DO NOT** try to start a flooded heater and **DO NOT** use starting aids such as ether to assist in heater Start-Up, a fire hazard may occur which could result in injury or death to personnel.

WARNING

DO NOT place combustible materials within three (3) feet of the heater exhaust.

WARNING

DO NOT smoke or allow open flame nearby while conducting maintenance work on the heater as diesel fuel and its fumes can be explosive.

WARNING

If the heater has been running recently, the Ignitor, the Exhaust Port, and the Heat Exchanger are hot enough to burn unprotected skin.

WARNING

Hearing can be PERMANENTLY DAMAGED if exposed to constant high noise levels of 85 dB or greater. Wear approved hearing protection devices when working within two (2) feet of the heater inlet. Personnel exposed to high noise levels shall participate in a hearing conservation program in accordance with DA PAM 40-501. Hearing loss occurs gradually but becomes permanent over time.

WARNING

After disconnecting electrical power from the heater and detaching the MS Power Connector, the Pins A and D of the heater's male connector remain electrically live with 24VDC. This condition remains for approximately five (5) minutes while the capacitor discharges. Personnel should avoid touching the contacts of this connector as electrical shock may occur.

WARNING

Remove rings, bracelets, wristwatches, and neck chains before performing maintenance on the heater. Jewelry can catch on equipment and cause injury or may short across an electrical circuit and cause severe burns or electrical shock.

WARNING

Remove A20 heater from vehicle prior to any welding on hull as transient current could damage circuit boards.

WARNING

Particles blown by compressed air are hazardous. When using compressed air to clean the inside parts of the heater, do not exceed 30psi (207 kPa) air pressure. Make certain that the airstream is directed away from the user and other personnel in the immediate area. To prevent injury, personnel must wear protective gloves and goggles or face shields when using compressed air. For first aid information refer to FM 4-25.11

WARNING

Fuel is slippery and can cause falls. To avoid injury, clean up spilled fuel immediately. For first aid information refer to FM 4-25.11

WARNING

Fuel lines must be inspected on a regular basis for the presence of cuts, leaks, or other damage that may lead to fire or other damage. Failure to do so may result in injury or death to personnel.

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 JULY 2007

TECHNICAL MANUAL
OPERATOR, FIELD, AND SUSTAINMENT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)
FOR
HEATER, VEHICULAR COMPARTMENT
NSN 2540-01-396-2826

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this Publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Equipment Technical Publications), through the internet, on the Army Electronic Product Support (AEPS) website. The Internet address is http://aeps.ria.army.mil. The DA 2028 is located under the Public Applications section in the AEPS Public Home Page. Fill out the form and click on SUBMIT. Using this form on AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 Program. You may also mail, fax or E-mail your letter or DA Form 2028 direct to: AMSTA-LC-LPIT/TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The e-mail address is ROCK-TACOM-TECH-PUBS@conus.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

CURRENT AS OF 31 July 2007

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GLOSSARY OF TERMS

Ambient Temperature – This is the natural temperature of the environment surrounding the heater and the Vent Air Inlet.

BTU/Hr – An acronym for British Thermal Units per Hour, which is a measurement of heat flow.

Diagnostic – The process of identifying the cause of a fault by analyzing operating parameters.

Microprocessor – An integrated circuit that is used for the purpose of executing software instructions.

MS Connector - A five-pin connector used to connect the heater control box to the heater. The connecting cable and control box are parts of the vehicle equipped components.

PC Board – An electronic printed circuit board that can control power and logic, Vent Fan, Burner Fan, or Diagnostic Display.

PSI – An acronym for Pounds per Square Inch, which is a measurement of pressure.

SCFM – An acronym for Standard Cubic Feet per Minute, which is a measurement of airflow. Standard means that the air density has been corrected to standard pressure and temperature.

USG/Hr – An Acronym for United States Gallons per Hour, which is a measurement of liquid (fuel) flow.

Watts - A measure of electrical power, which is calculated as the product of Voltage and Electrical Current (V x A).

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1 INTRODUCTION

1.1 The A20 heater

The model A20 heater is an electrically controlled fuel-fired 60,000 BTU/Hr. vehicle personnel heater. It is able to operate from any available 24 Volt dc power source, and produces heat through the combustion of diesel or jet grade fuels.

The A20 heater utilizes rotary atomization of fuel in conjunction with a heated wick to provide the rated output of 60,000 BTU/hr. Two separate fan systems are used. The vent fan system provides the heated air at a rate of 205 SCFM, while the burner fan supplies the combustion air. The heater can operate with combustion air drawn either from inside or outside the vehicle, with conversion between single and dual air modes quick and easy. The heater utilizes an on-board computer system for operation control, and to signal to the operator the occurrences of any operating faults or abnormal situations.

It is intended to re-circulate and heat air in the crew compartment of military vehicles. The A20 heater meets the requirements of the Class II heater described in specification sheet number: MIL-H-62550D(AT); "Heater Assembly, Combustion Vehicular Compartment, 8.8/17.6 kW (30,000/60,000 BTU/Hr)".

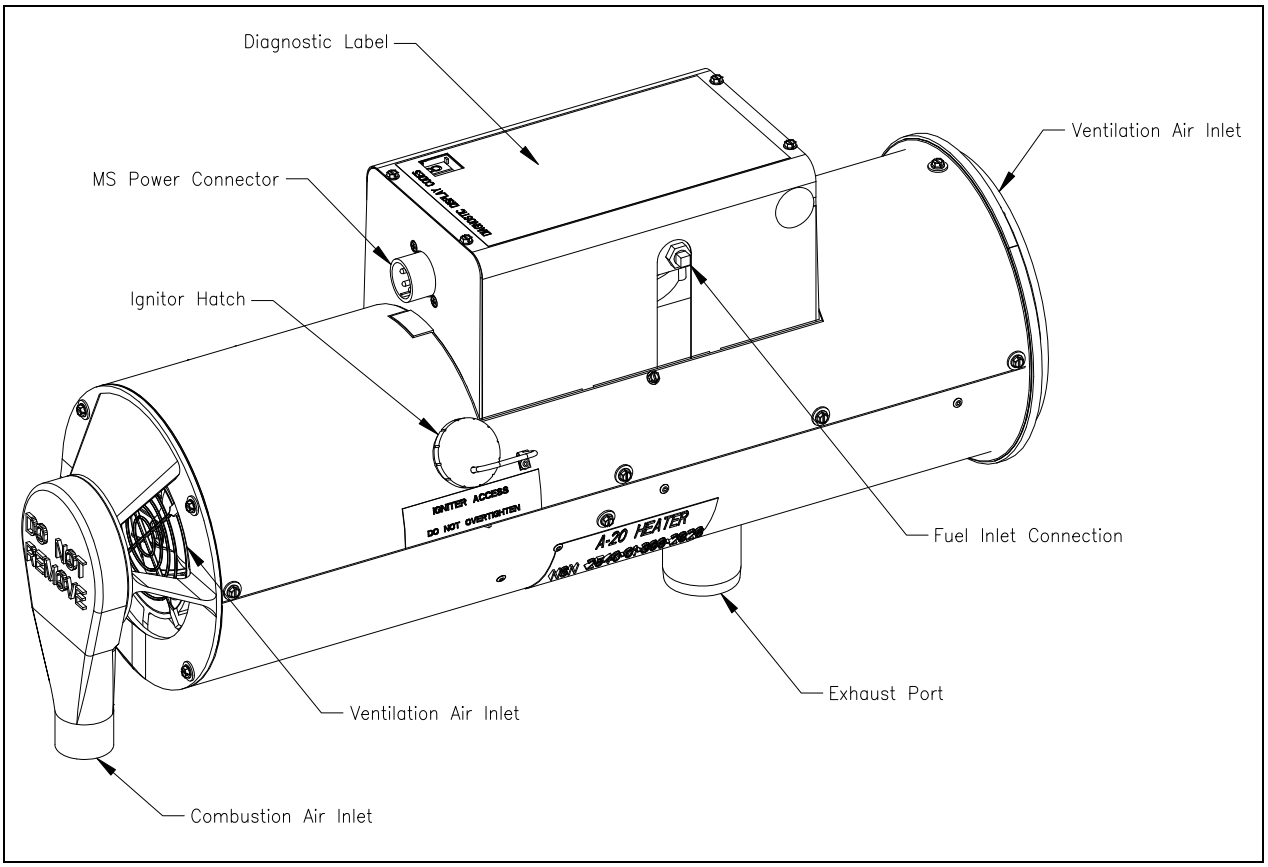

Figure 1.1-1. A20 heater

1.2 Principles of Operation

1.2.1 Electronic Controller

The heater operation is controlled by an electronic micro controller (Programmed Controller) supported by hardware and software. The hardware is based on a microprocessor and power handling circuits that direct signals and power to and from all inputs and outputs. The microprocessor is programmed with software to receive input data, perform calculations, and send output signals and data. The software is a unique set of instructions that the microprocessor executes to perform calculations, store information, read input data, control output signals, and measure time.

Programmed Controller inputs are required to power the electronic controller board, and to provide input data to the micro-processor. Programmed Controller outputs are used to operate the heater assemblies for ignition, air delivery, fuel delivery, safety, and self diagnosis.

1.2.2 Burner

The Burner uses a fuel spinner that can atomize all types of diesel fuel; a sheathed glow plug Ignitor is used to ignite the fuel; a Burner Temperature Sensor (Thermocouple) in the Burner, and another in the Heat Exchanger exhaust monitor operating temperatures. During the heater start up, the Ignitor is energized, and a small amount of fuel is then introduced (approximately one minute after the Ignitor is turned on). When ignition of the fuel happens, the Programmed Controller will sense a rapid Burner temperature increase. When this temperature increase is detected, the Programmed Controller will output signals to deliver more combustion air and fuel to the primary burner. Fuel is pumped through a spinning shaft spraying the fuel into a mist, which is then ignited. As the Burner temperature steadily increases, so does the air and fuel delivery rates. If at any time during this ramp-up phase a flame-out should occur, the Programmed Controller will reduce air and fuel delivery until the Burner temperature sensor detects that ignition has been re-established.

During start up, about 10 to 20 percent of the normal fuel quantity is delivered for ignition purposes. This ensures a safely controlled start and prevents the Burner from flooding with fuel. This allows the operator to restart the heater without excessive fuel build up inside the Burner and the Heat Exchanger.

Note: The operator should not try more than three (3) consecutive start attempts without referring to the Diagnostic Display code displayed, and commencing Troubleshooting and any recommended maintenance actions.

1.2.3 Heat Exchanger

The Heat Exchanger transfers the heat from the combustion gases to the ventilation air stream. Hot combustion gases from the Burner enter the Heat Exchanger, circulate through a number of passage ways and exit through the Exhaust Port. Ventilation air is passed from the Ventilation Air Inlet end of the heater, blown through the Heat Exchanger (where it exchanges heat from the walls of the flame tube), and then exits at the Ventilation Air Outlet end.

! Warning !
Nothing should be welded, screwed or otherwise attached to the Heat Exchanger because this may cause the Heat Exchanger to leak and introduce toxic fumes into the ventilation air stream.

1.2.4 Combustion Air System

Combustion air is drawn either from inside the vehicle (single air mode), or from outside the vehicle (dual air mode), using a fan and motor completely separate from the ventilation air system. (The combustion fan and motor are located in the Top Housing). The combustion air is then blown into the Burner in two locations, through primary, and secondary air ducts.

If combustion air is coming from outside the vehicle, then the Combustion Air Inlet must be connected to a duct, and in turn to the outside of the vehicle. The Combustion Air Inlet connects to a 1.5" inside diameter duct that must be suitable to withstand ambient temperature and humidity conditions and an internal negative pressure of 10 inches water column. The Combustion Air Duct must be securely clamped at the Dual Air Adapter Assembly.

Note: The nozzle of the Dual Air Adapter can swivel 360° to align with the vehicle's combustion air inlet ducting.

Note: The heater does not require a combustion air filter.

1.2.5 Fuel Delivery

Fuel is delivered by a Fuel Pump and a Fuel Injector located in the Top Housing. The Fuel Pump is used to boost the fuel pressure during extremely cold weather and low fuel pressure conditions so that sufficient fuel is delivered for heating.

Note: The heater can be operated without the Fuel Pump functioning as long as the fuel supply remains at reasonable temperatures and pressures.

The Fuel Injector is used to regulate fuel flow with a high degree of resolution (from 0% to 100% flow). Since the Injector is normally closed, it must receive signals from the Programmed Controller to deliver fuel. As an additional safety feature, a Thermal Fuse is placed in line with the injector control signal so that if a serious over temperature condition should happen, the injector control signal is interrupted, and the normally closed Injector will stop fuel flow.
The fuel supply line must have a fuel filter to prevent contaminates from entering the heater fuel system. Large contaminates may block fuel flow, or prevent the Injector from closing properly.

A Fuel Pressure Sensor on the Heater Fuel Inlet will signal when the fuel pressure delivered to the heater is below 3 PSIG. Normal operation, with full heat output, can still be achieved even at a fuel supply pressure as low as 3 PSIG.

1.2.6 Ventilation Air

Ventilation air is drawn from within the vehicle at the Heater Inlet by a high flow Vent Fan. The vent air stream is heated as it flows past the Burner and the Heat Exchanger before it is discharged out of the heater outlet.

In high heat mode the temperature of the outlet air is about 250°F higher than the inlet air. For example, if the inlet air is -40°F, then the outlet air will be about 210°F. In low heat mode the vent air flow remains the same, but the outlet air temperature is about 125°F higher than the inlet air.

The amount of heat produced will begin to be automatically reduced if the outlet air temperature exceeds 325°F. If the outlet air temperature exceeds 345°F, the heater will force a shut down, and enter purge mode.

The heated outlet air may be discharged into a duct that distributes the heated air throughout the vehicle. Such an air duct should be 8" inside diameter, and be rated for 350°F under continuous operation. The duct must allow unobstructed air flow.

Note: The ducting should be directed away from walls or obstructions to allow clear re-circulation of vent air.

1.2.7 Exhaust

The exhaust temperature of the heater always exceeds 500°F in run mode and can reach temperatures as high as 1,300°F. The Heater Exhaust Tube connects to a 2" inside diameter duct. The duct must be rated for at least 1,100°F continuous operation, be leak tight, and secured from movement.

1.2.8 Enclosure

Two semi-circular shells, top and bottom, are used to enclose the heater. A seam on each side of the enclosure is used to minimize ventilation air leakage and maximize structural strength. A Top Housing protrudes from the Top Shell of the heater. This Top Housing contains most of the fuel system, combustion air system and diagnostic display components. The Top Housing can be accessed directly by removing the Top Cover.

1.3 Specifications

Reference Table 1.3-1 for A20 heater Specifications.

Nominal Heat Output	60,000 BTU/Hr High Heat 30,000 BTU/Hr Low Heat
Size	Ref. Figure 1-2
Weight	38.4 Lbs (17.5 Kg)
Power Consumption	480 Watts at 24VDC
Air Flow	225 SCFM Free Flow 205 SCFM (minimum) at 3" Back Pressure
Combustion	Rotary Slinger Fuel Atomization Replaceable Nickel Alloy Burner Cartridge Replaceable Nickel Alloy Sheathed Glow Plug
Control	Automatic Electronic Control Hands Free Start
Diesel Fuel Consumption	0.8 USG/Hr High Heat 0.5 USG/Hr Low Heat
Durability	2,500 Hours
Heat Exchanger Construction	Nickel Alloy
Operation	-55°F to 95°F (-48°C to 35°C)
Environment	Corrosion Protected Shock and Vibration Resistant
Diagnostics	Automatic Fault Detection of Components Serial Port Data Output
Safety	Vent Outlet Temperature Limit: 350°F (177°C) Exhaust Temperature Limit: 1,300°F (704°C)

Table 1.3-1. Heater Specifications

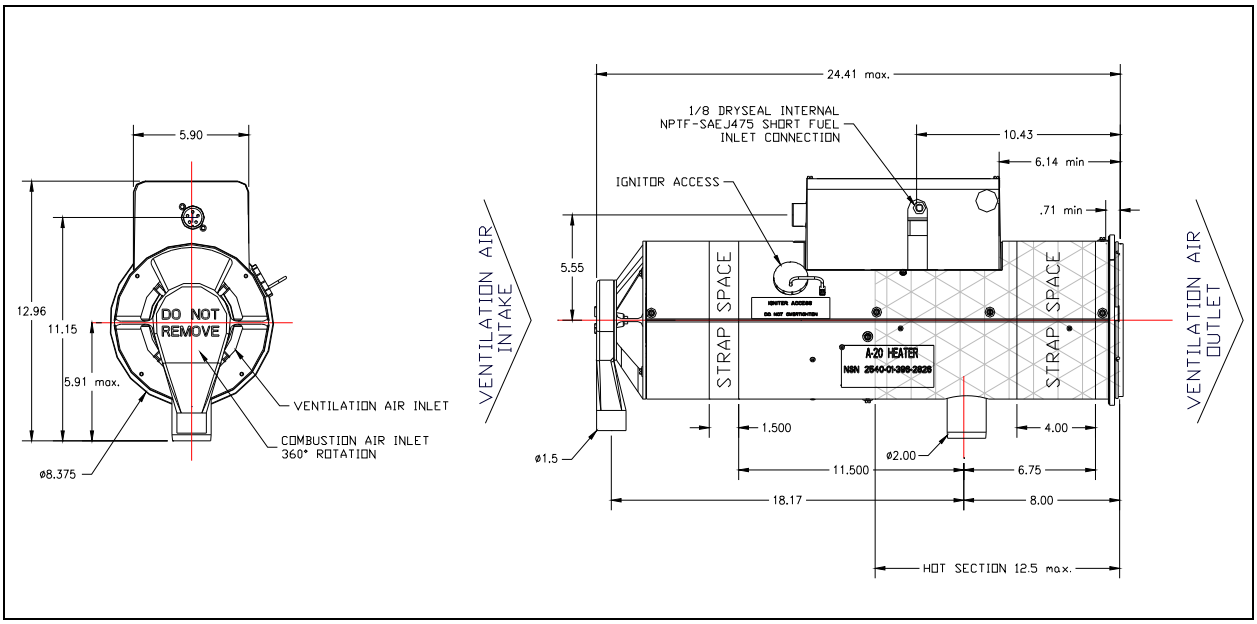

Figure 1.3-1. A20 heater, General Dimensions

1.4 Shipping Container

Each heater is sealed in a plastic bag and shipped in an individual container.

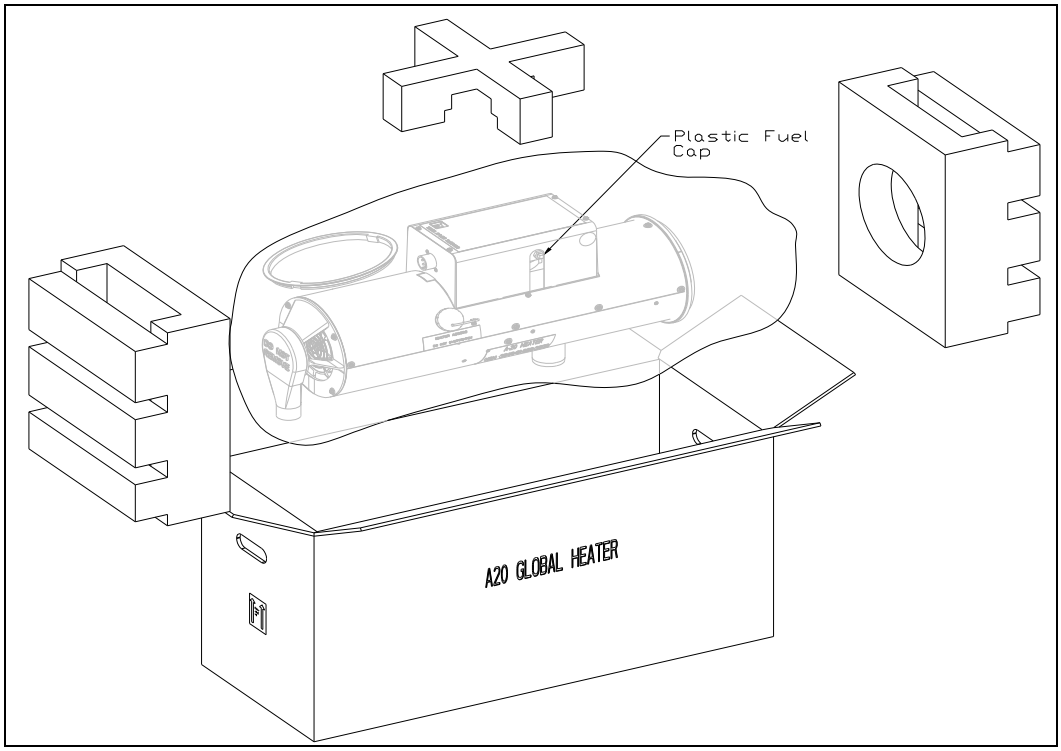

Figure 1.4-1. Shipping Container

Shipping Container (continued)

If the shipping container appears damaged, inspect the contents and look for dents on the exterior of the heater. There are no loose parts in a functional heater.

! CAUTION !
When transporting the heater, ensure it is done so in the correct orientation, as depicted in Figure 1.4-1.

1.5 Heater Operation Verification

To unpack the heater, complete the following steps:

1. Open the box.

2. Verify contents:
(1) Fully Assembled Heater NSN: 2540-01-396-2826.

Note: The Vent Outlet Seal is shipped loose in the plastic bag to avoid shipping damage from the protective end packaging material.

3. Lift out top packaging brace.

4. Lift out the heater (enclosed in the sealed plastic bag) and end packaging pieces.

5. Remove the two end packaging pieces and remove the heater and seal from the plastic bag and install the Vent Outlet Seal.

6. Remove the plastic cap from the fuel inlet.

7. Save all packaging for shipping or storage.

! CAUTION !
When handling the heater be careful NOT to damage the rubber Outlet Seal on the Ventilation Air Outlet end as this will affect performance of the heater when installed!

1.6 Tools And Supplies

The equipment described does NOT require Metric tools. Operator and Maintenance Instructions are provided using Imperial/SAE units. For informational purposes, a Metric conversion table is included on inside back cover.

Tools And Supplies (continued).

No special tools or test items are required for operating and maintaining the heater. The standard tools and supplies required are outlined in Table 1.6-1.

Open Ended Wrenches:	3/8", 7/16", 9/16", 3/4"
Sockets:	5/16" & 1/4" socket
3/8" & 3/4" deep socket	
Nut Drivers	1/4" & 5/16"
Allen Wrenches:	3/32"
Screwdrivers:	Small blade, #1 blade
	#1 cross tip at least 6" in length, #2 cross tip
Pliers:	Standard pliers, Expandable pliers
Punches/Stamps:	Lettering & numbering punch set
	Pop rivet gun
Wire Brush	
Digital Multi-Meter	Part of General Mechanics Tool Kit (NSN 5180-01-483-0249)
Nippers.	
Supplies:	Thread lock, Loctite 243 (blue)
	Teflon thread sealant, Loctite PST 592
	Nickel anti-seize, Loctite 77164
	Primer, Loctite 770, with Adhesive Loctite 401
	Adhesive, Loctite 609
	Dow Corning 340 Heat Sink Compound
	Silicone RTV (red)
	P80, DF2
	Common grease (GAA)
	Fuel Line Lubricant, International Products Corp. P-80

Table 1.6-1. Tools and Supplies Required

1.7 Disposition of Used Parts

Dispose of used and replaced parts from the heater in accordance with unit Standard Operating Procedures (SOP).

1.8 Storage

The following provides guidelines for storing the heater:

- The dimensions of the heater container are 12" X 24" X 36”.
- Store the heater indoors, at a temperature between -65 & 160°F (-85 & 71°C).
- When packing the heater for storage or shipping ensure that the plastic cap is placed in the fuel inlet and the heater is placed in the plastic bag before packaging.
- The heater containers may be stacked up to three (3) on top of each other.
- The container and the heater together weigh 48 pounds (22Kg).
- Ensure the heater is stored in the correct orientation, as shown in Figure 1.4-1.

2 INSTALLATION

The heater meets the performance requirements specified when it is mounted, in any position from horizontal to vertical with the ventilation air inlet level with, or higher than the ventilation air outlet. For installation instructions, consult the Vehicle Technical Manual (see Appendix A) for the appropriate location and mounting methods for the particular vehicle.

2.1 Dual Air Conversion

The heater can operate in either the dual air, or the single air configuration. The A20 heater is supplied in the Dual Air Configuration, but can be converted to the Single Air Configuration by removing the Combustion Air Adapter as illustrated in Figure 2-1. Conversion from dual to single air requires the use of a 1/4" socket or nut driver to remove the four (4) hex head screws, star washers, and flat washers, that attach the Dual Air Adapter to the Heater Ventilation Air inlet.

!CAUTION!
The letters "DO NOT REMOVE" refer to the center bolt on the Dual Air Adapter Assembly that holds the inlet swivel to the dual air standoff. Removal of this bolt may damage the swivel seal assembly.

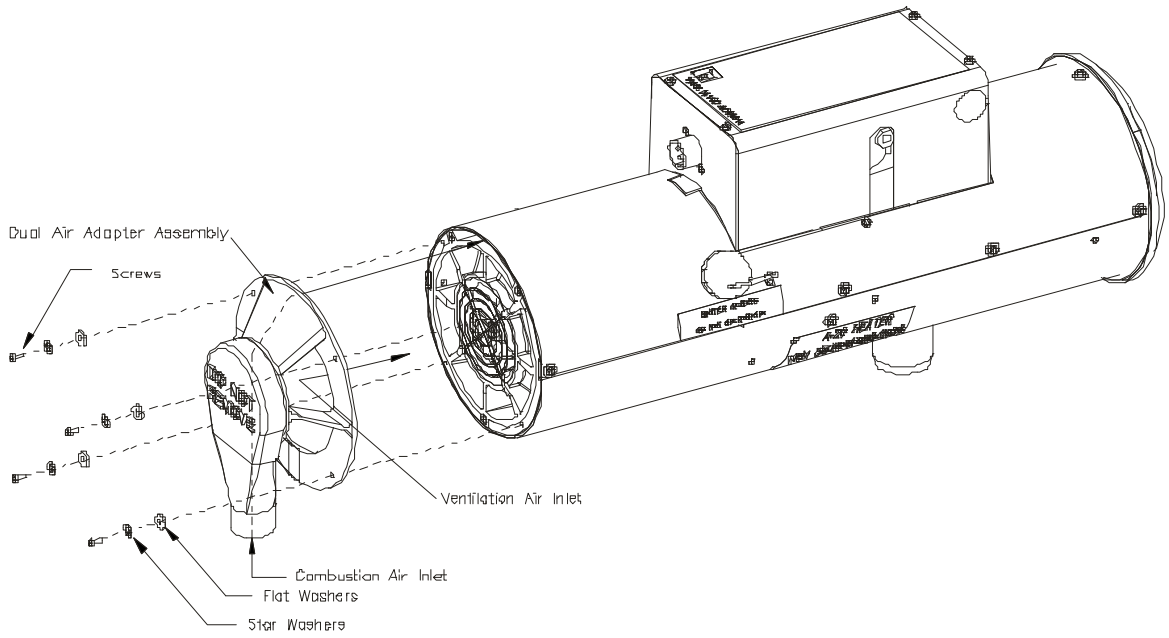

Figure 2.1-1. Single Air Configuration

2.2 Combustion Air Inlet Connection

For Dual Air Configuration - Refer to appropriate vehicle TM for instructions.

For Single Air Configuration - No Combustion air inlet ducting is required.

2.3 Exhaust Connection

Secure Heater Exhaust Port (Ref. Figure 2-3) to the existing vehicle exhaust duct so it is leak tight and secured from movement. Ensure that the exhaust ducting is rated for **continuous operation** at temperatures of 1,300°F(593°C).

2.4 Mounting

Attach two mounting straps on either side of the Top Housing in the locations illustrated in Figure 2-2.

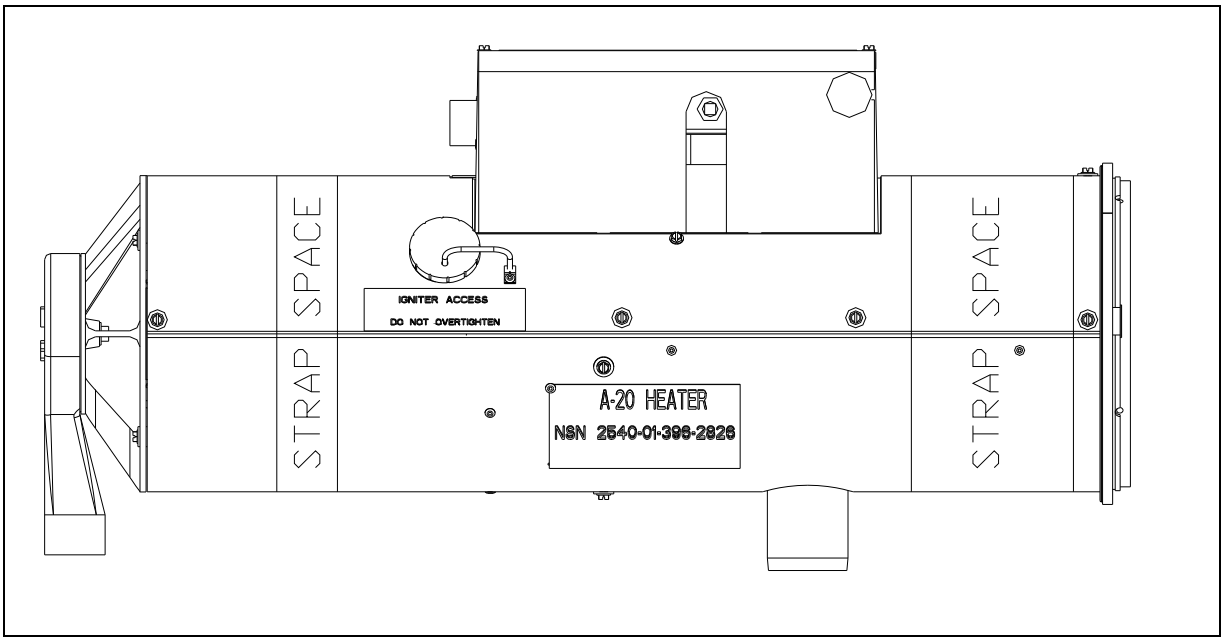

Figure 2.4-1. Mounting Strap Locations

2.5 Electrical Connections

Connect the vehicle heater power cable (see Vehicle Technical Manual) to the “keyed” Heater Military Standard (MS Power) connector (Control Box Connection). No other ground strap or other electrical connections are required. The heater provides full performance at 24VDC drawing 20 amperes of current.

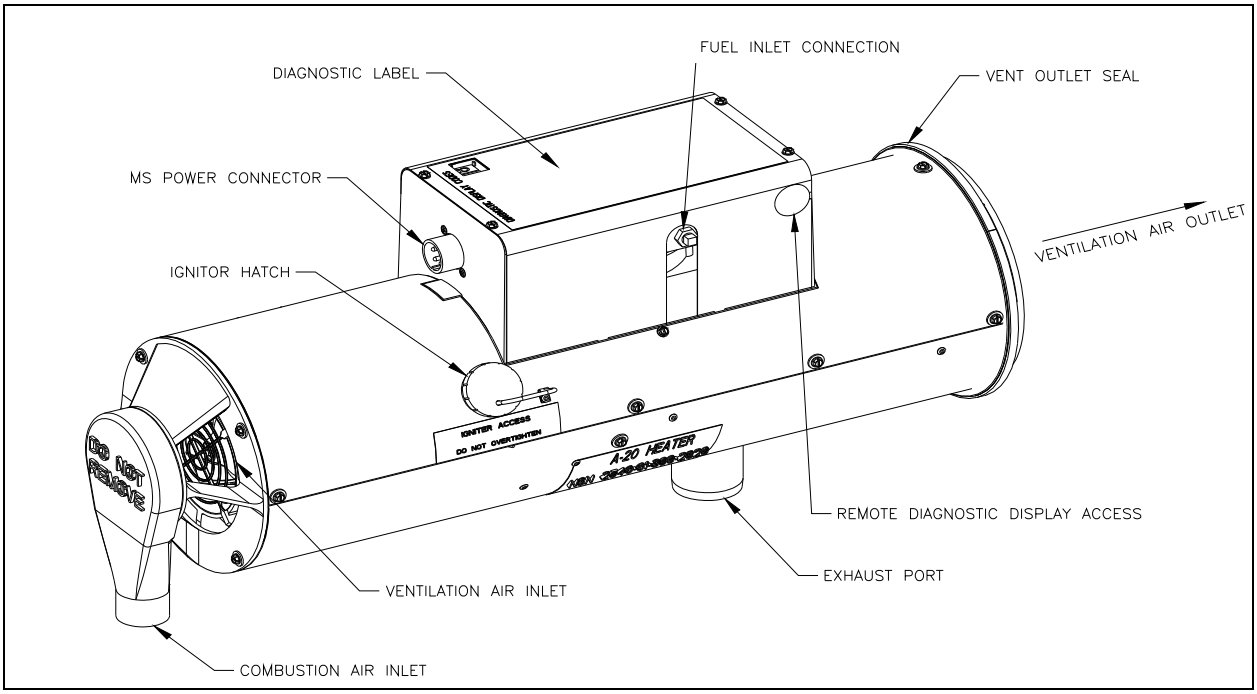

Figure 2.5-1. Hunter A20 heater

Note: The heater will operate at voltages between 19VDC & 30VDC.

!CAUTION!
All vehicle wiring and fuses must be rated for 20 amperes at continuous operation!

2.6 Fuel Inlet Connection

Remove the plastic fuel inlet plug and apply Teflon Tape (Appendix C, Item 12) or Loctite PST 592 (Appendix C, Item 5) to the vehicle fuel supply line connector threads.

!CAUTION!
Do NOT apply thread sealant to the threads on the heater's fuel inlet connection.

Screw the vehicle fuel supply line into the short fuel inlet connection (1/8-27 PTF SAE J475). The fuel supply pressure must be between 3 PSI (minimum) and 15 PSI (maximum). The fuel type used must be suitable for operating at the expected ambient seasonal temperatures (Ref.Table 2-1).

Fuel Type	Nominal Temperature Range
DL-1 (Winter Diesel)	-40°F to +104°F (-40°C to +40°C)
DL-2 (Summer Diesel)	+40°F to +104°F (4°C to +40°C)
DF-A (Arctic Diesel)	-55°F to +104°F (-48°C to +40°C)
JP-8	-53°F to +104°F (-47°C to +40°C)
JET A1	-52°F to +104°F (-46°C to +40°C)
Kerosene	-55°F to +104°F (-48°C to +40°C)

Table 2.6-1. Fuel Type Nominal Temperature Ranges

2.7 Heat Outlet Connection

A ventilation air duct should be 7.94 to 8.23" inside diameter and rated for continuous operation at 350°F. Fasten four (4) #10-32 UNF bolts (supplied with vehicle ducting) into the Heater Ventilation Air Outlet.

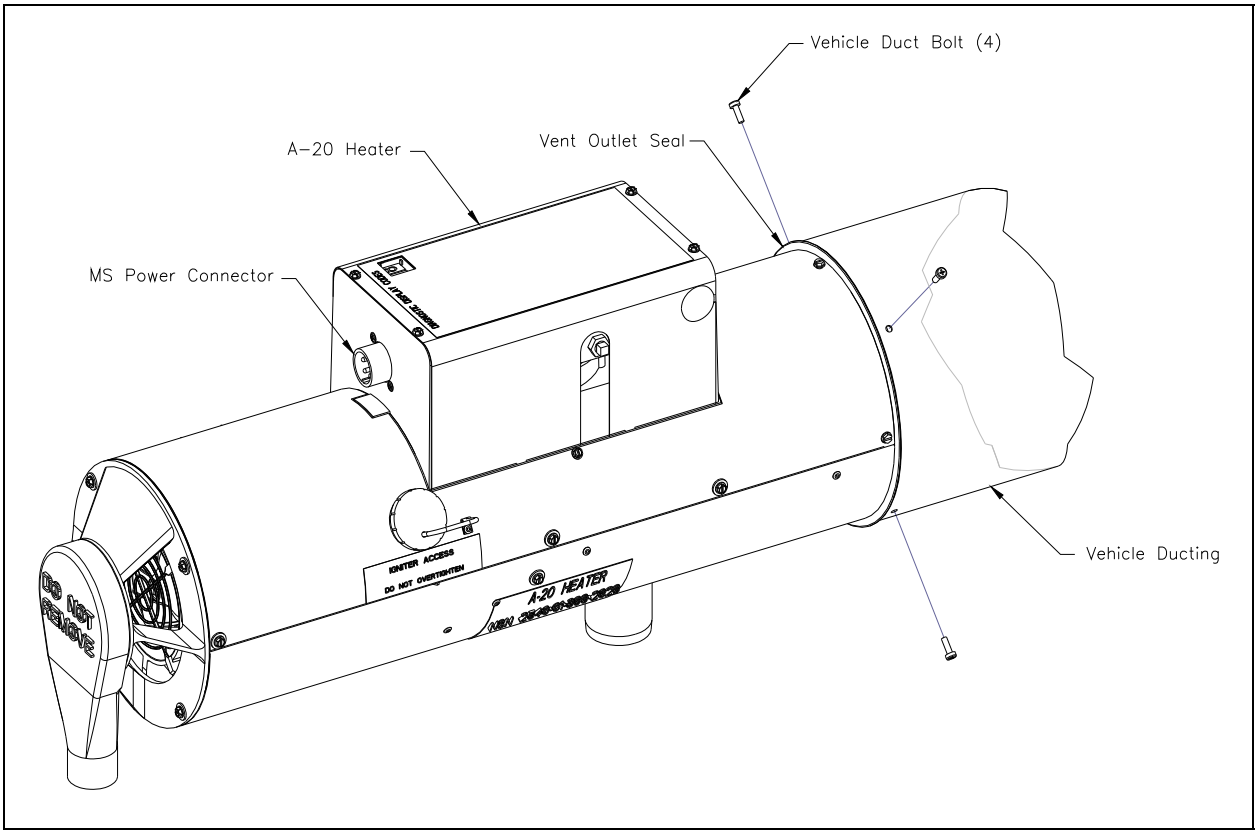

Figure 2.7-1. Ventilation Air Duct

Note: The duct should seat properly with the Vent Outlet Seal. Some resistance may be felt as the duct compresses the seal.

Note: The Vent Outlet Seal MUST be replaced EVERY time the heater is re-installed into a vent ducting system.

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3 OPERATING INSTRUCTIONS

3.1 Approved Control Boxes

The heater is compatible with the vehicle control boxes identified in Table 3-1.

Note: See appropriate Vehicle TM for proper Control Box configuration.

Control Boxes:	11669705 (NSN: 2590-01-125-6154) 12268109 (NSN: 2490-01-083-5417) 12330264 (NSN: 2540-01-158-0837)
Panel Assembly:	12345539 (NSN: 6110-01-266-4006)
Test Stand:	VHTS-89102 (NSN: 4910-01-318-4508) (for non-Depot level calibration) Hunter Model 6500 (for Depot level calibration)

3.1-1. Approved Control Boxes

3.2 Starting the heater

1. The START/OFF/RUN switch on the control box should initially be in the OFF position.

2. The HI/LO switch on the Control Box may be in either position during start up.(If the switch is in the HI position, the heater will start and enter High Heat mode. If the switch is in the LO position, the heater will start and enter Low Heat mode.)

3. To start the heater, move the START/OFF/RUN switch momentarily to START for at least four (4) seconds or until indicator light comes on, then move switch directly to RUN. The heater will now run automatically and does not require any further actions by the operator.

3.3 Starting Systems Procedures

1. The heater will start the Vent and Burner Fans. After checking for vent overheat condition, if none is found, the heater displays 01 on the Diagnostic Display. For the next 20 seconds, the heater will perform a number of diagnostic checks on both the Vent and Burner Fans and certain other components for possible failure.

2. The heater then enters Stage 02. The Ignitor will turn on and requires approximately 50 seconds to heat fully. During this delay the heater will check the condition of the ignitor, perform a diagnostic check of the segments and control circuit of the Diagnostic Display, check for reverse air flow, combustion air inlet over pressure, and low voltage conditions.

3. During the check of the Diagnostic Display it will go through a series of steps in the sequence shown in Table 3-2., each step consisting of two digits or two letters. A delay separates one check segment from the next. Observation of this check will confirm that the Diagnostic Display is operating correctly. Should the segments not appear as illustrated in Table 3-2, refer to Section 5.9.2.

Starting Systems Procedures (Continued).

Note: For A20 Design Iteration Version 3 and up (see Section 5 for details), the diagnostic display segment steps "BB" and "DD" will appear in lower case as "bb" and "dd".

00 - 11 - 22 - 33 - 44 - 55 - 66 - 77 - 88 - 99 - AA - BB - CC - DD - EE - FF

Table 3.3-1. Diagnostic Display, Segment Steps

4. The heater then enters Stage **03**. The Vent Fan speed will adjust in preparation for the ignition process and the heater will begin to deliver fuel to the Burner. A number of parameters will be monitored and components checked for failure.

5. When the heater has achieved ignition, the Ignitor automatically turns off, the Control Box Lamp illuminates, and the Diagnostic Display will read **04**.

6. If all systems are operational, immediately after ignition the heater will automatically ramp the Burner and Vent Fans to full speed, the display will read **05**.

7. While the heater is setting itself for full Run mode, the display will read **06**.

00	Shutdown Purge Mode
01	Self Check
02	Ignitor On
03	Deliver Fuel
04	Ignitor Off
05	Full Heat Ramp
06	Enter Run Mode
07	Low Heat Mode
14	High Heat Mode
99	Vent Only

Table 3.3-2. Operating Modes

3.4 Normal Operation

When the heater is in Run mode, the Diagnostic Display indicates either **07** (Low Heat mode) or **14** (High Heat mode), depending on which heat mode has been selected. At any time during Start Up or Run mode the heater can be switched into Low (30,000 BTU/Hr), or High Heat (60,000 BTU/Hr).

Note: The M1 Tank ONLY is equipped with the ability to run the heater in "Vent Only" Mode. In this case the Diagnostic Display reads "99", and the Control Box Lamp will flash with a cycle comprising two quick flashes followed by a two (2) second delay.

3.5 Shutdown Procedures

!WARNING!
In the event that an emergency shut down is required, disconnect the heater power by detaching the MS Power Connector from the heater, or disconnect the breaker to the heater.

!WARNING!
In the event of an emergency shut down, DO NOT TOUCH the heater until it has had sufficient time to cool. The Heat Exchanger remains at full temperature and the heater will not have completed a purge cycle, both of which will pose a safety hazard.

Note: The heater will also automatically shut down if an unsafe operating condition or component fault is detected.

3.5.1 Manual Shutdown

At any time during Start Up or Run Operation, the heater may be manually shut down by moving the START/OFF/RUN switch to the OFF position. When the switch remains in the OFF position for more than two (2) seconds, the heater will enter Purge Mode, and after three (3) minutes will automatically shut off. During a Manual Shut Down, the Heater's Diagnostic Display will report the Heater's Data Codes (ref. 3.6).

During Shut Down and Purge, the heater will not respond to the Control Box Switch until the three (3) minute Purge Cycle has been completed.

3.6 Purging the Heater

To manually Purge the heater, hold the Control Box Switch in the "Start" position for ten (10) seconds, and the let switch go to "Off" position. The heater will then commence a three (3) minute Purge cycle while the Diagnostic Display Code shows **00** for one minute, then cycles through the Heater Data Codes (ref. 3.6).

3.7 Heater Data Codes Mode

To force the heater to Data Codes Mode, hold the Control Box Switch in the "Start" position for one (1) second, then let switch return to "Off" position. The heater will then cycle through the Data Codes.

Note: If the Diagnostic Display appears blank and the heater is operating, the Diagnostic Display circuit has failed. Ref to section 5.5.2 for details.

Note: The codes below will appear with a lower case "d" for A20 design iteration version 3 and above (see Section 5 for more detail on design iteration versions).

D1 Operation Hours
D2 Number of Starts
D3 Version Level

Table 3.7-1. Data Codes

Heater Data Codes Mode (Continued).

Note: The codes below will appear with a lower case "d" for A20 design iteration version 3 and above (see Section 5 for details on design iteration versions).

D1 - OPERATION HOURS
Display code **D1** will be followed successively by a pair of two digit numbers (4 numbers in total) indicating the total number of hours that the heater has operated. For example **D1** followed by **12** followed by **34** means - the heater has operated 1,234 hours.

D2 - NUMBER OF STARTS
Display code **D2** will be followed successively by a pair of two digit numbers (4 numbers in total) indicating the total number of starts that the heater has experienced. For example **D2** followed by **22** followed by **17** means - the heater has been started 2,217 times.

D3 - VERSION LEVEL
Display code **D3** will be followed by a two digit number that is the version number of the Heater Software. For example **D3** followed by **02** means - the Heater Software is production version 2.

One minute after switching the heater off, the diagnostic system will display hours, starts, and version level of the heater. See Data Codes Mode Example, Table 3-5, which illustrates the display code sequence for the examples presented above (D1, D2, and D3). The shaded segments in Table 3-5 represent the time when the display is blank for one (1) second. The 'real world' numeric values associated with the respective Data Codes in the display will likely vary from those shown in the Example below.

D 1		**1 2**		**3 4**		**D 2**		**2 2**		**1 7**		**D 3**		**0 2**	

Table 3.7-2. Data Codes Mode Example

3.8 Warning & Shutdown Faults

If the Control Box Lamp begins to flash, the heater is signaling that an abnormal condition is present. The appropriate maintenance technician can correct this condition by referencing the diagnostic codes and instructions in Section 6 (TROUBLESHOOTING) of this manual.

If a Fuel Pressure Sensor or Low Fuel Pressure Warning Fault, or any of the Shut Down faults is encountered during Start Up or ignition is not achieved in the allowable 3 ½ minutes, the heater will enter Purge mode, flash the Control Box Lamp, and display the component fault.

If a Warning Fault is encountered during Run operations, the heater will alternately display the fault code and the current run code (07 or 14) on the Diagnostic Display. If possible, the heater will adjust its operation to compensate for the condition. If the condition continues and operation is no longer possible, the heater will enter Purge mode, and steadily display the Warning fault. With the exception of the Low Fuel Pressure and Fuel Pressure Sensor Fault warnings, the Control Box Lamp will **not** flash if a **Warning** fault is displayed. In the case of a Low Fuel Pressure Fault, the Control Box Lamp will flash in a cycle comprising two (2) quick flashes

Warning & Shutdown Faults (Continued)

followed by a two (2) second delay. In the case of a Fuel Pressure Sensor Fault, the Control Box Lamp will flash in a cycle comprising three (3) quick flashes followed by a two (2) second delay.

If the Shut Down faults in Table 3-7 are encountered, the heater will cease to attempt a Start Up or, if in Run mode at the time of the fault occurrence, will cease to produce heat and will immediately enter the Shut Down and Purge modes to avoid operating in an unsafe condition. The Diagnostic Display will display the fault code and the Control Box Lamp will flash in a cycle comprising one (1) flash followed by a two (2) second delay.

C7	Fuel Pressure Sensor Fault
C9	Fuel Pump Fault
E2	Low Fuel Pressure
E5	Inlet Over Pressure
E6	System Voltage*
F3	Heat Limit
F6	Ambient Over Temperature

* Displayed only for A20 Design Iteration Version 3 and above.

Table 3.8-1. Warning Faults

C1	Ignitor Fault
C2	Ignitor Short
C3	Vent Fan Fault
C4	Burner Fan Fault
C5	Burner/Exhaust Sensor Fault
C6	Vent Sensor Fault
C8	Controller Fault
CA	Fuel Injector Fault
E1	Low Voltage
E3	Low Burner Air Flow
E4	Reverse Burner Air Flow
E6	System Voltage*
F1	Ignition Overtime
F2	Burner Flame Out
F4	Vent Air Over Heat
F5	Over Current
F7	Exhaust Over Temperature
F8	Ignition Flames Out

* Displayed only for A20 Design Iteration Version 3 and above.

Table 3.8-2. Shut Down Faults

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4 HEATER INSPECTION

Failure to follow these safety precautions could result in serious injury or death to personnel and/or property damage. Refer to FM 4-25.11 for first aid information.

WARNING

Carbon monoxide is a colorless, odorless gas, and if inhaled, can be lethal. Never operate a heater without venting the exhaust out of the test area or vehicle. The heater consumes oxygen and produces carbon monoxide gas which is vented through the exhaust. Adequate exhaust ducting must be provided to avoid carbon monoxide leakage and poisoning of personnel.

WARNING

Should the heater not start within three (3) consecutive attempts, refer to the Troubleshooting guide in Section 6 of this manual. **DO NOT** try to start a flooded heater and **DO NOT** use starting aids such as ether to assist in heater start-up, or a fire hazard may occur resulting in possible injury or death to personnel.

WARNING

DO NOT place combustible materials within three (3) feet of the heater exhaust.

WARNING

DO NOT smoke or allow open flame nearby while conducting maintenance work on the heater as diesel fuel and its fumes can be explosive.

WARNING

If the heater has been running recently, the Ignitor, the Exhaust Port, and the Heat Exchanger are hot enough to burn unprotected skin.

WARNING

Hearing can be PERMANENTLY DAMAGED if exposed to constant high noise levels of 85dBA or greater. Wear approved hearing protection devices when working within two (2) feet of the heater inlet. Personnel exposed to high noise levels shall participate in a hearing conservation program in accordance with DA PAM 40-501. Hearing loss occurs gradually and becomes permanent over time.

WARNING

After disconnecting electrical power from the heater and detaching the MS Power Connector, the Pins A and D of the heater's male connector remain electrically live with 24VDC. This condition remains for approximately five (5) minutes while a capacitor discharges. Personnel should avoid touching the contacts of this connector as electrical shock may occur.

WARNING

Remove rings, bracelets, wristwatches, and neck chains before performing maintenance on the heater. Jewelry can catch on equipment and cause injury or may short across an electrical circuit and cause severe burns or electrical shock.

WARNING

Particles blown by compressed air are hazardous. When using compressed air to clean the inside parts of the heater, do not exceed 30psi (207 kPa) air pressure. Make certain that the airstream is directed away from the user and other personnel in the immediate area. To prevent injury, personnel must wear protective gloves and goggles or face shields when using compressed air. For first aid information refer to FM 4-25.11.

WARNING

Fuel underfoot is slippery and can cause falls. To avoid injury clean up spilled fuel immediately. For first aid information refer to FM 4-25.11.

WARNING

Fuel lines must be inspected on a regular basis for the presence of cuts, leaks, or other damage that may lead to fire or other damage. Failure to do so may result in injury or death to personnel.

4.1 Periodic Service and Inspection

The A20 heater is designed to operate with unscheduled maintenance. However, conducting regular inspections will help improve the life and performance of the heater.

At the beginning of **every** winter season:

1. Clear of lines of fuel and inspect the lines for the presence of cuts, leaks, or other damage that may lead to fire or other damage. Failure to do so may result in injury or death to personnel.

2. Operate the heater and allow it to run in high for approximately one hour. If the heater functions correctly, no further inspection is required.

4.2 Mandatory Fuel Line Inspection

All A20 heaters must be inspected at the first opportunity upon receipt in accordance with the procedures outlined below.

The initial setup for this task is engine stopped and heater off. The inspection is to be performed by a unit maintenance representative using a general mechanics tool kit, automotive. There are no materials or parts needed for this inspection.

1. Inspect heater area for fuel leaks:

    a. Check Vehicle fuel filter, fuel pump, fuel inlet hose and all fittings for leaks.

    b. Check heater mounting area for signs of fuel pooled in the area (leaks are found refer to step eight (8)).

2. Check personnel heater for signs of fuel leaks:

    a. Check body of heater for signs of leaks or stains from prior leaking (leaks are found refer to step eight (8)):

3. Remove heater top housing cover (TM 9-2540-207-14&P). Remove four (4) screws and washers from top cover. Gently remove heater cover from heater body.

4. Inspect heater components for leaks (leaks are found refer to step eight (8)):

    a. Check fuel injector, fuel pressure sensor, and fuel pump connections for leaking fuel.

    b. Check all flexible hoses, fittings and connections for leaking fuel.

5. Start personnel heater (TM 9-2350-284-10-1, WP 0026-00, TM 9- 2350-284-10-1-1, WP 0028-00, TM 9-2350-294-10-1, WP 0025-00).

6. Re-inspect heater components for fuel leaks:

    a. If fuel leaks are found in step one (1), repair at unit level.

b. Check fuel injector, fuel pressure sensor, and fuel pump connections for leaking fuel.

7. Observe heater for excessive smoke for approximately twenty (20) minutes. Look for smoke around and under heater. Look for smoke in heated air stream (excessive smoke is observed (TM 9-2350-294-20-1-1, WP 0121-00)).

8. If leaks are found:

   a. If fuel leaks are found in steps one (1) and two (2), repair at unit level.

   b. If fuel leaks are found in steps four (4) through six (6), remove heater and turn into appropriate level maintenance for repair.

Repair of any internal heater component is not authorized at unit level. If repairs are needed, turn component in to appropriate level maintenance facility.

Crewmembers must always be aware of the warning signs of potential fire, abnormal smells, smoke, flames, or fuel leaks while operating their vehicles. If any area of your vehicle has questionable shortcomings, report them to maintenance.

Operators must remain with the vehicle during heater operation to detect and suppress fires.

Crewmembers must physically rehearse fire and evacuation drills on a regular basis in accordance with the operator's manuals and applicable field manuals. As duty positions change, so do individual responsibilities during fire and evacuation. Institute these drills in your routine training activities and practice them until they become second nature.

Unit Commanders, contact your local TACOM Logistics Assistance Representative (LAR) or your State Surface Maintenance Manager for assistance if necessary.

4.3 Inspection Level

Unit Level Maintenance Procedures include Ignitor & Ignitor Holder Maintenance ONLY (ref. 4.4.1). **ALL other maintenance required on the heater is considered Direct Support.**

4.4 Unit Level Inspection

The following section, Ignitor & Ignitor Holder Inspection (4.4.1), details the required Unit Level Inspection for the A20 heater.

4.4.1 Ignitor & Ignitor Holder Maintenance

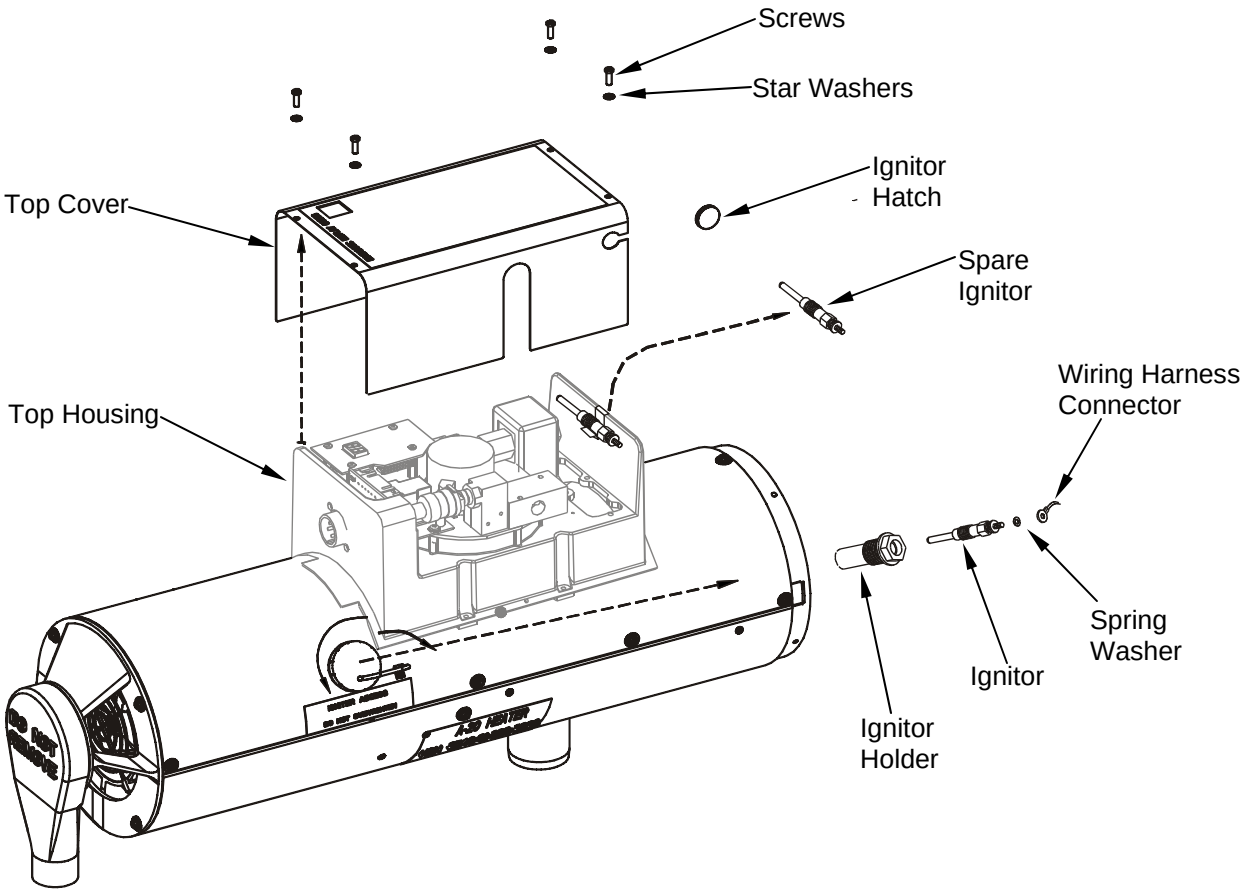


Figure 4.4-1. Ignitor & Ignitor Holder Inspection

4.4.1.1 Removal

1. Remove Ignitor Hatch by unscrewing the cap counter-clockwise.

2. Remove Ignitor electrical connector wire attached to the electrical post of the Ignitor. DO NOT pull or twist the connector wire.
   DO NOT remove the spring washer from the electrical post of the Ignitor.

3. Using a 3/8" open ended wrench, remove Ignitor threaded into the Ignitor Holder.

   Note: If the Ignitor will not release from the Ignitor Holder, it may be necessary to remove the Ignitor Holder and the Ignitor as one unit from the Burner Housing. In this case, use a 3/4" deep socket to remove Ignitor Holder threaded into the Burner Housing. Once removed, remove the Ignitor from the Holder using a 3/8" open ended wrench as well as a 3/4" open ended wrench to hold the Ignitor Holder.

4. Using a 3/4" socket, remove Ignitor Holder threaded into the Burner Housing.

5. Use a wire brush to carefully remove any carbon deposits from the Ignitor Holder.

6. Gently wipe the Ignitor with a cloth to remove any carbon buildup.

Ignitor & Ignitor Holder Inspection (Continued)

!CAUTION!
When removing or installing the Ignitor and/or Ignitor Holder, Do NOT allow any objects to come into contact with the Fuel Shaft. Damage will occur and cause heater malfunction.

Installation

!CAUTION!
Do NOT allow grease, dirt, or fingers to touch components inside Top Cover. Contaminants may cause heater failure.

1. If a NEW Ignitor is to be installed:

    a. Remove Top Cover (ref 5.1.1).

    b. Remove spare Ignitor mounted in the Top Housing.

    c. Remove the nut on the electrical post of the Ignitor, but **DO NOT remove the spring washer**. Discard Nut.

    d. Install Top Cover (ref. 5.1.1).

2. Apply Nickel anti-seize (Loctite 77164) to the threads of the Ignitor.

! CAUTION !
Be sure NOT to pinch or crush any wires when installing the Ignitor and/or Ignitor Holder.

3. Using a 3/4" socket deep socket, install Ignitor Holder threaded into the Burner Housing.

4. Using a 3/8" socket, install the Ignitor into the Ignitor Holder. DO NOT over tighten.

5. Check that the spring washer is installed on the Ignitor electrical post.

6. Place the electrical wire connector onto the Ignitor electrical post.

7. Install Ignitor Hatch by screwing the cap clockwise. DO NOT over tighten but ensure that the Hatch gasket is conforming properly to the shape of the Top Shell to seal the Hatch hole.

    Note: The Ignitor Hatch must be properly in place so that the Hatch gasket seals against the Top Shell to prevent air leakage during operation.

5 HEATER MAINTENANCE

5.1 General

!WARNING!
It is mandatory to replace the fuel lines whenever the A20 is being serviced regardless of the service task being performed. Fuel Line replacement should be done in accordance with the appropriate portion of Section 5.9.5 depending on Design Iteration. For more information on Design Iterations, refer to Section 5.2.

Repairing the heater involves disassembly, repairing of parts, replacing parts, and re-assembly. It does not involve computer programming**.**

Note: Programming of the control boards for the heater is factory set and does not require any modification or calibration. Alarms, sensors, and fault controls do not require any modification or calibration. Any attempt to override these controls may permanently damage the heater or cause personnel injury and/or property damage.

Note: The Vent Outlet Seal MUST be replaced EVERY time the heater is re-installed into a vent ducting system(ref. 5.8.4).

Note: All O-rings, Lock-washers, Star Washers, and Gaskets are mandatory replacement items.

Note: The heater power & fuel connections must be removed prior to the commencement of any repair. Some procedures may require removal of the heater from the vehicle.

Refer to the Vehicle Technical Manual to complete the following:

- The vehicle heater fuel filter
- The vehicle fuel pump
- Straightening sharp bends in the fuel supply line
- Connect all vehicle ducting to heater
- Remove any obstructions in combustion air inlet ducting
- Remove any obstructions in exhaust ducting
- Remove any obstructions in vent air ducting
- Verify that the heater is receiving proper electrical power.

These maintenance instructions provide a step-by-step approach to access the necessary components and perform maintenance. Throughout these instructions there will be references to figures that will assist in locating the various assemblies and parts.

5.2 Determining differences between design versions

There are three different design versions/iterations of the A20 Vehicular Compartment heater currently in use. This technical manual encompasses all three of those versions. In the case where the procedures in this manual vary from version to version, a separate section will be shown calling attention to the design iteration to which the procedure applies.

In general, a particular design iteration can be identified through the serial number of the heater or by the nameplate. For example, design iteration #1 was used in all heaters that have a Global Thermoelectric nameplate. Refer to Table 1 for a list of design iterations and their respective serial number ranges. However, in order to be certain of the design iteration of the A20 being used, refer to the following instructions in order to confirm.

Table 1. A20 Design Iterations

Design Iteration #1	All heaters with Global Thermoelectric nameplates
Design Iteration #2	Hunter Mfg. Co. S/N: 10001 - 21069
Design Iteration #3	Hunter Mfg. Co. S/N: 21070 - Present

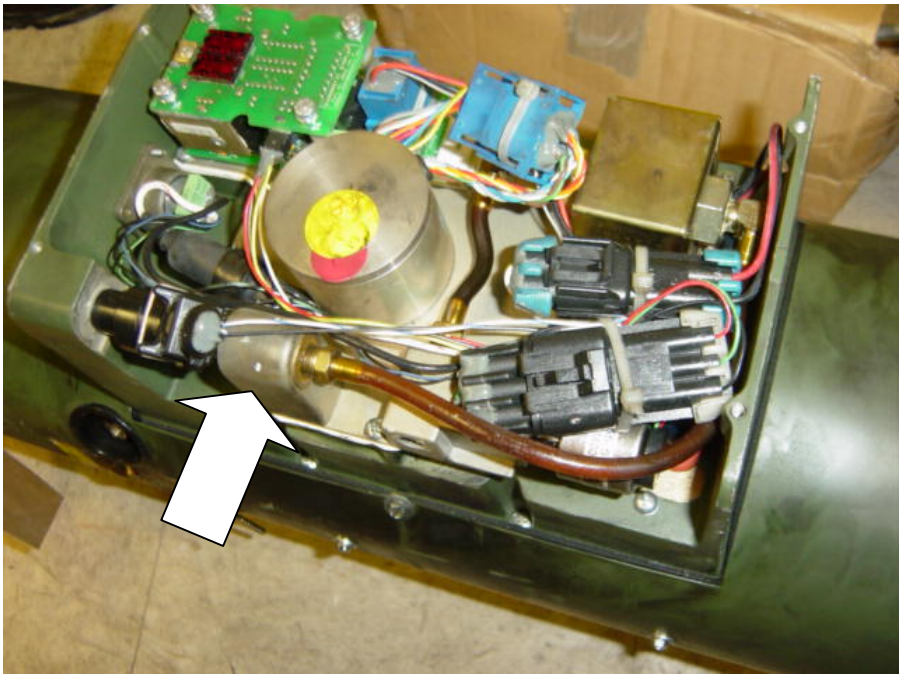
In order to determine the design version of A20, remove the top control cover by removing the four screws as shown in Figure 5.2-1 A20 Control Cover. Set the cover and screws aside.

Figure 5.2-1 A20 Control Cover

Once the cover is removed, inspect the control head area and note the following features in order to identify design iterations.

5.2.1 Design Iteration 1

This design version is the initial release of the heater and applies to all heaters with a Global Thermoelectric nameplate. This design features a cast aluminum fuel manifold with integral burner fan plate as shown in Figure 5.2-2 Design Iteration #1.



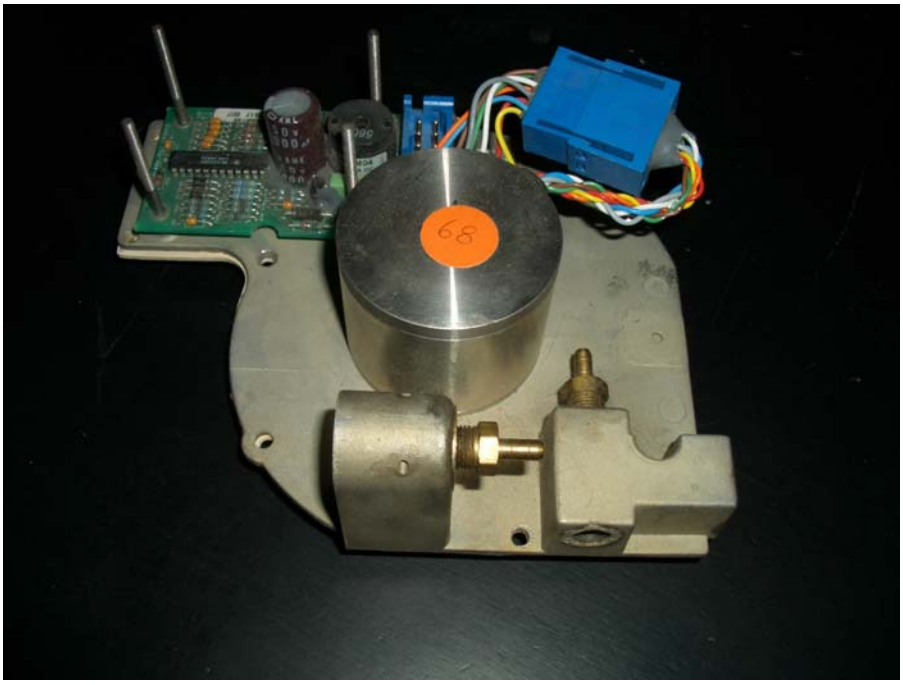


Figure 5.2-2 Design Iteration #1

5.2.2 Design Iteration 2

As shown in Figure 5.2-3 Design Iteration #2, Design Iteration 2 features a fuel manifold that is no longer cast aluminum but rather machined billet aluminum components (Item 1) and a separable burner fan plate (Item 2).

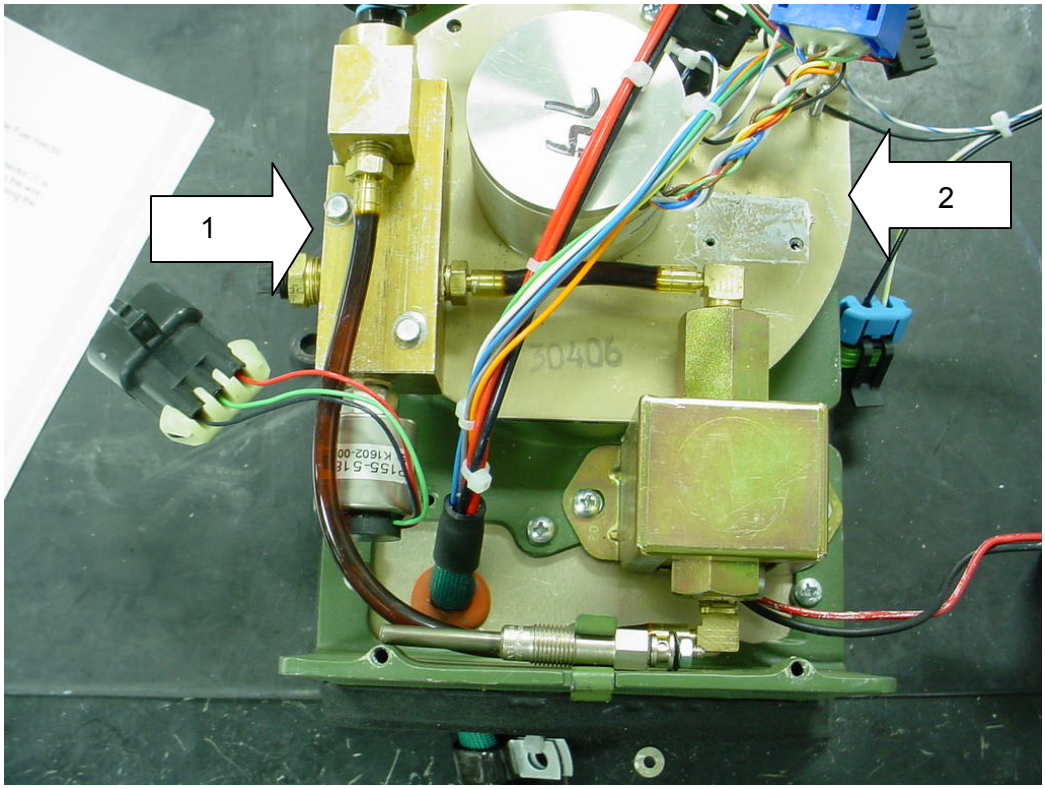


Figure 5.2-3 Design Iteration #2

5.2.3 Design Iteration 3

Design Iteration 3 can be identified by a number of electronic upgrades. All of the printed circuit boards and the wiring harness have been upgraded in this design iteration. Refer to Figure 5.2-4 Design Iteration #3 to indentify the features of Design Iteration 3.

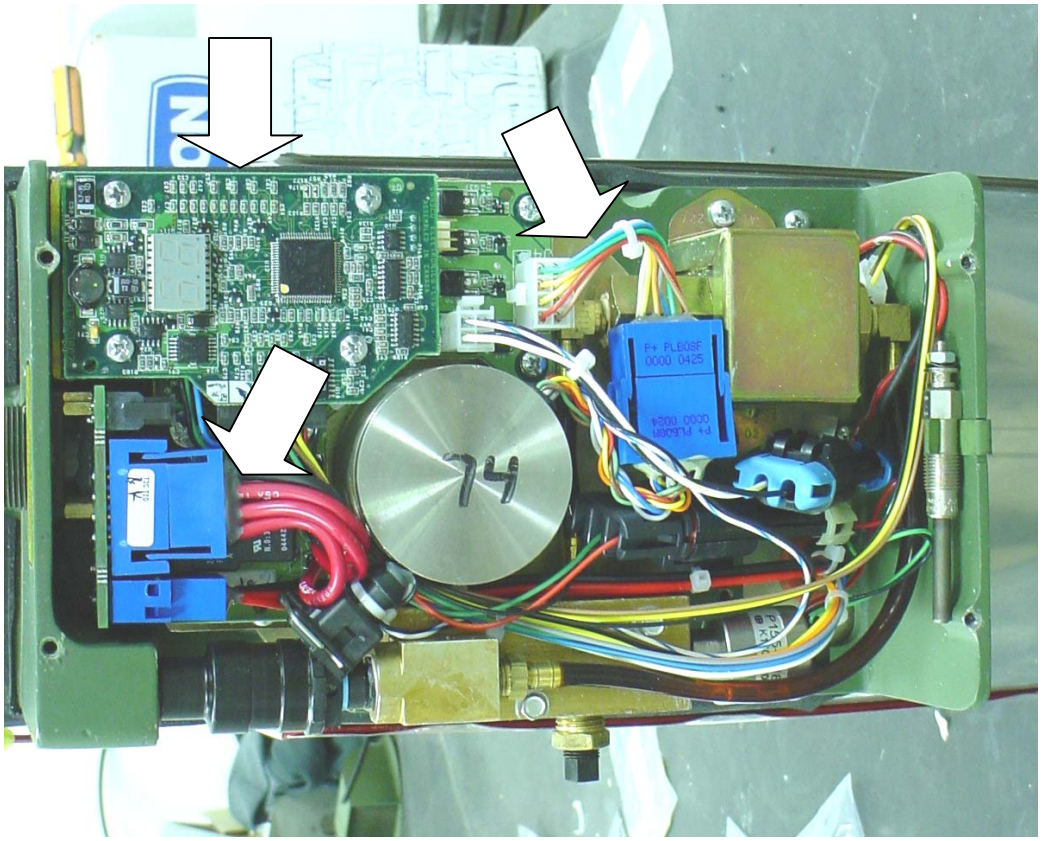


Figure 5.2-4 Design Iteration #3

5.3 A20 Major Assemblies (Applies to all design iterations)

To aid in repairs, the heater can be broken into five major assemblies:

1. Shell Assembly.
2. Vent Fan Assembly.
3. Combustion Assembly.
4. Heat Exchanger Assembly.
5. Top Housing Assembly.

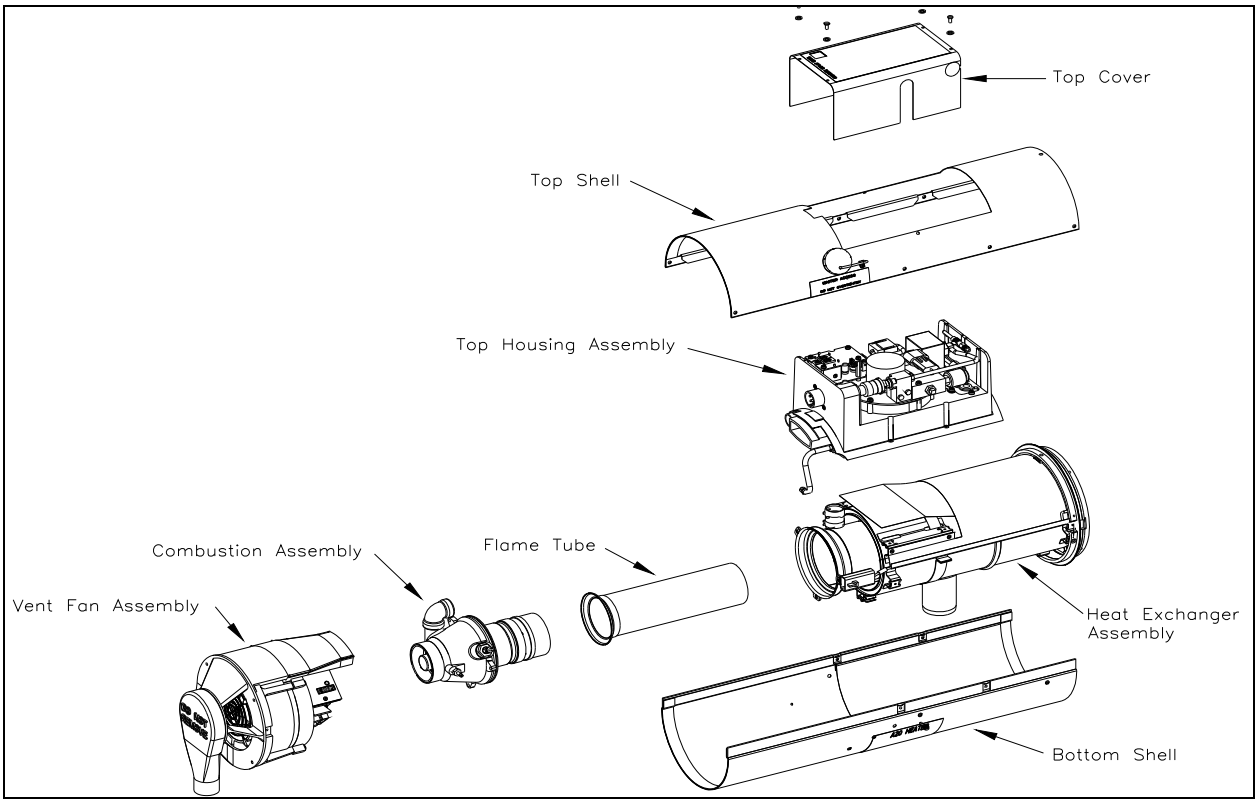


Figure 5.3-1 heater, Major Assemblies

5.3.1 Test Stand Installation & Removal

Reference TM 9-4910-755-13&P for information regarding installation and removal of the heater on a Test Stand.

Note: For service, the heater may be set on the vent air discharge end. This permits good access to the shells and most subsystems.

DO NOT set the heater with the Diagnostic Display Label facing downwards. If this configuration is necessary for removal of the Vent Sensor or Heat Exchanger, ensure that any residual fuel in the Burner or Heat Exchanger is first drained.

!CAUTION!
DO NOT set the heater on the vent air INLET end (i.e. On the casting marked "DO NOT REMOVE") as the heater will be unstable and may tip over.

5.4 Shell Assembly

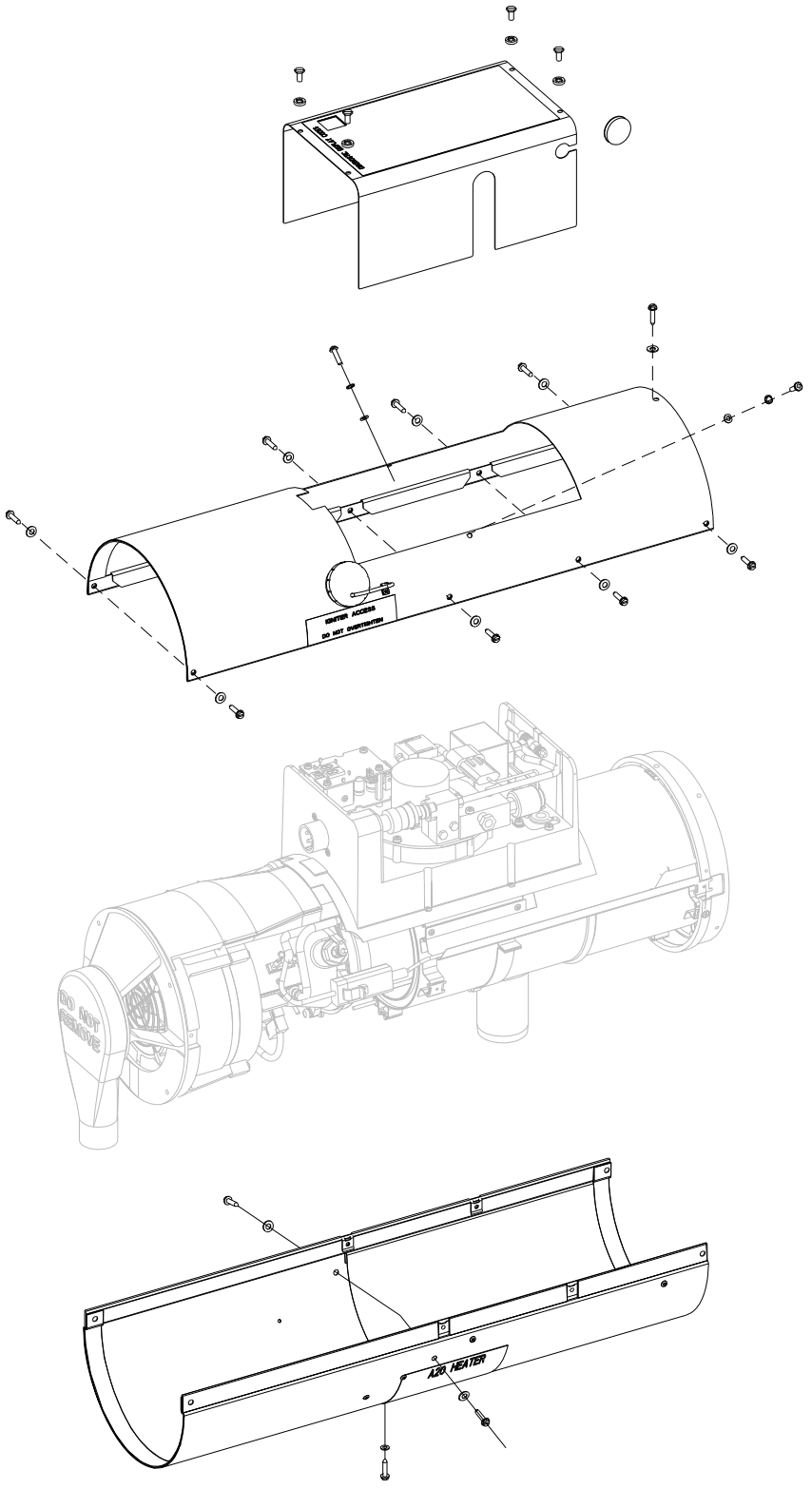


Figure 5.4-1 Shell Assembly

5.4.1 Top Cover

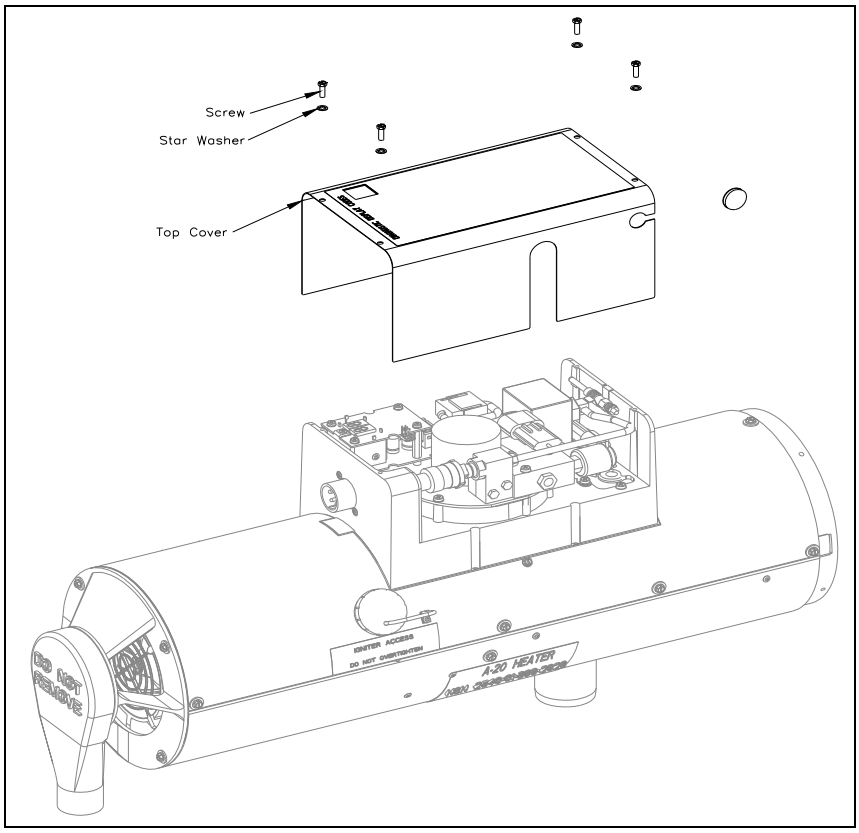


Figure 5.4-2 Top Cover

5.4.1.1 Removal

1. Use either a 1/4" nut driver, a 1/4" socket, or #2 flat blade screwdriver to remove four (4) #8-32 machine screws and star washers.

2. Gently pull top cover away from Top Housing.

   Note: The Diagnostic Code Label is permanently attached with adhesive to the Top Cover.

5.4.1.2 Installation

1. Align the slot in the Top Cover with the 1/8 inch NPT inlet fitting in the Top Housing, and place the Top Cover onto the Top Housing. Ensure the two sides of the Top Cover are kept **inside** the edges of the Top Shell.

2. Use either a 1/4" nut driver, a 1/4" socket, or a #2 flat blade screwdriver to secure the Top Cover to the Top Housing with four (4) #8-32 machine screws and star washers.

   Note: Ensure that the Wiring Harness is properly tucked inside the Top Housing and the Top Cover does not put pressure on any components or other wires.

5.4.2 Top Shell

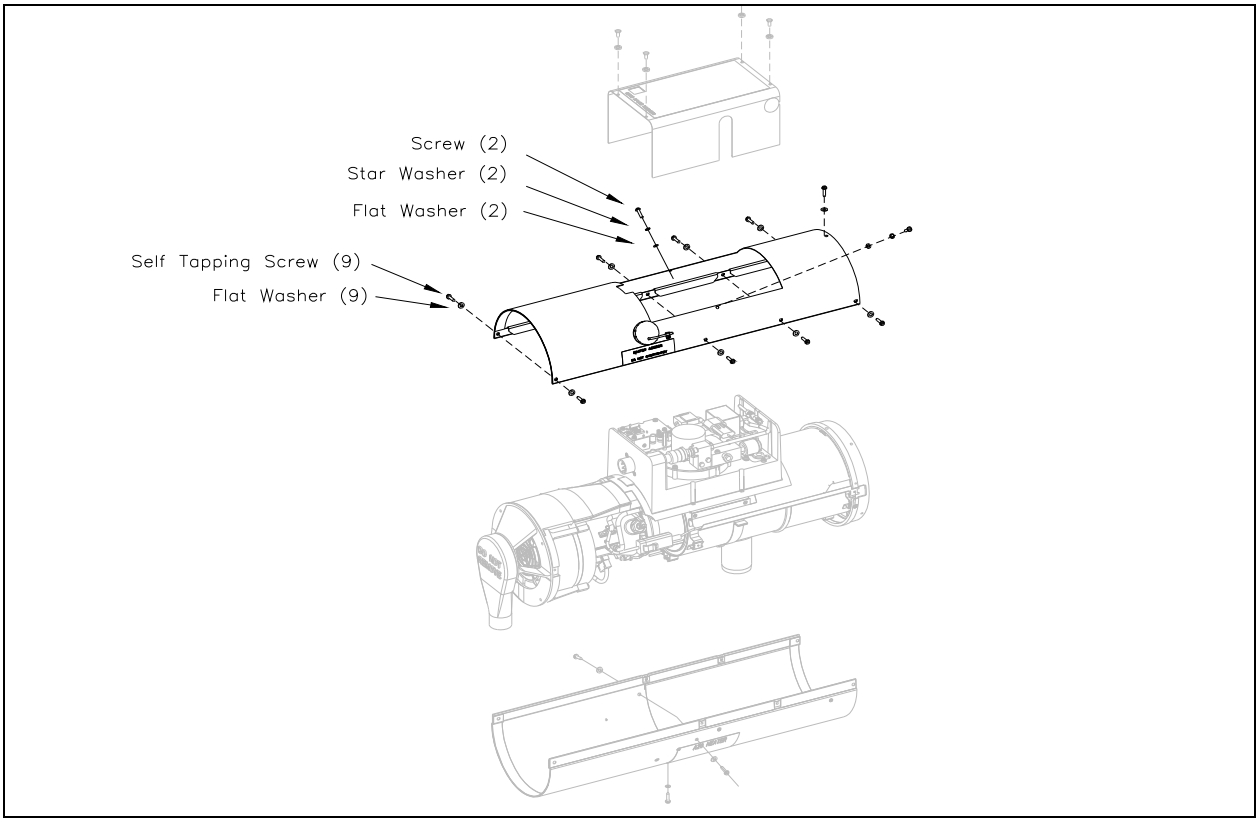


Figure 5.4-3 Top Shell

5.4.2.1 Removal

1. Remove Top Cover (ref 5.4.1).

2. Unscrew counter-clockwise and remove the Ignitor Hatch.

3. Use a 1/4" nut driver, or 1/4" socket to remove nine (9) self tapping screws and two (2) machine screws and detach Top Shell. Lift off Top Shell.

   Note: The Top Shell has gaskets on its underside which may have become compressed during use. Some careful prying of the Top Shell may be required to release the gaskets.

Top Shell Installation (Continued).

5.4.2.2 Installation

1. Check that the Top Shell is fitted with two gaskets, one on each end. Inspect the end gaskets and replace if damaged.

   Note: The gasket around the square hole should stay fixed to the Top Housing. Inspect the gasket and replace if damaged.

2. Check the condition of the side seam gaskets on the bottom shell. Replace if damaged.

3. Check that the spring washer is installed on the Ignitor electrical post.

4. Check that the Ignitor electrical connection is in place on the Ignitor. Place the Top Shell over the Top Housing, and ensure that the holes in the Top Shell line up with the holes in the Bottom Shell.

   Note: Ensure that the Wiring Harness is properly tucked inside the Top Housing and the Top Shell does not put pressure on any components or other wires.

   Note: The Top Shell has seam tabs that fit inside the mating tabs on the Bottom Shell.

   Tip: Make sure the locking tabs fit together properly, then push the Top Shell onto the Bottom Shell to compress the gaskets.

5. Using a 1/4" nut driver or socket, install the nine (9) self tapping screws and two (2) machine screws. Ensure that the seals between the two shells are properly in place.

   Note: The gaskets and the seals along the edges of the Top and Bottom Shells prevent air leakage during operation.

6. Check that the Ignitor electrical connection is in place on the Ignitor. Screw the Ignitor Hatch into place. DO NOT over tighten. Ensure that the Hatch is fitting properly to the shape of the Top Shell.

   Note: the Ignitor Hatch must be properly secured in order to prevent air leakage during operation and to ensure a good electrical connection for the Ignitor.

7. Install Top Cover (ref 5.4.1).

8. Place the heater on the Test Stand and check for operation (ref 3.1).

5.4.3 Bottom Shell

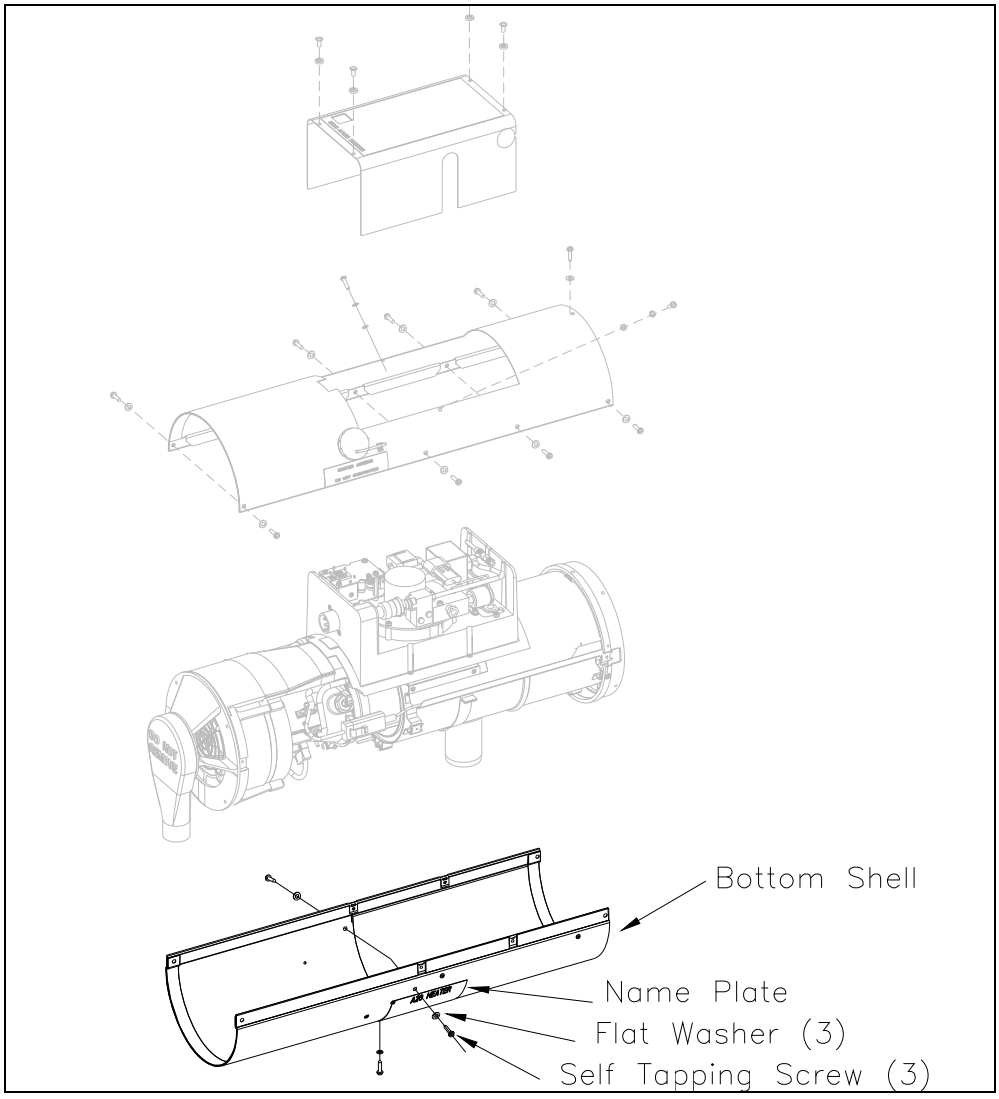


Figure 5.4-4 Bottom Shell

5.4.3.1 Removal

1. Remove Top Shell (ref. 5.4.2).
2. Using a 1/4" nut driver or 1/4" socket, remove three (3) self tapping screws. Lift the Bottom Shell off by gripping both sides and flexing open.

5.4.3.2 Installation

Note: If the Name Plate is to be replaced:
Stamp heater serial number onto replacement Name Plate using punches and stamps.

Attach the Name Plate to the replacement Bottom Shell with four (4) 1/8” x 1/4" stainless steel pop rivets using a pop rivet gun.

Bottom Shell (Continued)

Installation (Continued)

1. Replace Bottom Shell ensuring the holes in the Bottom Shell line up with the fasteners on the Heat Exchanger.

   Note: To allow alignment of Bottom Shell and screw holes, adjust the slider plate found at the exhaust hole in the Bottom Shell.

   Tip: Fit the Bottom Shell seams into the slots on each end of the heater before tightening the screws.

2. Using a 1/4" nut driver or 1/4" socket, install three (3) self tapping screws.

3. Install Top Shell (ref. 5.4.2).

5.5 Ignitor & Ignitor Holder

Refer to Section 4.4.1.

Vent Fan Assembly

5.6 Vent Fan Assembly

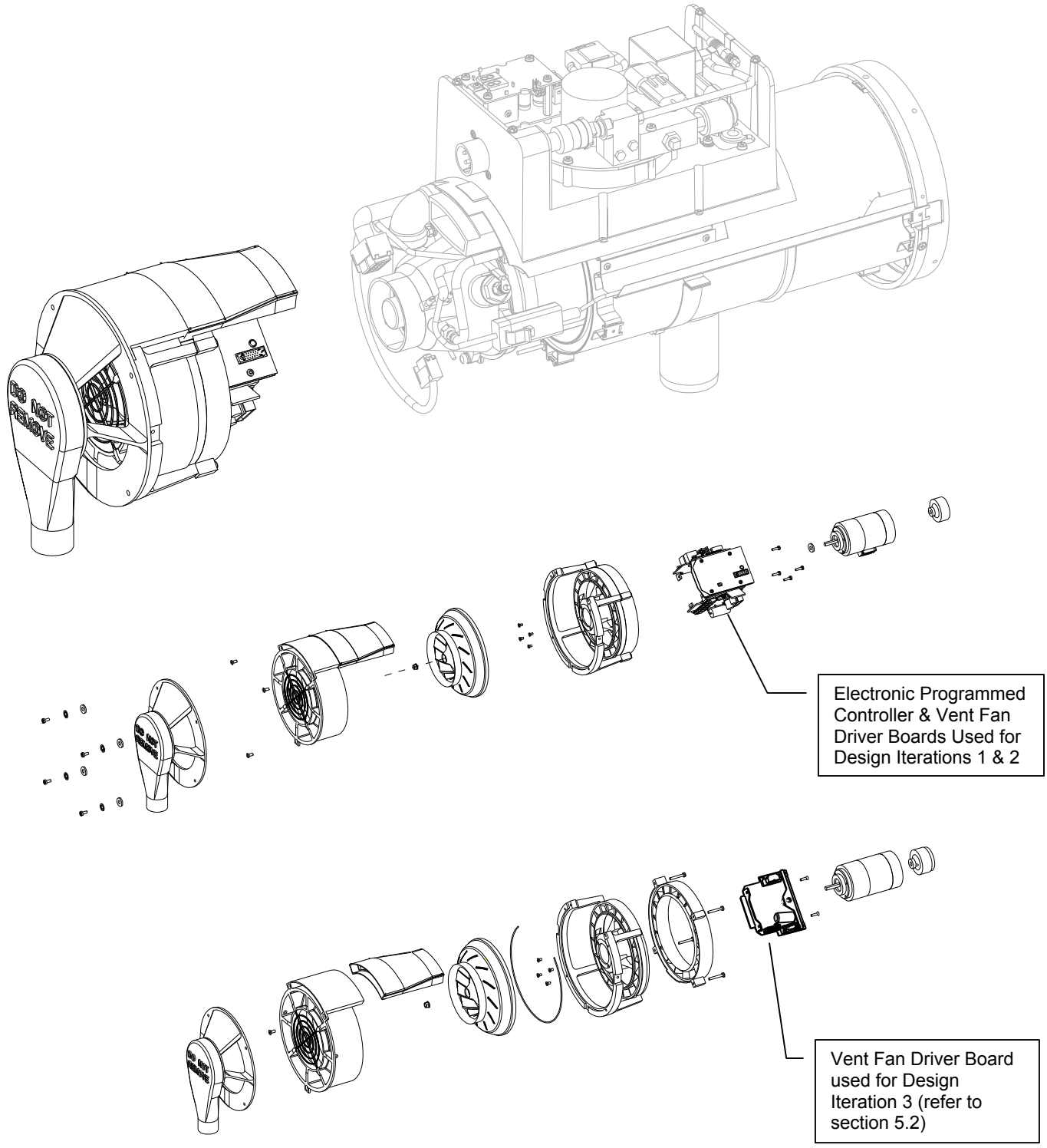


Figure 5.6-1 Vent Fan Assembly

5.6.1 Vent Fan Assembly Repair

5.6.1.1 Vent Fan Assembly Repair Procedure For Design Iterations 1 and 2 Only. (Refer to Section 5.6.1.2 for Design Iteration 3)

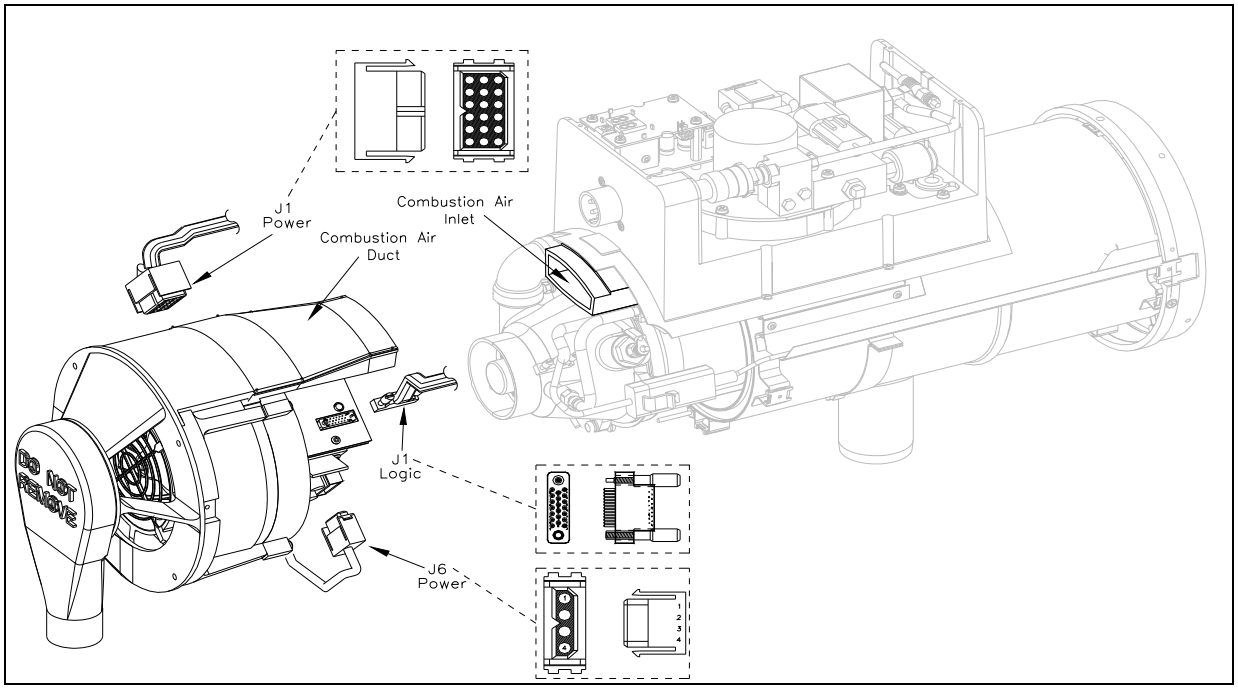


Figure 5.6-2 Vent Fan Assembly

5.6.1.1.1 Removal

!CAUTION!
When handling electronic circuits, personnel must be electrically grounded to avoid electrostatic damage to electronic components.
During the following operations take care not to damage the electronic boards.

Note: It is NOT necessary to remove the Dual Air Adapter for this operation.

1. Remove Top Shell (ref. 5.4.2).

2. Remove Bottom Shell (ref. 5.4.3).

3. Disconnect **Wiring Harness** connection **J6** to the Vent Fan Driver Board.

Note: Connector J6 is released by pressing the sides of the connector together with your fingers, releasing the locking tabs, and gently pulling apart the two halves.

Vent Fan Assembly Design Iteration 1 and 2 (Continued)

Note: To release the small Logic connector J1, use a 1/8" flat blade screwdriver.

!CAUTION!
Ensure the edge of the screwdriver blade does NOT nick the connector wires while unscrewing the connector.

4. Disconnect **Wiring Harness** connection **J1** to the Electronic Programmed Controller Board.

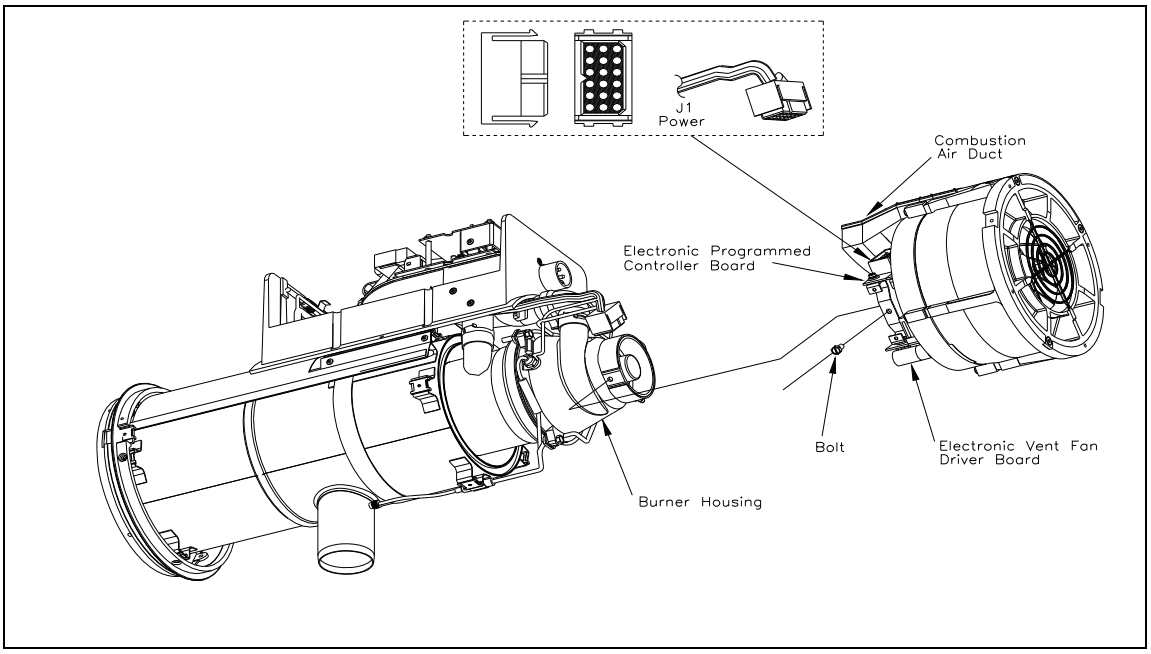


Figure 5.6-3 Bolt Removal Detail, Vent Fan Assembly

5. Use a 5/16" socket to remove the bolt that holds the Vent Fan to the Burner Housing.

!CAUTION!
Take care not to damage the Combustion Air Duct during Vent Fan removal.

6. Gently pull the Vent Fan Assembly away from the Burner Housing Assembly.

7. While holding the Vent Fan Assembly with one hand, remove the Wiring Harness connector **J1** from the Electronic Programmed Controller by squeezing with fingers and separating.

Vent Fan Assembly Design Iteration 1 and 2 (Continued)

5.6.1.1.2 Installation

Note: The Combustion Air duct should remain with the Vent Fan Assembly as it is removed. Loctite 770 primer and Loctite 401 are used to seal the Combustion Air Duct to the Vent Fan Assembly.

8. Clean the Top Housing Combustion Air Inlet by removing any old sealant, and then coat with Silicone RTV to provide a seal for the Combustion Air Duct.

   Note: The ends of the Combustion Air Duct must be sealed to the Vent Fan Assembly and to the Top Housing.

   Place Vent Fan Assembly onto the Burner Housing Assembly, ensuring that the motor frame sits correctly over the Burner Housing, and that the Combustion Air Duct is aligned with the Top Housing air inlet. DO NOT use excessive force.

9. When pushing the Vent Fan Assembly onto the Burner Housing, check that the gasket around the Burner Housing stays in position, and that the wires of the Wiring Harness are not trapped. Check that the Combustion Air Duct is properly mated with the Top Housing air inlet.

10. Tighten the bolt using a 5/16" socket. DO NOT OVER TIGHTEN. Check that the Vent Fan rotates freely.

11. Attach Wiring Harness connector **J1** to the Electronic Programmed Controller board. Ensure that the locking tabs are properly engaged.

12. Attach Wiring Harness connector **J6** to the Vent Fan Driver. Ensure that the locking tabs are properly engaged.

!CAUTION!
Ensure the edge of the screwdriver blade does NOT nick the Logic connector wires while screwing down the J1 connector.

13. Attach **Wiring Harness** connector **J1** to the Electronic Programmed Controller board. Ensure that the pins are clean and aligned properly, and tighten the jack screws evenly using a 1/8" flat blade screwdriver until the surfaces mate. DO NOT OVER TIGHTEN the jack screws.

14. Install Bottom Shell (ref. 5.4.3).

15. Install Top Shell (ref. 5.4.2).

5.6.1.2 Vent Fan Assembly Repair Procedure For Design Iteration 3 Only. (Refer to Section 5.6.1.1 for Design Iterations 1 and 2)

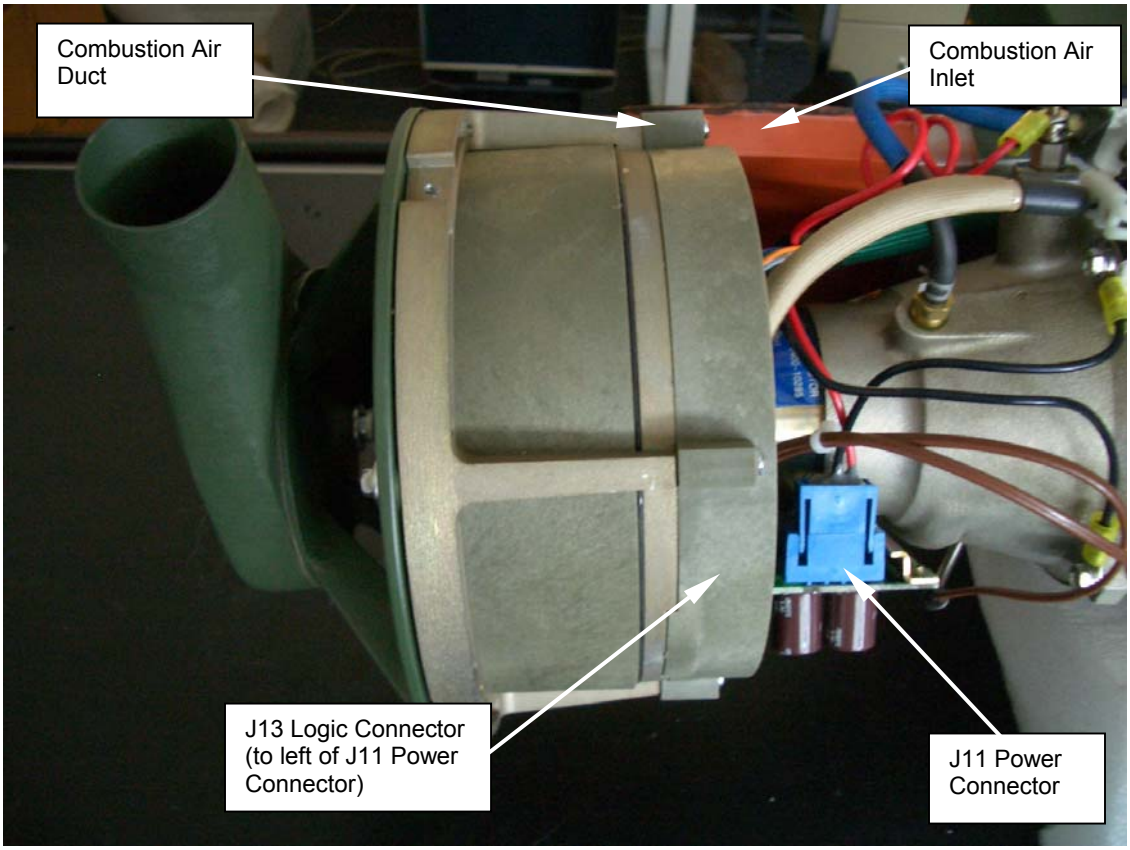


Figure 5.6-4 Vent Fan Assembly

5.6.1.2.1 Removal

!CAUTION!
When handling electronic circuits, personnel must be electrically grounded to avoid electrostatic damage to electronic components.
During the following operations take care not to damage the electronic boards.

Note: It is NOT necessary to remove the Dual Air Adapter for this operation.

1. Remove Top Shell (ref. 5.4.2).

2. Remove Bottom Shell (ref. 5.4.3).

Note: Power Connector J11 is released by pressing the sides of the connector together with your fingers releasing the locking tabs, and gently pulling apart the two halves.

Vent Fan Assembly Procedure for Design Iteration 3 (Continued)

3. Disconnect **Wiring Harness** connection **J11** to the Vent Fan Driver Board.

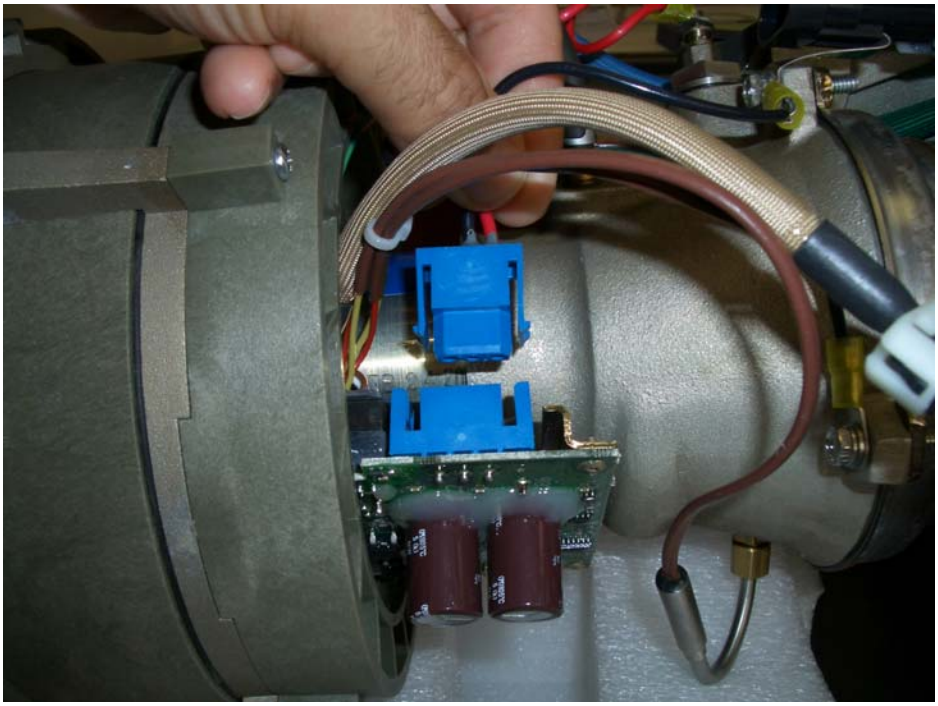


Figure 5.6-5 Vent Fan Assembly

Note: To release the small Logic connector J13, use a 1/8" flat blade screwdriver.

!CAUTION!
Ensure the edge of the screwdriver blade does NOT nick the connector wires while unscrewing the connector.

4. Disconnect **Wiring Harness** connection **J13** to the Electronic Programmed Controller Board by carefully putting the blade of the screwdriver between the connector sections. Gently pull up on the connector while using the blade of the screwdriver to aid in separating the halves of the connector.

Vent Fan Assembly Procedure for Design Iteration 3 (Continued)

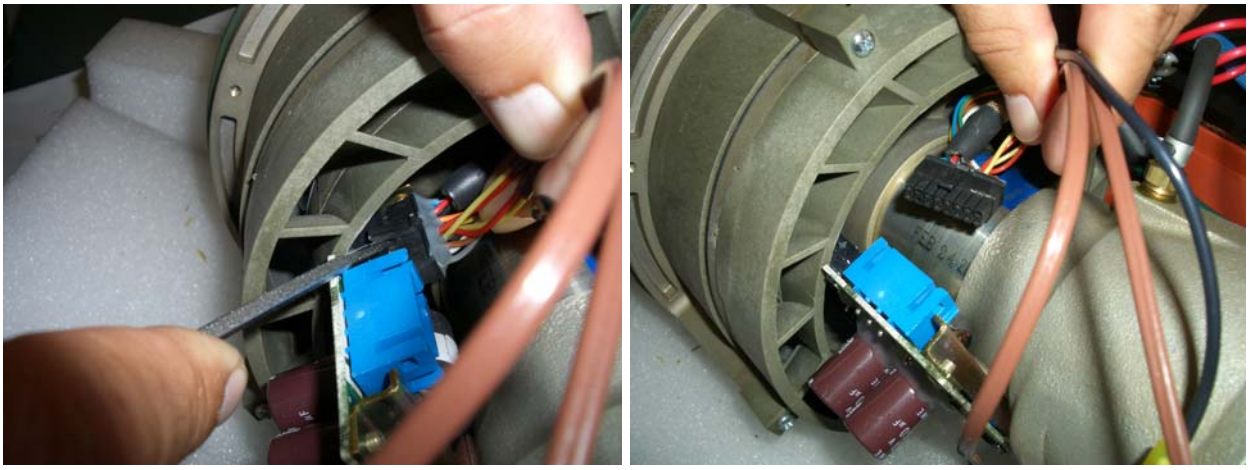


Figure 5.6-6 Vent Fan Assembly

5. Use a 5/16" socket to remove the bolt that holds the Vent Fan to the Burner Housing. Thread lock compound is used to secure this screw, so gentle force may be needed to break the screw's grip.

Figure 5.6-7 Bolt Removal Detail, Vent Fan Assembly

!CAUTION!
Take care not to damage the Combustion Air Duct during Vent Fan removal.

6. Wiggle the Vent Fan Assembly while also pulling the Vent Fan Assembly away from the Burner Housing Assembly. A silicone sealant is used to seal the end of the combustion air duct to the combustion air inlet. This seal must separated in order to remove the vent fan assembly.

Vent Fan Assembly Design Iteration 3 (Continued)

5.6.1.2.2 Installation

Note: The larger end of the Combustion Air duct is permanently secured to the Vent Fan Assembly housing with Loctite 770 primer and Loctite 401. These materials are used to seal the Combustion Air Duct to the Vent Fan Assembly.

1. Clean any loose, residual sealant on the inside surface of the combustion air duct.

2. Clean the outside surface and front edge of the Combustion Air Inlet by removing any old sealant, and then coat with Silicone RTV to provide a seal for the Combustion Air Duct.

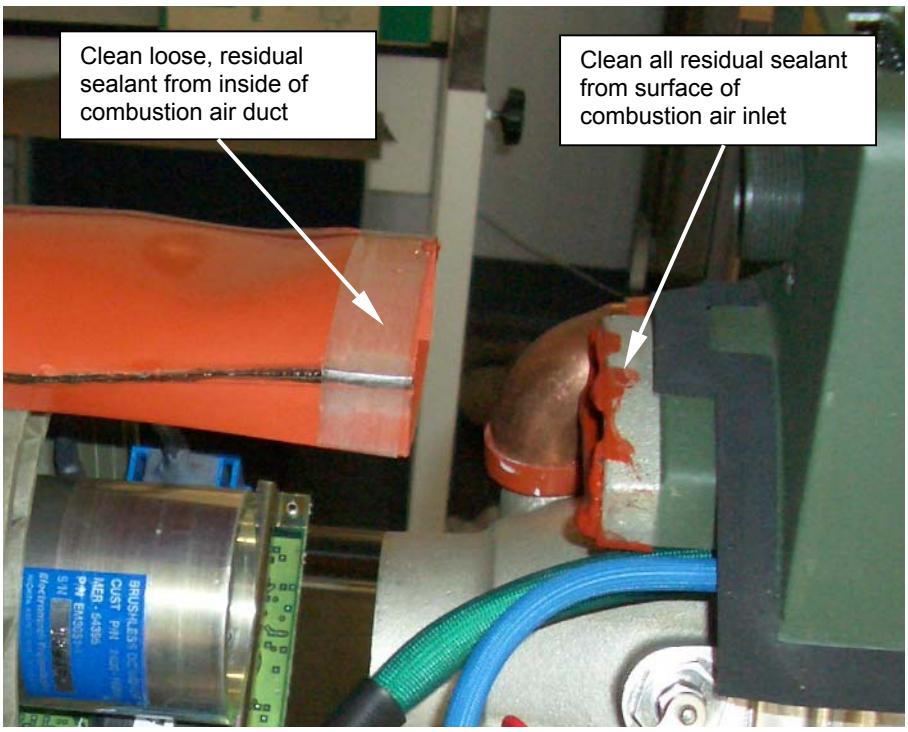


Figure 5.6-8 Combustion Air Duct and Inlet Sealant Application

Note: The ends of the Combustion Air Duct must be sealed to the Vent Fan Assembly and to the Top Housing.

3. Engage the Vent Fan Assembly onto the Burner Housing Assembly ensuring that the motor frame sits correctly over the Burner Housing, and that the Combustion Air Duct is aligned with the Top Housing air inlet. DO NOT use excessive force.

Vent Fan Assembly Design Iteration 3 (Continued)

4. When pushing the Vent Fan Assembly onto the Burner Housing, check that the gasket around the Burner Housing stays in position, and that the wires of the Wiring Harness are not trapped. Check that the Combustion Air Duct is properly mated with the Top Housing air inlet.

5. Tighten the bolt using a 5/16" socket. DO NOT OVER TIGHTEN. Check that the Vent Fan rotates freely.

6. Attach **Wiring Harness** connector **J11** to the Electronic Programmed Controller board. Ensure that the locking tabs are properly engaged.

7. Attach **Wiring Harness** connector **J13** to the Electronic Programmed Controller board. Ensure that the pins are clean and aligned properly.

8. Install Bottom Shell (ref. 5.4.3).

9. Install Top Shell (ref. 5.4.2).

5.6.2 Motor Magnet

The motor magnet is located at the end of the motor assembly and is designed to use magnetic coupling in order to drive the Fuel Shaft located in the combustor assembly. If the motor magnet should require replacement, follow the procedures detailed in the next sections.

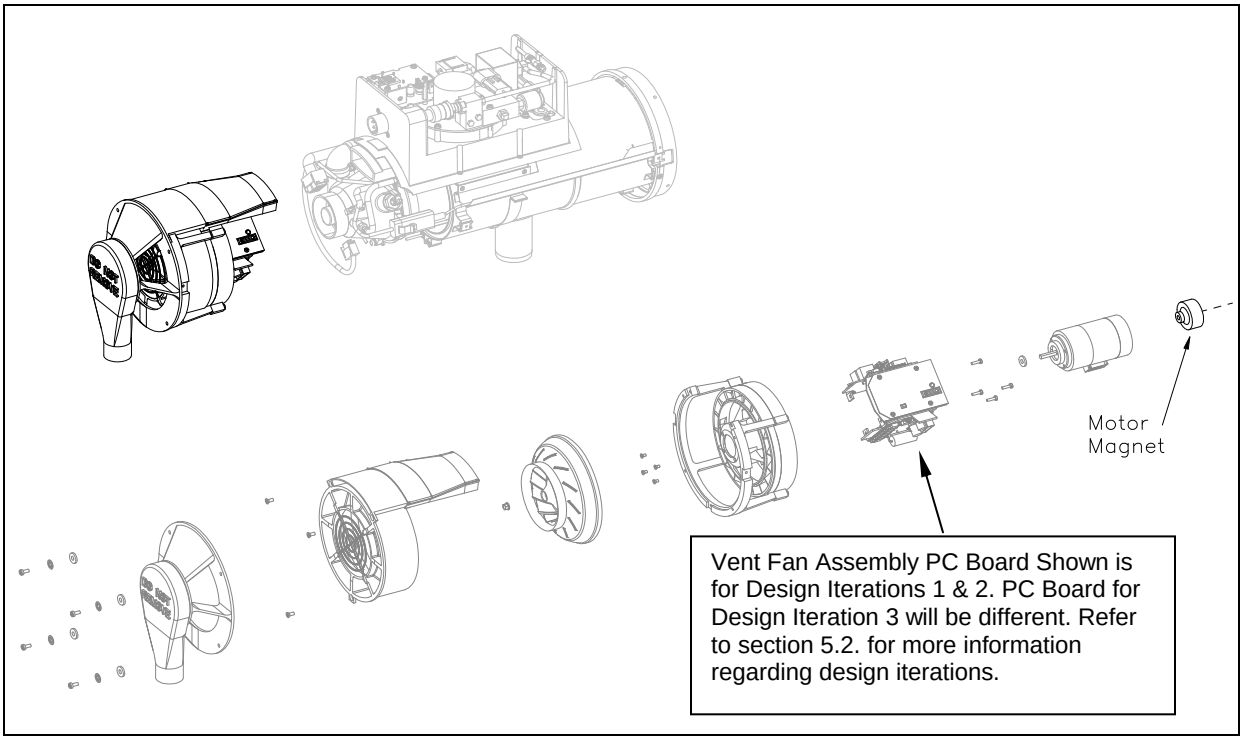


Figure 5.6-9 Motor Magnet

5.6.2.1 Removal

!CAUTION!
When handling electronic circuits, personnel must be electrically grounded to avoid electrostatic damage to electronic components.
During the following operations take care not to damage the electronic boards.

Motor Magnet (Continued)

1. Remove the Vent Fan Assembly in accordance with the appropriate portion of section 5.6.1. depending on the design iteration.

2. Disconnect the motor connector from the Vent Fan Assembly PC Board by squeezing the sides of the connector and pulling gently.

3. Remove the Electronic Programmed Controller & Vent Fan Driver Boards (Design Iteration 1 & 2) or Vent Fan Driver Board (Design Iteration 3) in accordance with the procedures detailed in section 5.6.5.1.1 or 5.6.5.2.1 respectively.

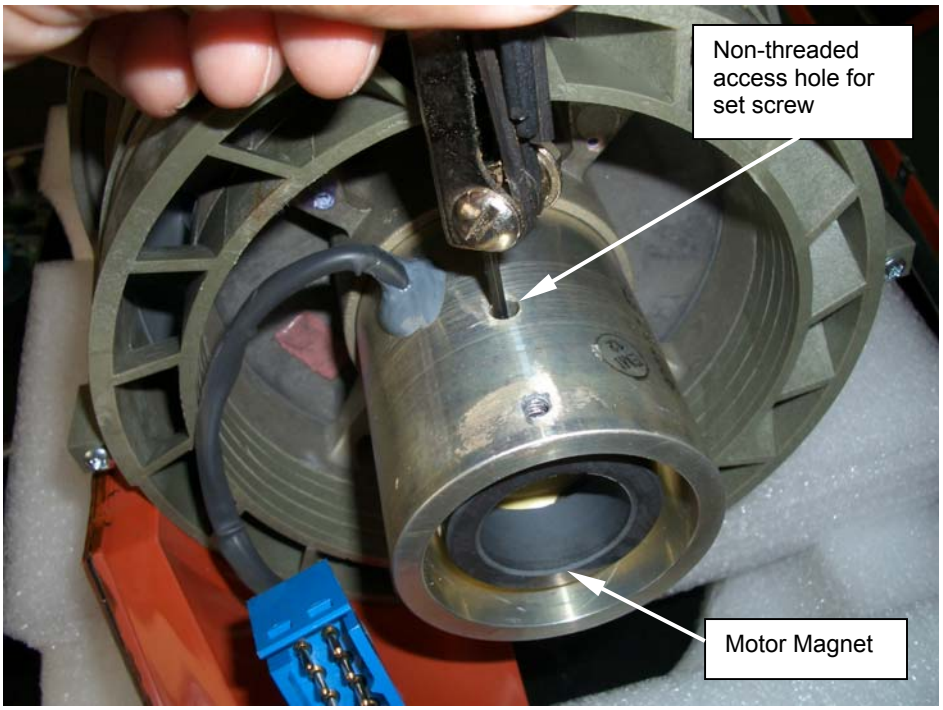
4. Rotate the Motor Magnet by hand until the set screw lines up with the non-threaded access hole.

   Note: There are two holes in the Motor Housing. The correct hole for the Allen Key wrench is the hole WITHOUT threads.

5. Insert a 3/32" Allen Key wrench through the hole in the Motor Housing and loosen the set-screw holding the Motor Magnet. DO NOT fully REMOVE the set-screw.

6. Remove Motor Magnet from the Motor shaft.

Motor Magnet (Continued)



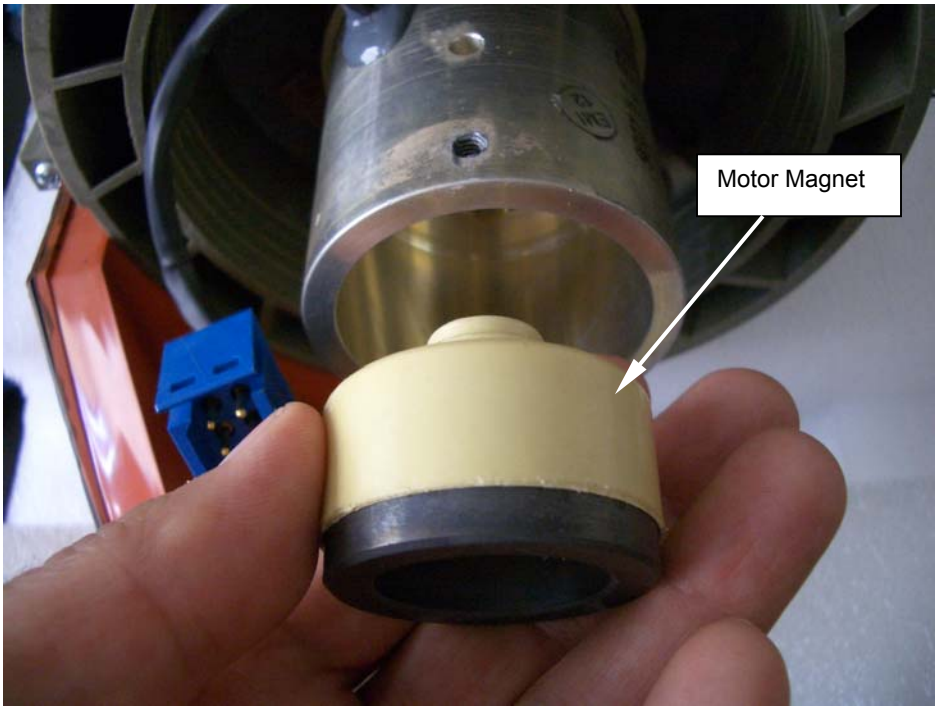


Figure 5.6-10 Motor Magnet Removal

5.6.2.2 Installation

1. Position the Motor Magnet, complete with set-screw, onto the shaft of the Motor. Ensure that the magnet is all the way down on the motor shaft. Note that there is a shoulder on the motor shaft where the magnet rests.

2. Insert a 3/32-inch Allen Key wrench through the non-threaded hole in the Motor Housing and tighten the set-screw. Ensure that the set-screw is tightened against the flat on the Motor shaft.

3. Reconnect the motor connector.

4. Install the Vent Fan Assembly PC Board with two screws removed earlier.

5. Install Vent Fan Assembly in accordance with section 5.6.1.1.2 (Design Iteration 1 and 2) or 5.6.1.2.2 (Design Iteration 3).

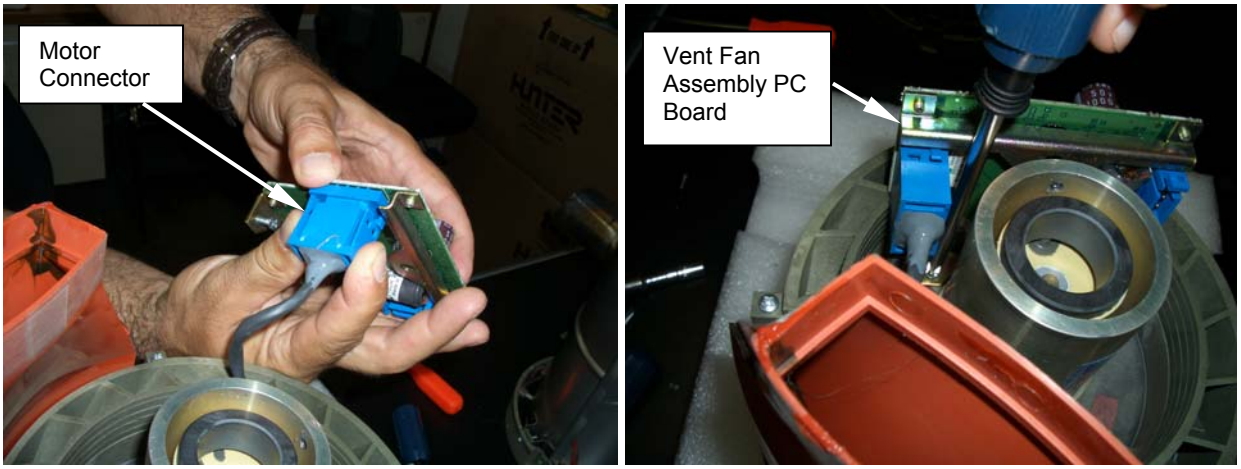


Figure 5.6-11 Motor Magnet Installation

5.6.3 Vent Fan Shroud

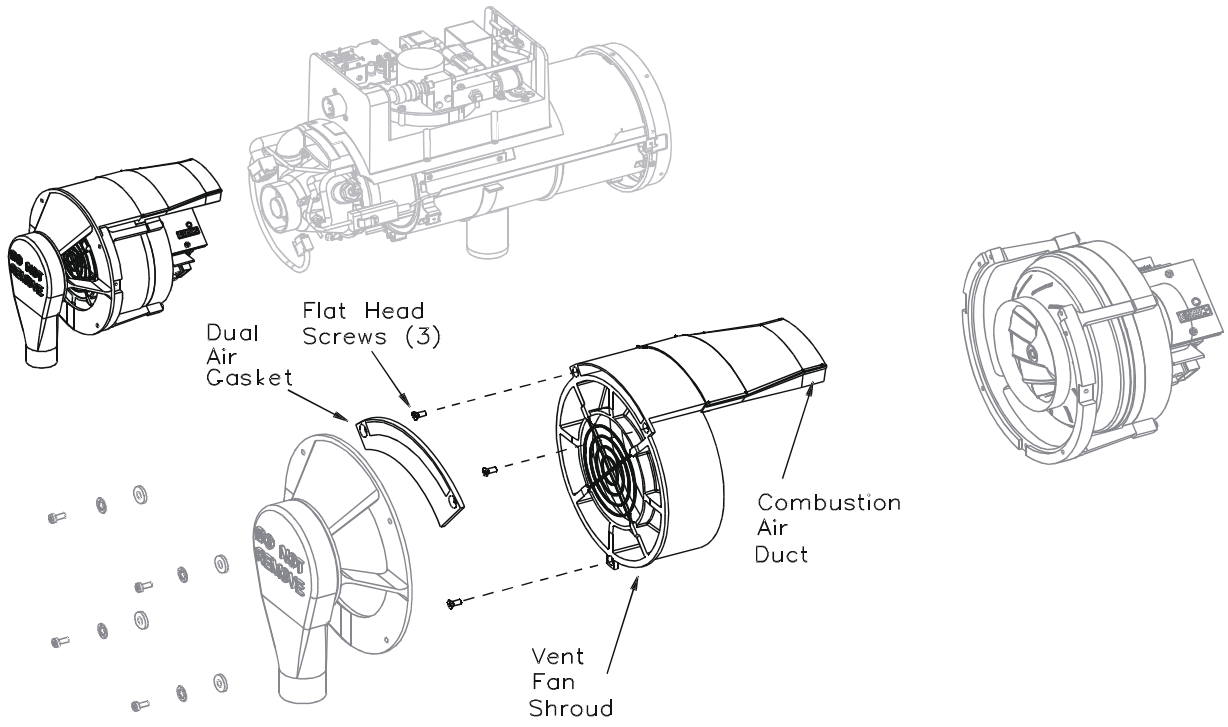


Figure 5.6-12 Vent Fan Shroud

5.6.3.1 Removal

!CAUTION!
When handling electronic circuits, personnel must be electrically grounded to avoid electrostatic damage to electronic components.
During the following operations take care not to damage the electronic boards.

1. Remove Vent Fan Assembly in accordance with the appropration section of 5.6.1 depending on the design iteration.

2. Using a 1/4" socket or 1/4" nut driver, remove four (4) hex-head screws to detach the Dual Air Adapter.

   Note: The Dual Air Adapter gasket should remain affixed to the Dual Air Adapter. Use Silicone RTV to re-attach, if required.

3. Using a #2 cross-tip screwdriver, remove three (3) flat-head screws from the front face of the Vent Fan Shroud.

!CAUTION!
DO NOT set the Vent Fan Assembly down on the Magnet end of the Motor or the Electronic circuit boards may be damaged.

Vent Fan Shroud (Continued)

Note: The Combustion Air Duct should remain attached to the Vent Fan Shroud. Loctite 770 primer and Loctite 401 are used to seal the Combustion Air Duct to the Vent Fan Shroud.

Tip: To start removal, a screwdriver blade may be used to gently pry the shroud tabs away from the Vent Fan Housing. Pull the Vent Fan Shroud evenly away from the Vent Fan Housing.

4. Pull the Vent Fan Shroud straight out from the Vent Fan Housing. The Combustion Air Duct will move up as it passes over the Vent Fan Housing.

5.6.3.2 Installation

1. Ensure that the Combustion Air Duct is firmly attached to the Vent Fan Shroud and that it is not damaged. Replace if required. If necessary, re-attach the Combustion Air Duct to the Vent Fan Shroud by using Loctite 770 and 401. Follow the manufacturer's instruction for gluing.

2. Check that the Impeller is free to rotate.

3. Check that the Shroud Seal on the Vent Fan Housing is in place. Re-attach with Loctite 770 and 401 if necessary.

4. Line up the Vent Fan Shroud with the Vent Fan Housing and push into place.

5. Apply Loctite 243 (blue) to the threads of the three (3) flat-head screws. Use a #2 cross-tip screwdriver to secure the Vent Fan Shroud to the Vent Fan Housing.

6. Check that the Impeller is free to rotate.

7. Apply Loctite 243 (blue) to the four (4) hex-head screws, and secure the Dual Air Adapter in place using a 1/4" socket, or 1/4" nut driver. Ensure that the flat washers and lock washers are in place on each screw.

8. Install Vent Fan Assembly to the heater (ref. 5.6.1).

5.6.4 Vent Fan Impeller Assembly

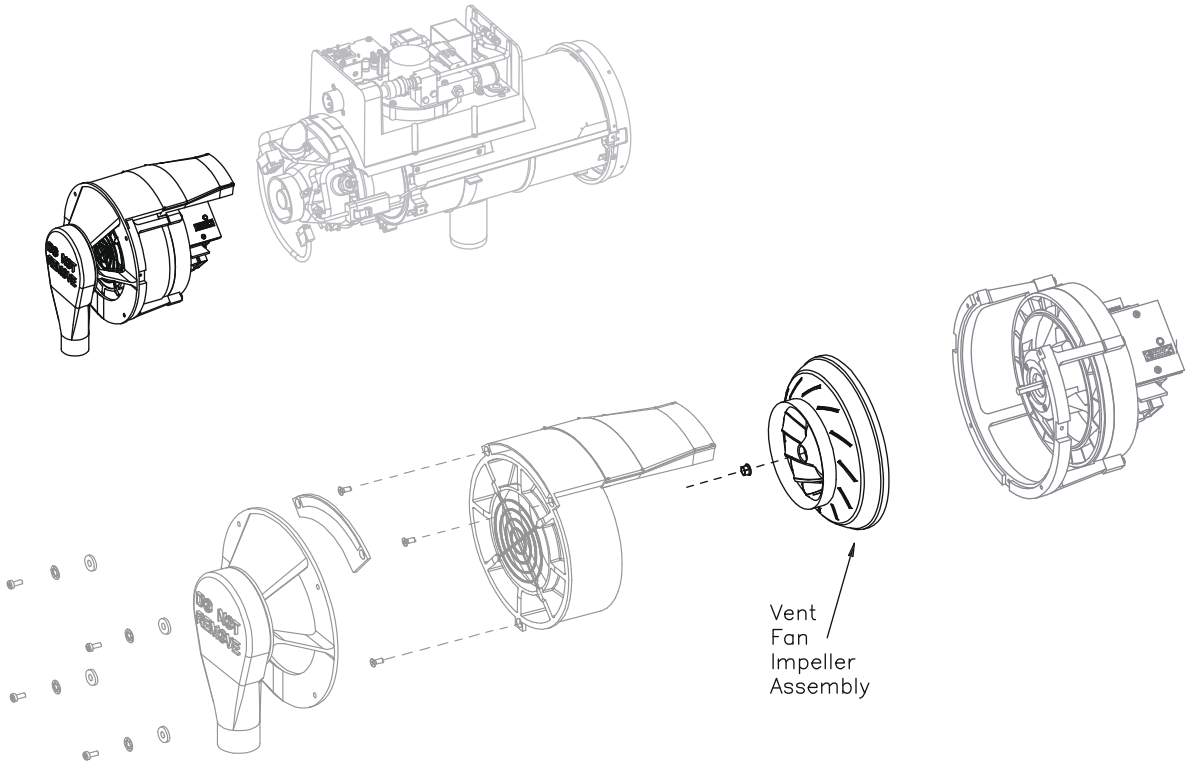


Figure 5.6-13 Vent Fan Impeller

5.6.4.1 Removal

1. Remove Vent Fan Assembly (ref. 5.6.1).

2. Remove Vent Fan Shroud (ref. 5.6.3).

!CAUTION!
When handling electronic circuits, personnel must be electrically grounded to avoid electrostatic damage to electronic components.
During the following operations take care not to damage the electronic boards.

Vent Fan Impeller Assembly (Continued)

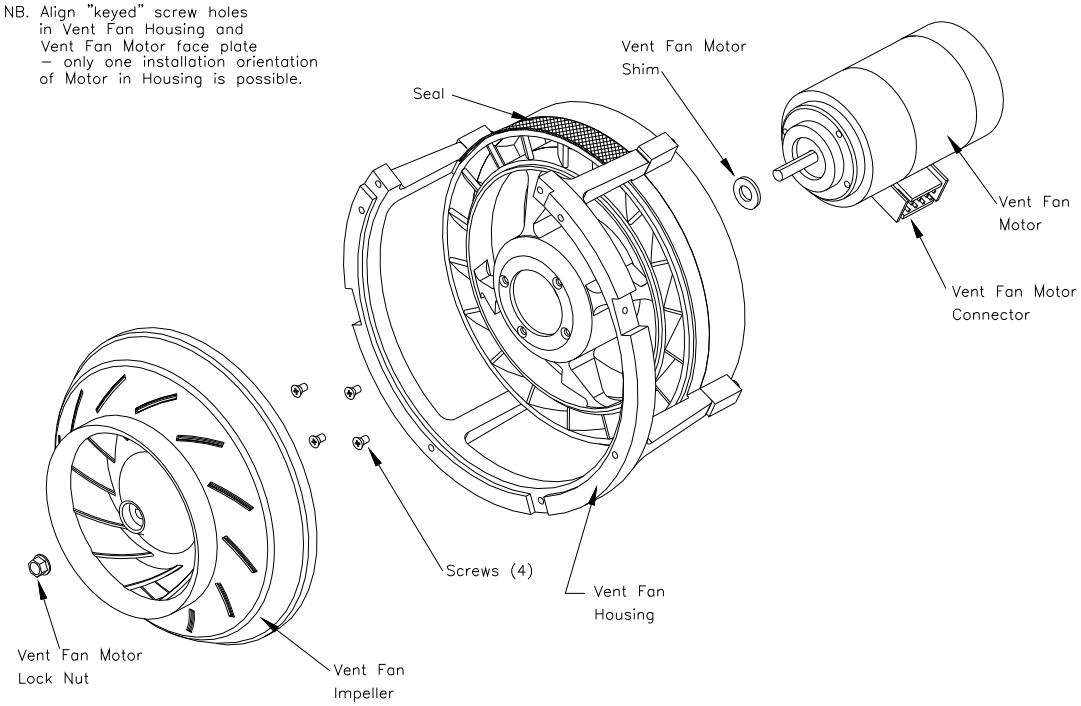


Figure 5.6-14 Detail, Vent Fan Impeller Orientation

3. While holding the Impeller to stop it from rotating, use a 5/16" socket to remove the Vent Fan Motor lock nut from the center of the Impeller. Inspect the lock nut and replace if damaged.

   Note: Force may be required to remove the Vent Fan Impeller. An even prying around the rim of the base of the Vent Fan Impeller between the Impeller and the Vent Fan Housing may be necessary. Use caution in the application of any such force, otherwise, the Vent Fan Housing may be damaged.

4. Pull Impeller from the motor shaft.

Vent Fan Impeller Assembly (Continued)

5.6.4.2 Installation

Note: When REPLACING the Vent Fan Impeller, a NEW Vent Fan Motor MUST also be installed (ref. 5.6.6).

Do NOT reuse Vent Fan Impeller.

1. Position the Impeller onto the motor shaft taking care not to damage the threads on the end of the shaft.

   Note: The motor shaft is "D" shaped, so the Impeller will only go on when the shaft and the Impeller are aligned.

2. Using a feeler gauge, check that the gap between the back face of the rim of the Vent Fan Impeller (large end) and the Vent Fan Housing is not less than 0.015" or more than 0.030". Re-shim as required.

3. While holding the Impeller to stop it from rotating, use a 5/16" socket to secure the NEW lock nut.

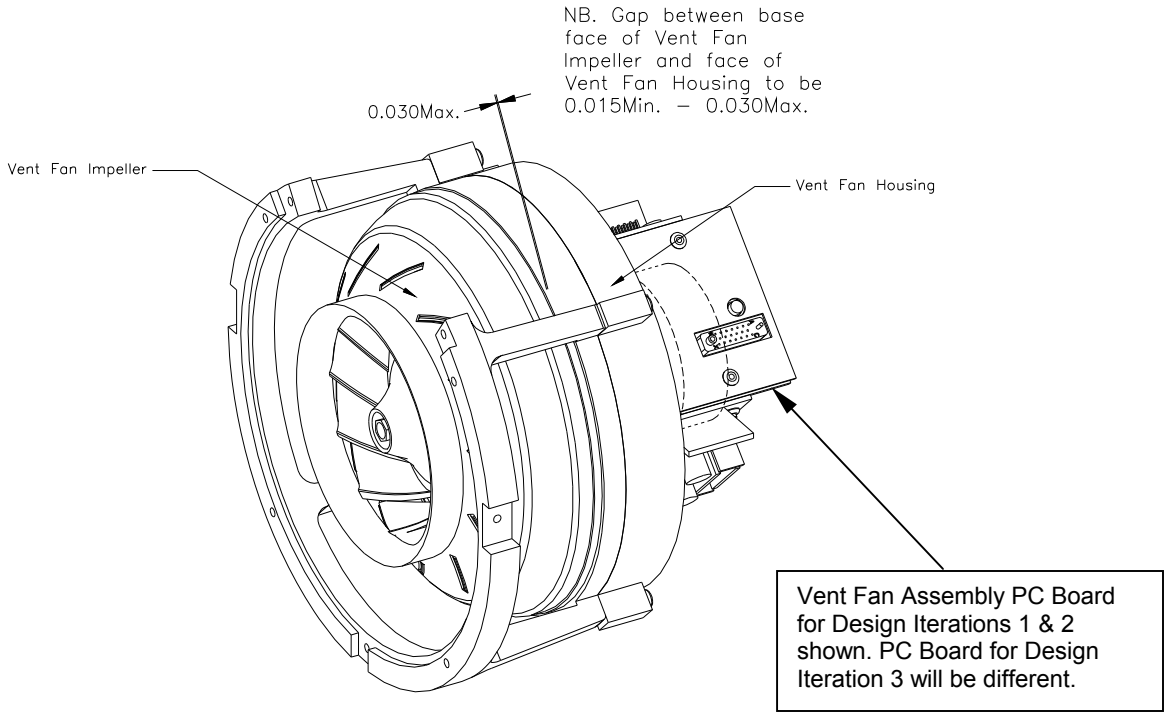


Figure 5.6-15 Detail, Vent Fan Impeller Assembly

1. Check that the Vent Fan Impeller spins freely.

2. Install Vent Fan Shroud (ref. 5.6.3).

3. Install Vent Fan Assembly to the heater (ref. 5.6.1).

5.6.5 Electronic Programmed Controller & Vent Fan Driver Boards (Design Iteration 1 & 2) or Vent Fan Driver Board (Design Iteration 3)

Design Iterations 1 and 2 utilized two printed circuit boards that are called the Electronic Programmed Controller and Vent Fan Driver Boards. The electronic programmed control is located in the top housing and the vent fan driver is located on the left.

In Design Iteration 3, this function is served by a single printed circuit board which is referred to as the Vent Fan Driver board. The procedures for the repair of these boards can be found in the sections that follow in accordance with the appropriate Design Iteration.

5.6.5.1 Electronic Programmed Controller & Vent Fan Driver Boards (Design Iteration 1 & 2)

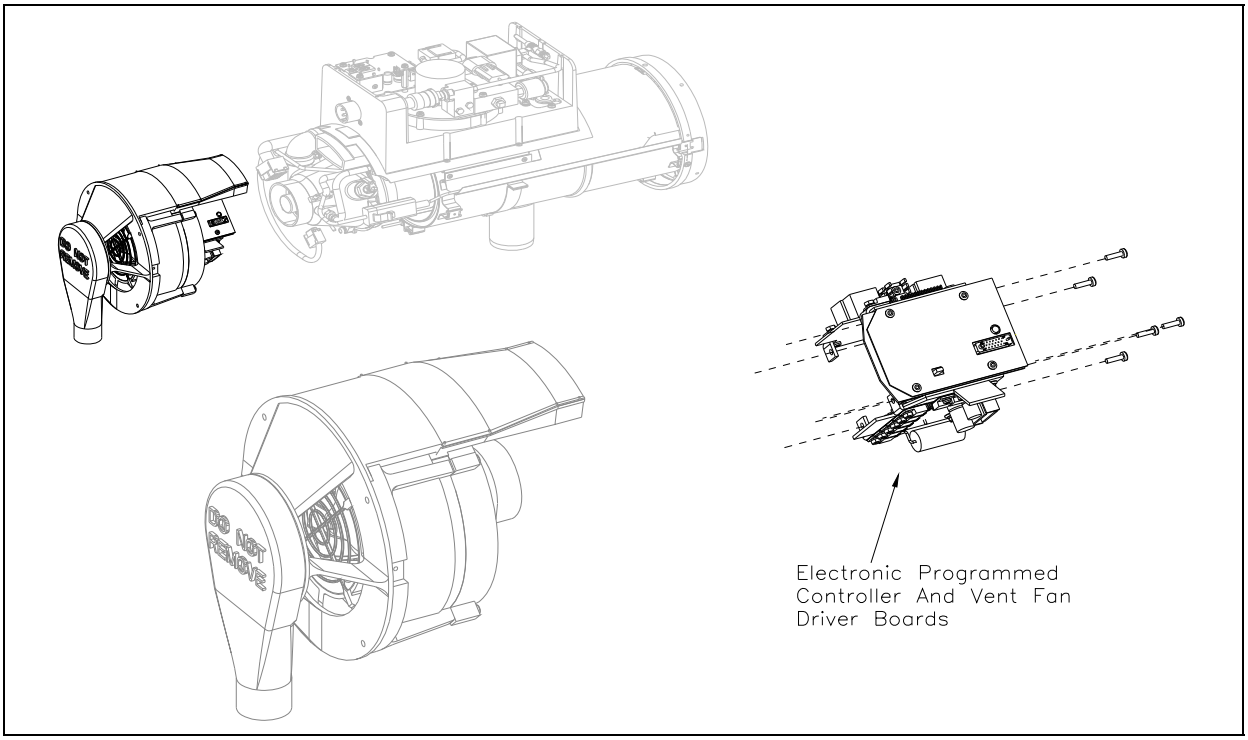


Figure 5.6-16 Electronic Programmed Controller & Vent Fan Driver Boards

5.6.5.1.1 Removal

1. Remove Vent Fan Assembly (ref. 5.6.1).

2. Disconnect the Vent Fan Motor Connector from the Electronic Vent Fan Driver Board. (ref. Figure 5.6-17 Detail, Removal of Printed Circuit Boards)

   Note: The connector is released by pressing the sides of the connector to release the locking tabs, and gently pulling apart the two halves.

Electronic Programmed Controller & Vent Fan Driver Boards (Continued)

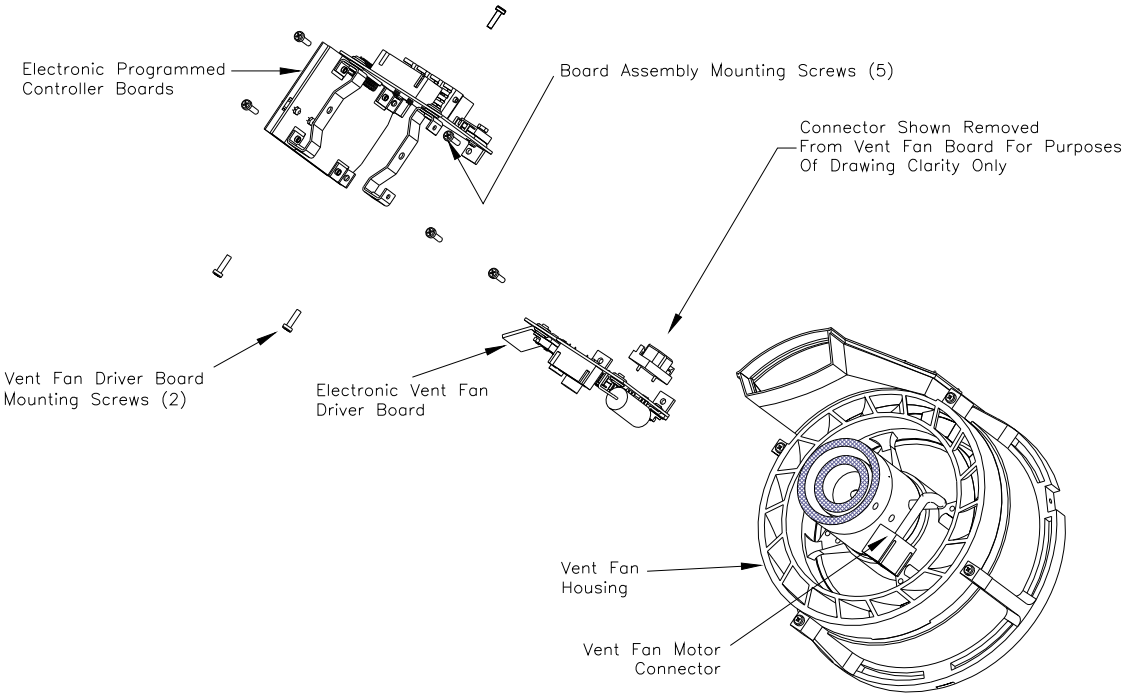


Figure 5.6-17 Detail, Removal of Printed Circuit Boards

!CAUTION!
When handling electronic circuits personnel must be electrically grounded to avoid electrostatic damage to electronic components.

3. Using a #1 cross-tip screwdriver, remove five (5) flat-head screws that hold the printed circuit boards to the Vent Fan Housing.

Electronic Programmed Controller & Vent Fan Driver Boards (Continued)

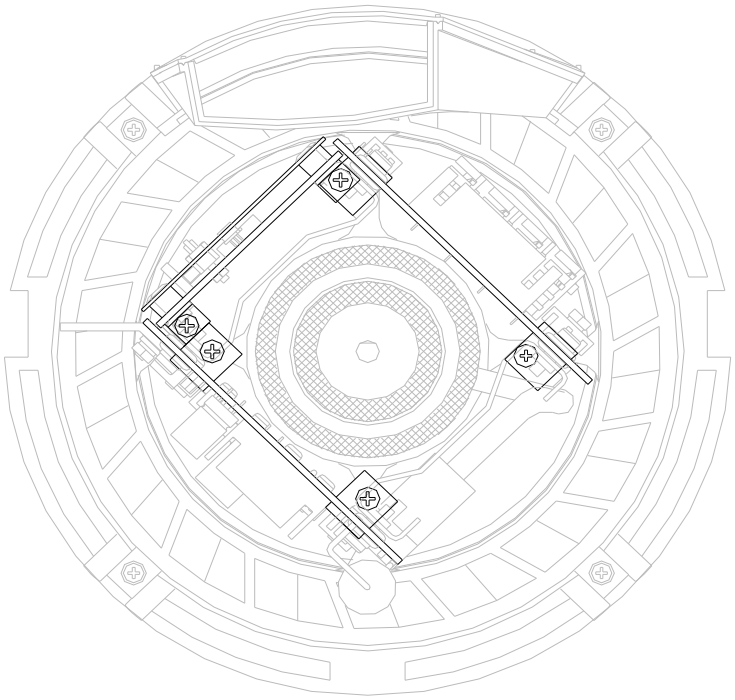


Figure 5.6-18 Detail, Screw Locations

4. Remove the Printed Circuit Board Assembly. Using a #1 cross tip screwdriver remove two (2) screws that hold the Vent Fan Driver Electronic Board to the Electronic Programmed Controller Boards (ref. Figure 5.6-18 Detail, Screw Locations).

5.6.5.1.2 Installation

1. If Vent Fan Driver Board and Electronic Programmed Controller Board have been taken apart, apply Loctite 243 (blue) to the threads of the screws before using a #1 cross-tip screwdriver, and fastening the Electronic Vent Fan Driver Board to the Electronic Programmed Controller with two (2) screws.

2. Apply Dow Corning 340 Heat Sink Compound to each of the mounting bracket surfaces of the printed circuit board assembly.

Electronic Programmed Controller & Vent Fan Driver Boards (Continued)

Note: The surfaces to be coated are metal bracket surfaces that will be in direct contact with the Vent Fan Housing when the printed circuit assembly is installed.

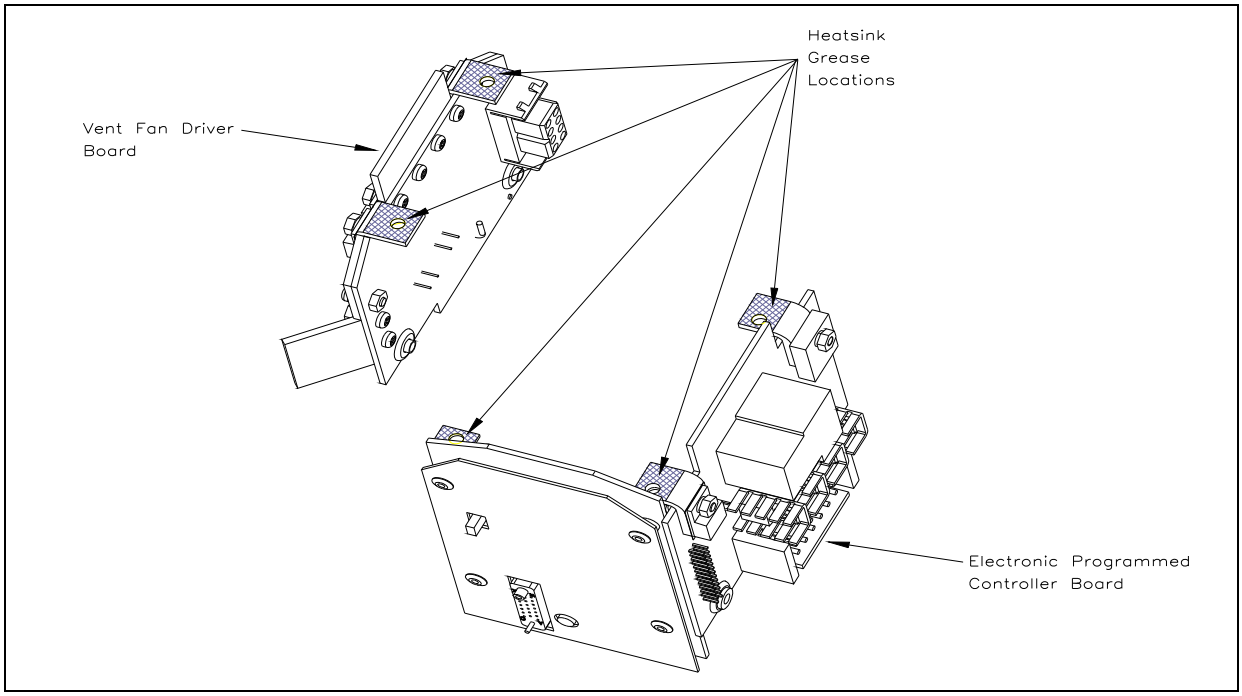


Figure 5.6-19 Detail, Circuit Board Brackets Requiring Heat-Sink Compound

3. Install the Printed Circuit Board Assembly into the Vent Fan Assembly, aligning the hole in the open bracket with the hole in the Motor Housing. Apply Loctite 243 (blue) to the screws and using a #1 cross-tip screwdriver secure using the five (5) flathead screws.

   Tip: Place the five (5) flat-head screws in the printed circuit board mounting holes first, then align and lower the assembly into place. Start EACH screw before securing any of them.

4. Connect the Vent Fan Motor Connector to the Vent Fan Driver Board, ensuring the connector locking tabs are properly engaged.

5. Install Vent Fan Assembly to heater (ref. 5.6.1).

5.6.5.2 Vent Fan Driver Board (Design Iteration 3)

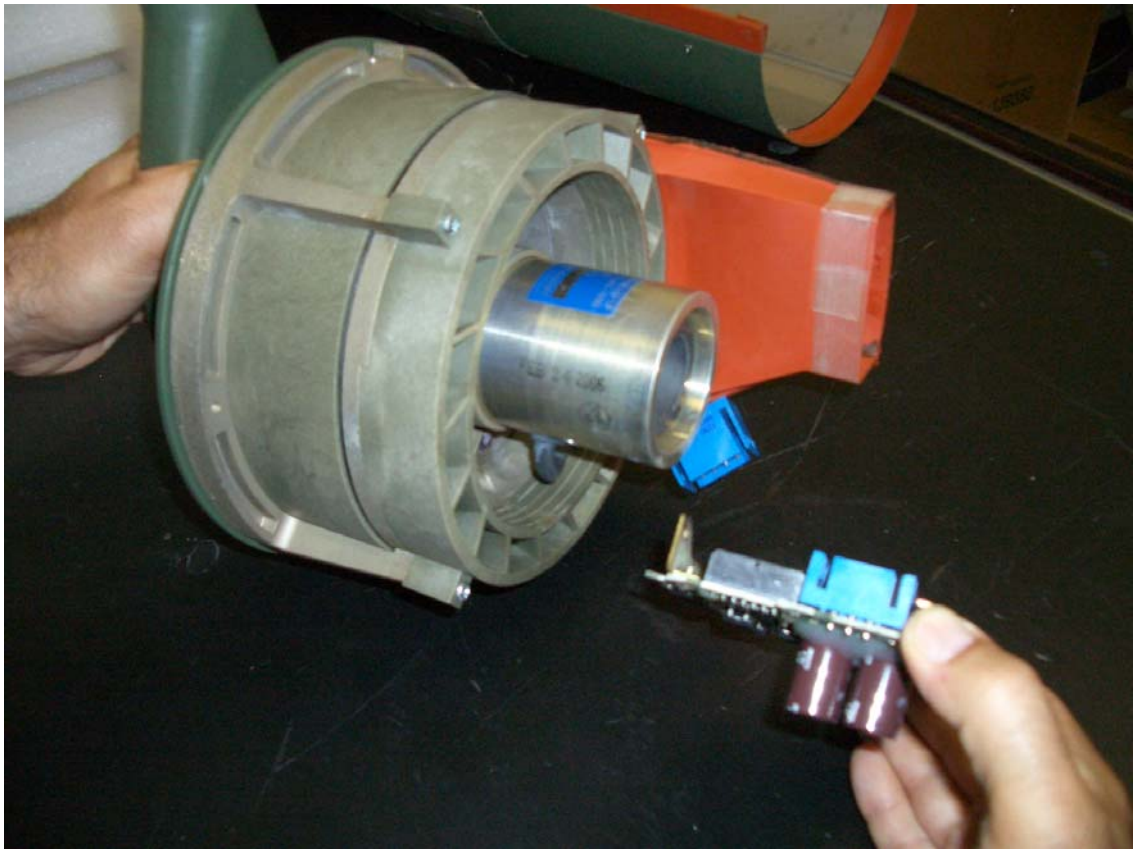


Figure 5.6-20 Vent Fan Driver Board

5.6.5.2.1 Removal

1. Remove Vent Fan Assembly (ref. 5.6.1)

2. Disconnect the Vent Fan Motor Connector from the Vent Fan Driver Board. (ref. Figure 5.6-21 Detail, Removal of Printed Circuit Board Connector)

   Note: The connector is released by pressing the sides of the connector to release the locking tabs, and gently pulling apart the two halves.

Vent Fan Driver Board (Continued)

Figure 5.6-21 Detail, Removal of Printed Circuit Board Connector

!CAUTION!
When handling electronic circuits personnel must be electrically grounded to avoid electrostatic damage to electronic components.

3. Using a #1 cross-tip screwdriver, remove two (2) flat-head screws that hold the printed circuit board to the Vent Fan Housing.

Vent Fan Driver Boards (Continued)

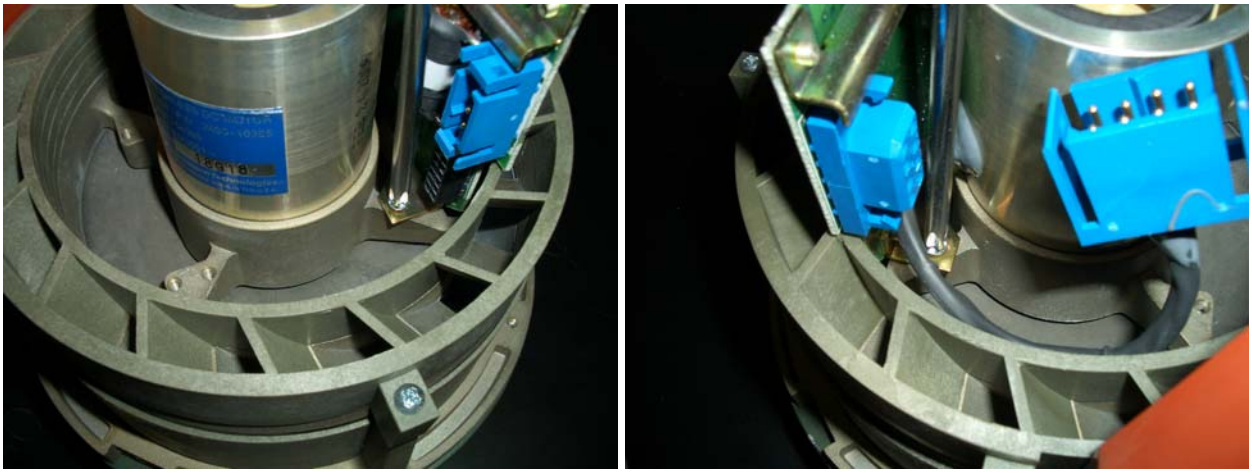


Figure 5.6-22 Detail, Vent Fan Driver Board Screw Locations

5.6.5.2.2 Installation

1. Apply Dow Corning 340 Heat Sink Compound to the mounting bracket surface of the printed circuit board assembly.

Vent Fan Driver Boards (Continued)

Note: The surfaces to be coated are metal bracket surfaces that will be in direct contact with the Vent Fan Housing when the printed circuit assembly is installed.

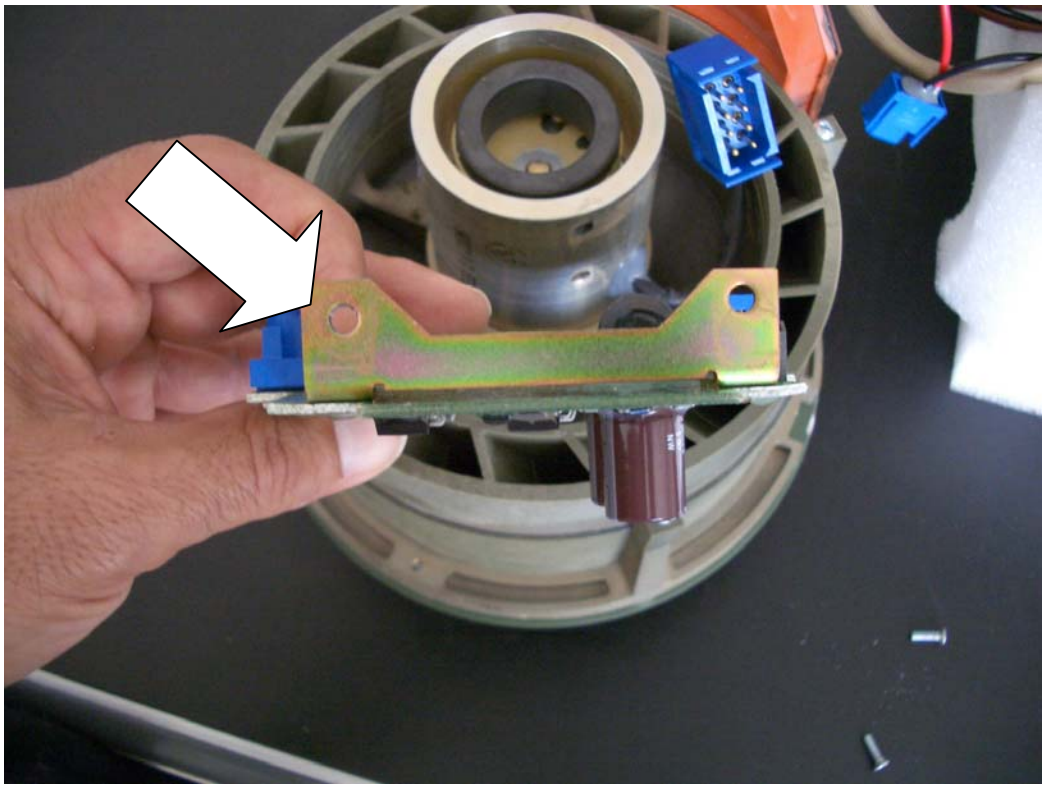


Figure 5.6-23 Detail, Circuit Board Brackets Requiring Heat-Sink Compound

2. Install the Vent Fan Driver Board into the Vent Fan Assembly, aligning the holes in the bracket with the holes in the Motor Housing. Apply Loctite 243 (blue) to the screws and using a #1 cross-tip screwdriver secure using the two (2) flathead screws.

   Tip: Place the two (2) flat-head screws in the printed circuit board mounting holes first, then align and lower the assembly into place. Start EACH screw before securing any of them.

3. Connect the Vent Fan Motor Connector to the Vent Fan Driver Board, ensuring the connector locking tabs are properly engaged.

4. Install Vent Fan Assembly to heater (ref. 5.6.1).

5.6.6 Vent Fan Motor

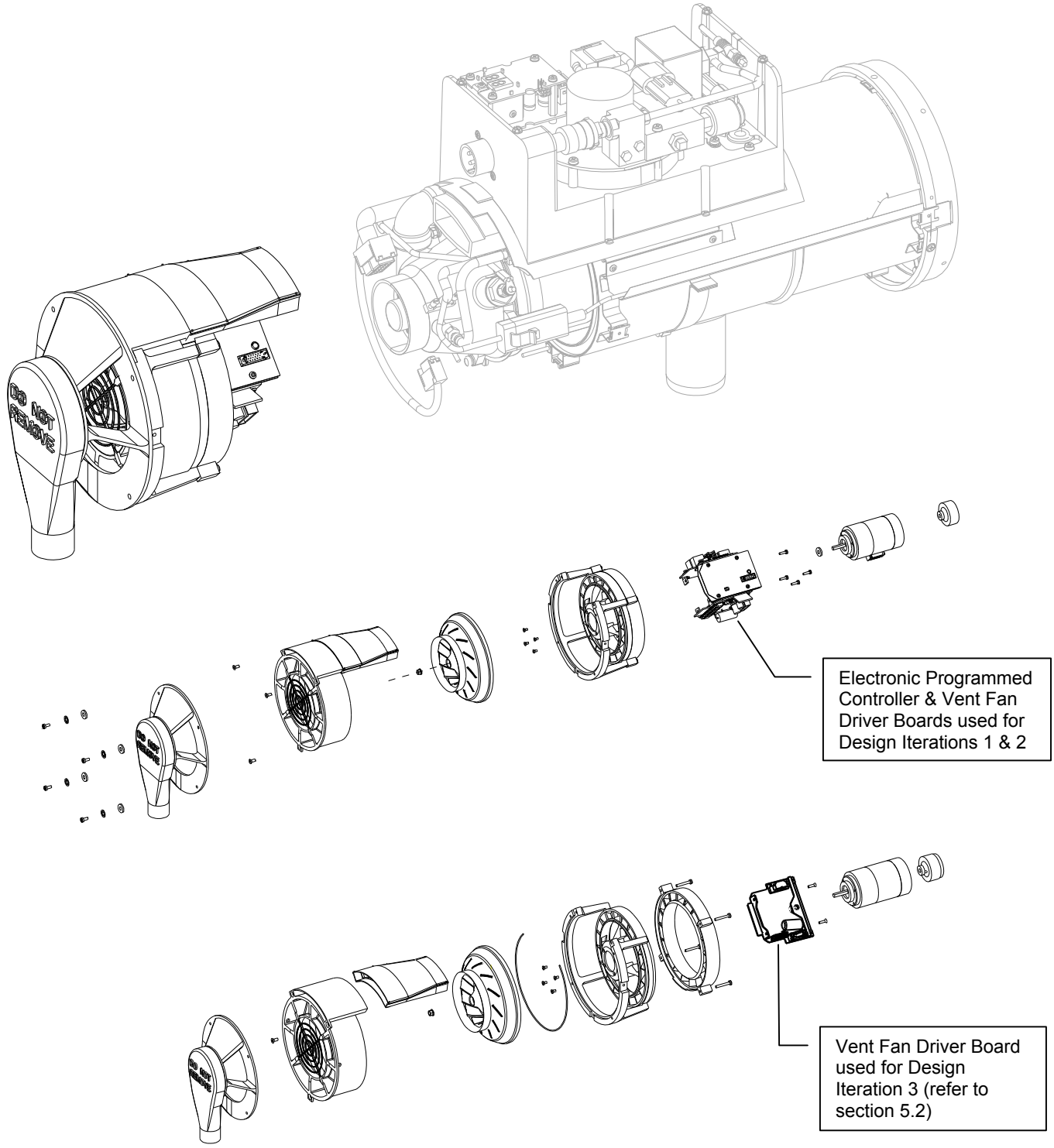


Figure 5.6-24 Vent Fan Motor

5.6.6.1 Removal

1. Remove Vent Fan Assembly (ref. 5.6.1).

2. Remove Electronic Programmed Controller & Vent Fan Driver Boards (Design Iteration 1 & 2) (ref. 5.6.5.1) or single Vent Fan Driver Board (Design Iteration 3) (ref. 5.6.5.2).

3. Remove Vent Fan Shroud (ref. 5.6.3).

4. Remove Vent Fan Impeller (ref. 5.6.4).

5. Using a #1 cross-tip screwdriver, remove four (4) #6 flat-head screws which hold the motor to the Vent Fan Housing (ref. Figure 5.6-25 Detail, Vent Fan Motor Orientation). Discard screws.

6. Remove Vent Fan Motor (ref. 5.6.6).

Vent Fan Motor (Continued)

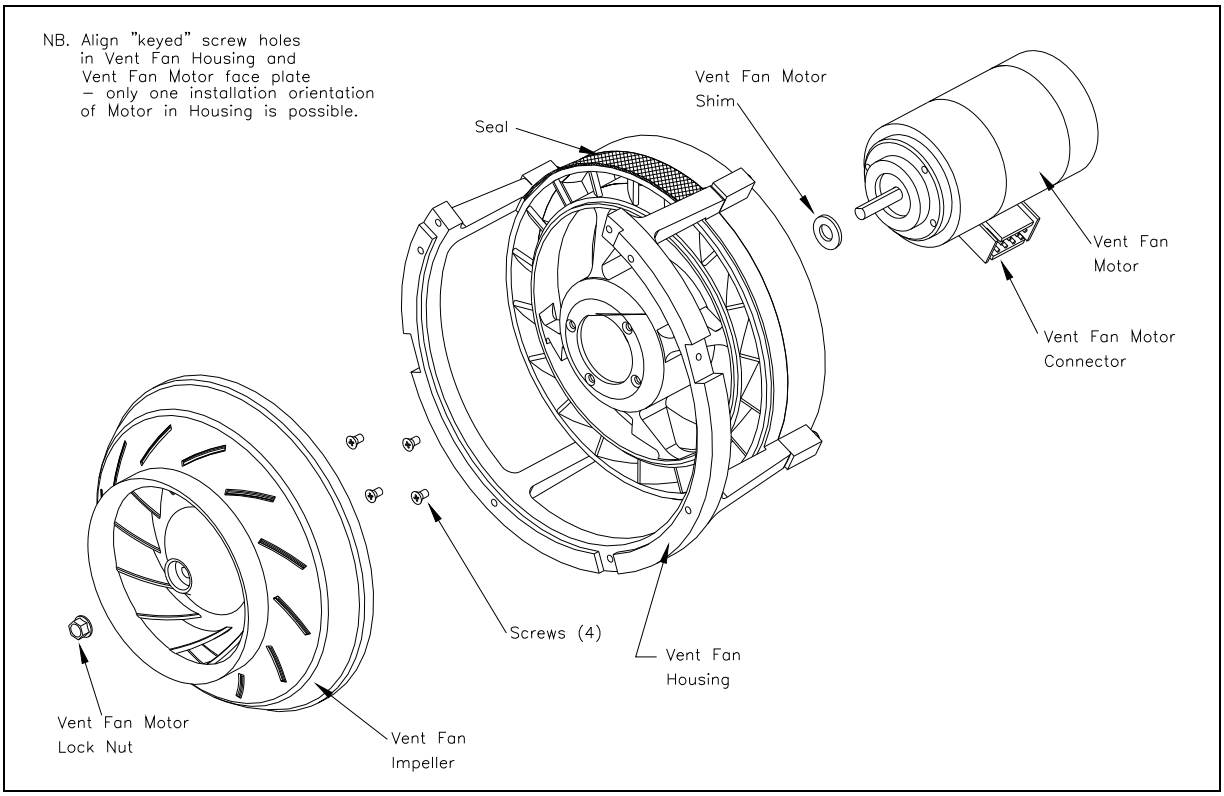


Figure 5.6-25 Detail, Vent Fan Motor Orientation

5.6.6.2 Installation

Note: When REPLACING the Vent Fan Motor, a NEW Vent Fan Impeller MUST also be installed (ref. 5.6.4). Impeller and Motor MUST be considered a "matched set".

Note: Inspect Driver Magnet for signs of scoring or rubbing. If rubbing is present, inspect burner casting magnetic cup for damage. Replace if necessary.

Note: If the Driver Magnet is scored sufficiently as to require replacement, the Burner Housing MUST also be replaced (ref. 5.7.7).

1. Apply Loctite 243 (blue) to four (4) flat-head countersunk screws. Insert the Motor into the Vent Fan Housing, and using a #1 cross-tip screwdriver, secure the Motor into the Housing with the screws.

   Note: It may be necessary to rotate the motor until all 4 screw holes are aligned because the screw hole pattern is 'keyed'.

2. Install Vent Fan Impeller (ref. 5.2.4).

3. Install Vent Fan Shroud (ref. 5.2.3).

4. Install Electronic Programmed Controller & Vent Fan Driver Boards (Design Iteration 1 & 2, ref. 5.6.5.1) or single Vent Fan Driver board (Design Iteration 3, ref 5.6.5.2).

5. Connect the Motor Harness (Connector **J6**) to the Vent Fan Driver Board ensuring the connector locking tabs are properly engaged.

6. Install Vent Fan Assembly to heater (ref. 5.6.1).

Combustion Assembly

5.7 Combustor Assembly (Applies to all Design Iterations)

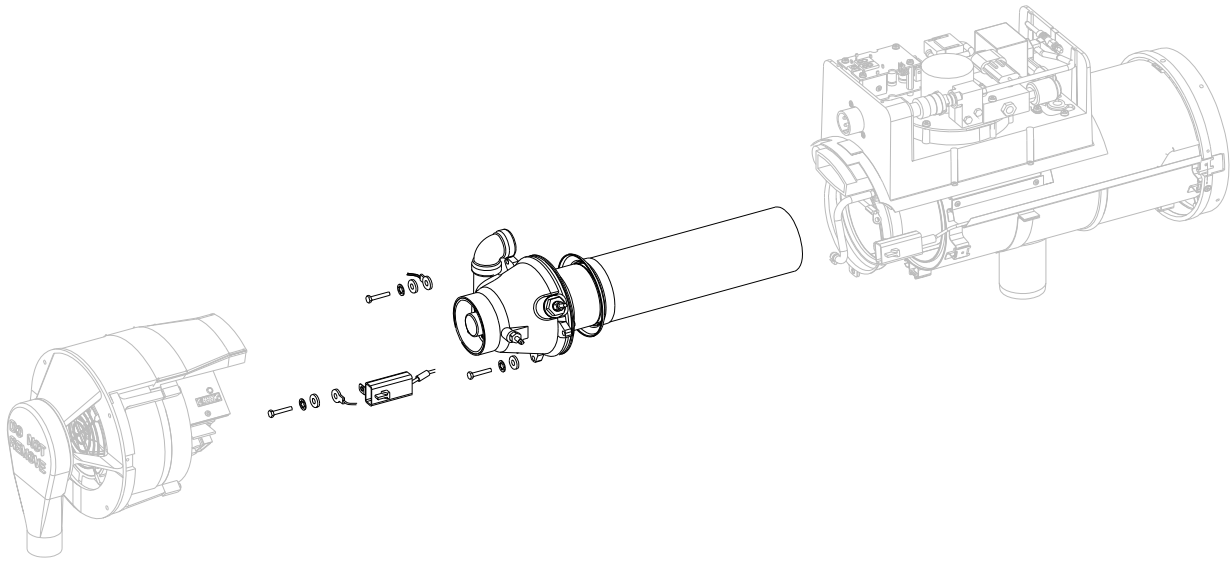


Figure 5.7-1 Combustor Assembly

5.7.1 Burner Assembly (Applies to all Design Iterations)

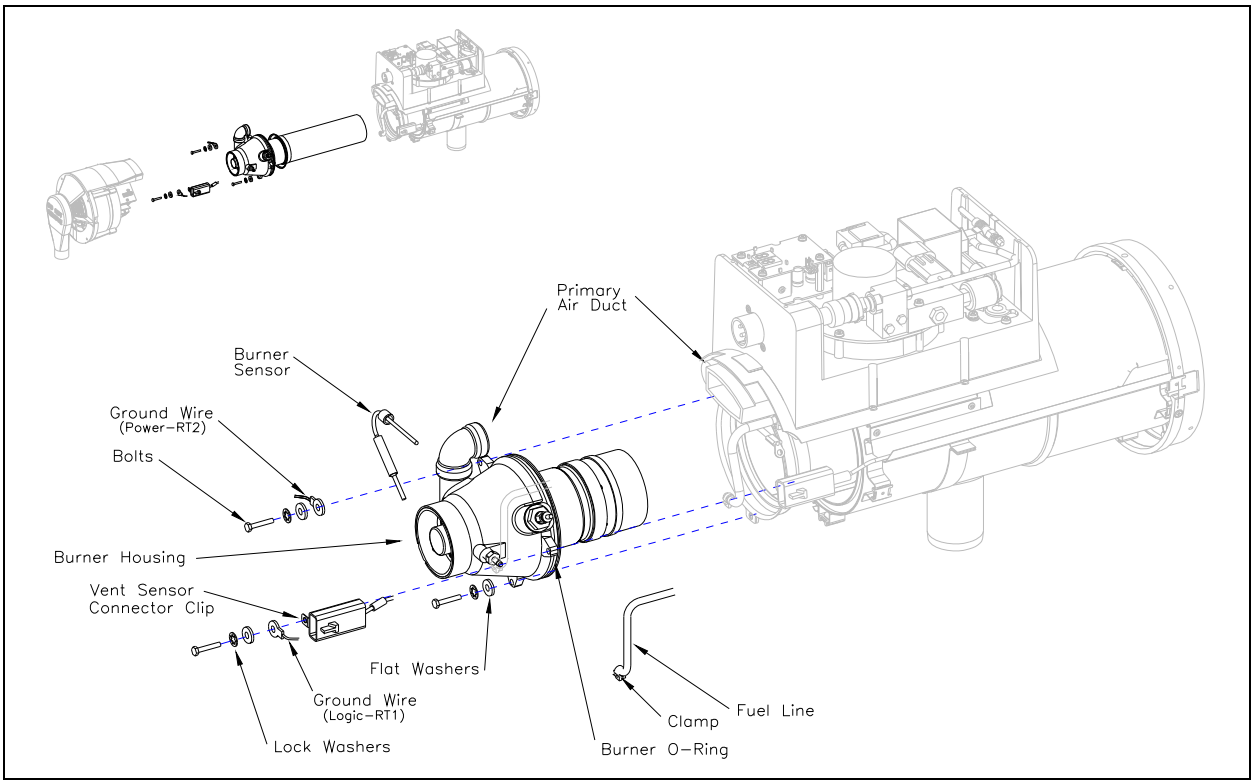


Figure 5.7-2 Combustor Assembly

5.7.1.1 Removal

1. Remove Top Shell (ref. 5.4.2).
2. Remove Bottom Shell (ref. 5.4.3).
3. Remove Vent Fan Assembly (ref. 5.6.1).
4. Disconnect the Fuel Line connected to the Burner Housing by releasing the hose clamp and pulling the Fuel Line straight off the fitting on the Burner. DO NOT REMOVE FUEL LINE FROM THE TOP HOUSING.
5. Remove Ignitor Wire from Ignitor Post.
6. Using a 7/16" open ended wrench, disconnect the Burner Sensor from the Burner Housing by undoing the nut from the fitting.

   Note: The brass Burner Sensor and Fuel fittings are installed into the Burner Housing with Loctite 620 and should NOT be removed.

   Note: If the metal primary air duct is being used, no clamps will be present.

7. Remove the nylon clamp holding the Primary Air Duct to the Top Housing by disengaging the locking jaws.
8. Ensure that the Primary Air Duct is not kinked. Align as necessary.

Burner Assembly (Continued)

9. Pull Combustor Assembly away from Heat Exchanger.

   Note: The Burner Housing is sealed to the Heat Exchanger with an O-Ring.

   Removal of the Combustor Assembly may require some twisting movement to release the seal.

   Remove Burner O-Ring from the Burner Housing and discard.

5.7.1.2 Installation

1. Coat a new Burner O-Ring with GAA grease and install the O-Ring onto the Burner Housing.

2. Clean the mating surfaces of the Heat Exchanger to the Burner Housing using a cloth.

3. Check that the Primary Air Duct is not damaged, torn, or nicked. Replace if necessary.

   Note: If the primary air duct is silicone rubber, it may be replaced with the new metal duct. Apply O-ring lubricant to the contact surfaces.

4. Line up the Burner Housing with the Heat Exchanger and push into place.

   Tip: To line up the Burner Housing use the Primary Air Duct as a guide to determine the screw hole locations.

5. Using a 5/16" socket or nut driver, secure the Burner Housing to the Heat Exchanger by installing three (3) hex-head bolts with flat washers and lock washers. Ensure that the two ground wires and Vent Sensor connector clip are included. Tighten until the Burner mounting lugs are resting on the flanges of the Heat Exchanger.

   Note: The three (3) bolts should be tightened so that the Burner Housing is pulled into the Heat Exchanger in an even manner.

6. Ensure that the braided sleeving is in place on a new fuel line. Place the hose clamp over the Fuel Line and secure the Fuel Line onto the Burner Housing.

   Note: Fuel Line removal may loosen the brass fuel line fittings. Check that all fittings are secured into their housings, and Loctite (PSP 620) if necessary.

7. Check that the Burner Sensor fitting is clean. Insert the Burner Sensor and secure using a 7/16" open ended wrench. DO NOT force the Burner Sensor through the hole.

8. Ensure that the Primary Air Duct is not kinked. Align as necessary.

Burner Assembly (Continued)

9. If using the silicone rubber duct, open the nylon clamp and place it over the Primary Air Duct where it meets the Top Housing. Check that the ears on the clamp are rotated so

10. that they will not interfere with the Top Shell, then squeeze the clamp tabs tightly so that the teeth are engaged and it grips the Primary Air Duct.

Note: The Primary Air Duct provides the passage for air to the Burner. NO air leakage is permitted.

Note: If new steel primary duct is to be used, it is only necessary to apply O-ring lubricant to the contact surfaces and ensure proper alignment.

11. Install Vent Fan Assembly (ref. 5.6.1).

12. Install Bottom Shell (ref. 5.4.3).

13. Install Top Shell (ref. 5.4.2).

5.7.2 Flame Tube (Applies to all Design Iterations)

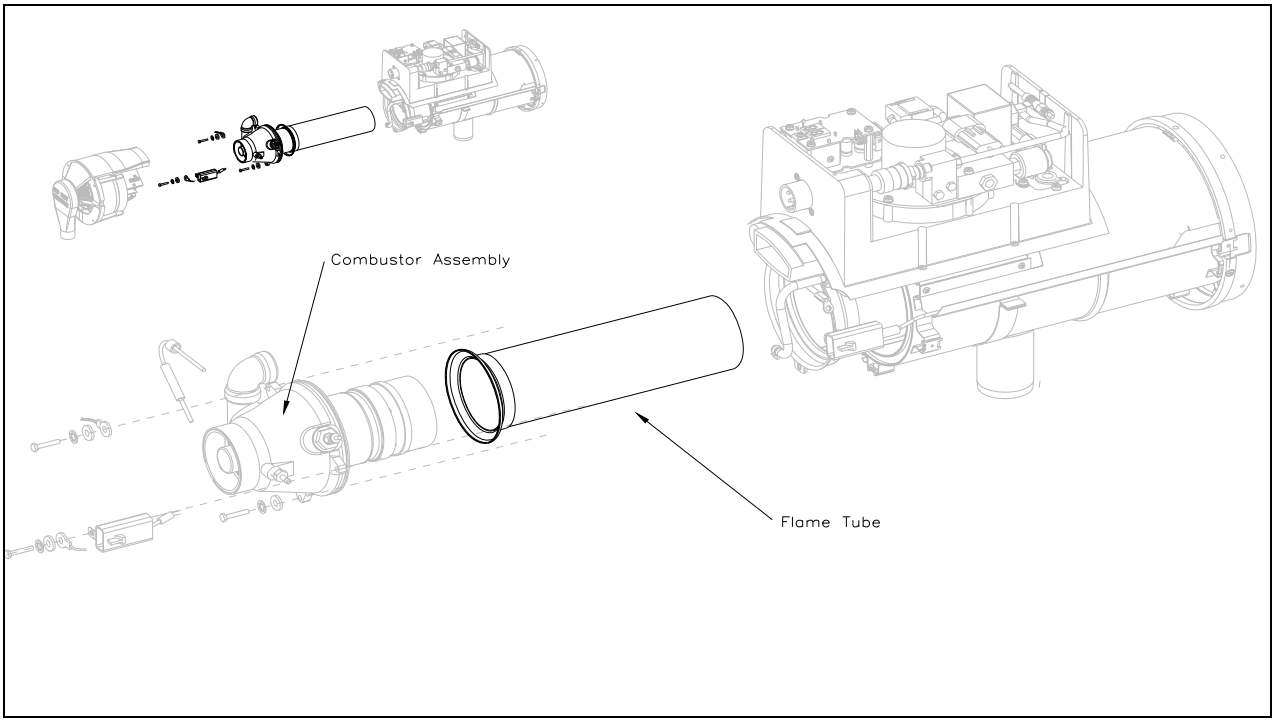


Figure 5.7-3 Flame Tube

5.7.2.1 Removal

1. Remove Top Shell (ref. 5.4.2).

Flame Tube (Continued)

2. Remove Bottom Shell (ref. 5.4.3).

3. Remove Vent Fan Assembly (ref. 5.6.1).

4. Remove Combustor Assembly (ref. 5.7.1).

5. Pull Flame Tube from Heat Exchanger.

5.7.2.2 Installation

NOTE: When REPLACING the Flame Tube, the Burner Chamber MUST be replaced also (ref. 5.7.5).

1. Insert Flame tube into Heat Exchanger.

2. Install Combustor Assembly (ref. 5.7.1).

3. Install Vent Fan Assembly (ref. 5.6.1).

4. Install Bottom Shell (ref. 5.4.3).

5. Install Top Shell (ref. 5.4.2).

5.7.3 Ignitor (Applies to all Design Iterations)

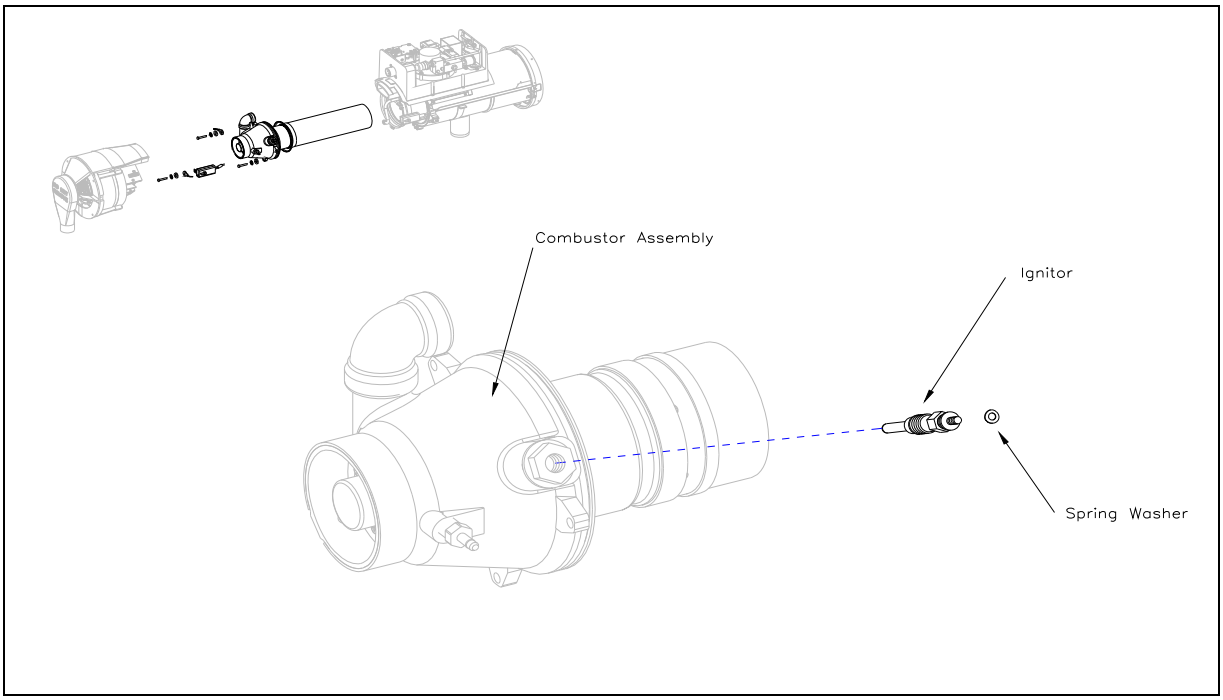


Figure 5.7-4 Ignitor

Ignitor (Continued)

5.7.3.1 Removal

1. Remove Ignitor Hatch (ref. 5.7.4).
2. Using a 3/8" socket or wrench, remove Ignitor threaded into the Ignitor Holder.

5.7.3.2 Installation

1. If a NEW Ignitor is to be installed:
    a. Remove Top Cover (ref 5.4.1).
    b. Remove spare Ignitor mounted in the Top Housing.
    c. Remove the shipping nut on the electrical post of the Ignitor, DO NOT remove the spring washer.
    d. Install Top Cover (ref. 5.4.1).
2. Apply Nickel anti-seize (Loctite 77164) to the threads of the Ignitor.
3. Using a 3/8" socket, or open ended wrench, install the Ignitor. DO NOT over tighten.
4. Install the Ignitor Hatch, DO NOT over tighten.

! CAUTION !
Be sure NOT to pinch or crush any wires when installing Ignitor and/or Ignitor Holder.

5.7.4 Ignitor Holder (Applies to all Design Iterations)

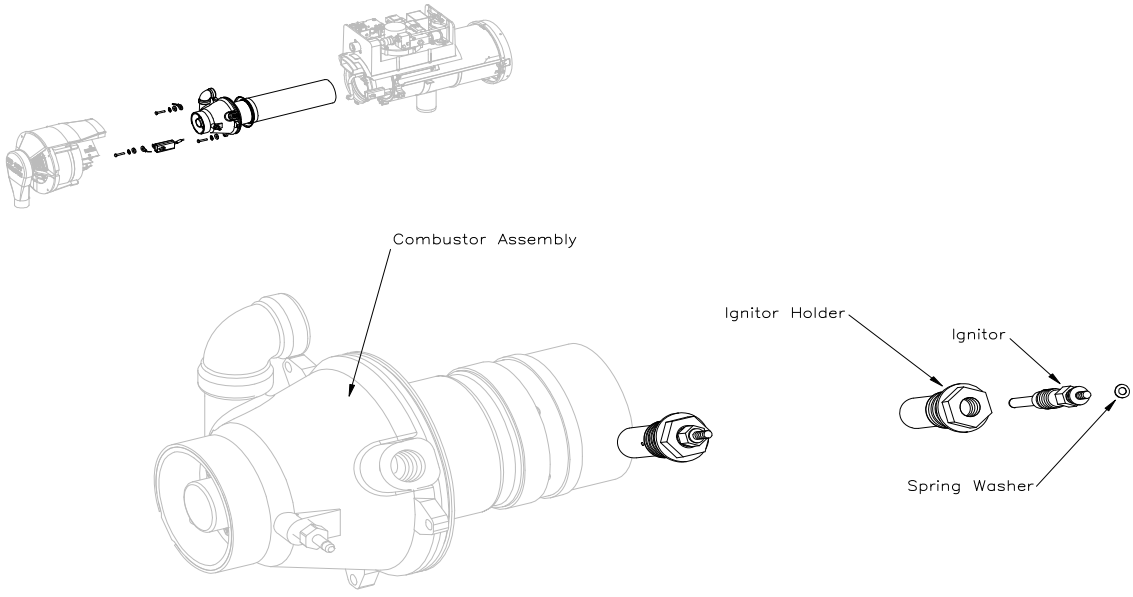


Figure 5.7-5 Ignitor Holder

5.7.4.1 Removal

1. Remove Ignitor Hatch (ref. 5.7.4).

2. Remove Ignitor.

3. Using a 3/4" deep socket, remove Ignitor Holder threaded into the Burner Housing.

5.7.4.2 Cleaning

1. Remove the Ignitor from the Holder using a 3/8" open ended wrench as well as a 3/4" open ended wrench to hold the Holder. Using a wire brush clean the Holder. Remove any carbon deposits, especially in the space between the Holder and the Ignitor tip.

Ignitor Holder (Continued)

5.7.4.3 Installation

! CAUTION !
Prior to re-installing the Ignitor Holder ensure that the threaded Ignitor Holder receptacle in the Burner Housing is fully aligned with the large holes in both the Burner Chamber and the Burner Cartridge.

1. Apply Nickel anti-seize (Loctite 77164) to the threads of the Ignitor Holder.
2. Using a 3/4" deep socket install the Ignitor Holder. DO NOT over tighten.

   Note: If the Ignitor has been removed, coat the threads with Nickel anti-seize (Loctite 77164) when installing.

3. Install Ignitor. Ensure that the Ignitor is firmly installed into the Ignitor Holder.
4. Install the ignitor hatch, DO NOT over tighten (ref 5.7.4).

5.7.5 Burner Chamber (Applies to all Design Iterations)

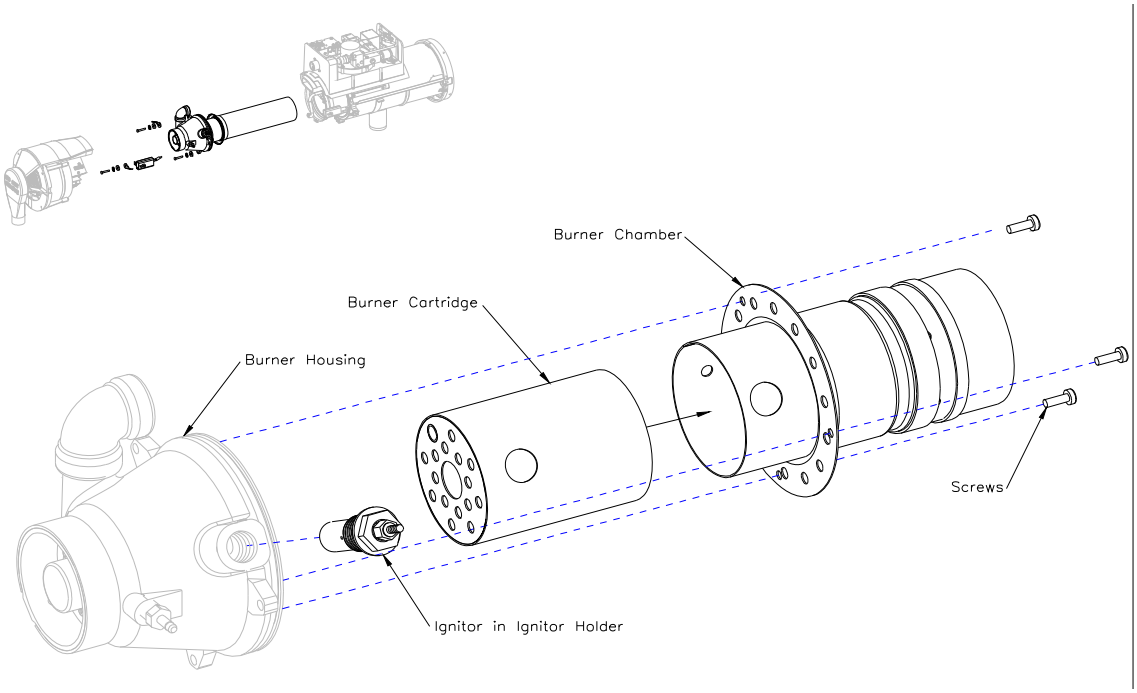


Figure 5.7-6 Burner Chamber

Burner Chamber (Continued)

5.7.5.1 Removal

1. Remove Top Shell (ref. 5.4.2).

2. Remove Bottom Shell (ref. 5.4.3).

3. Remove Vent Fan Assembly (ref. 5.6.1).

4. Remove Combustor Assembly (ref. 5.7.1).

5. Using a 3/4" deep socket or 3/4" wrench, remove Ignitor Holder from the Burner Housing.

6. Using a #2 cross-tip screwdriver, remove three (3) screws holding the Burner Chamber to the Burner Housing.

7. Remove the burner Cartridge from inside the Burner Chamber.

!CAUTION!
Do NOT use any metallic objects to clean the Push Nut or the Fuel Shaft.
Compressed air jets and/or cleaning spray (carburetor cleaner) is permitted.
The use of a rifle bore cleaning brush is permitted.
Gently wiping with a soft cloth is permitted.
See Figure 5.7-7 Burner Housing, Detail

!CAUTION!
Do NOT allow Burner Wick to fall from Burner Cartridge.

5.7.5.2 Cleaning

1. Carefully remove any carbon deposits from the Burner components by gently scraping away the deposits taking care not to damage the Fuel shaft and the Push Nut on the Fuel Shaft. Gently wiping carbon deposits from the fuel shaft and the Push Nut is usually sufficient.

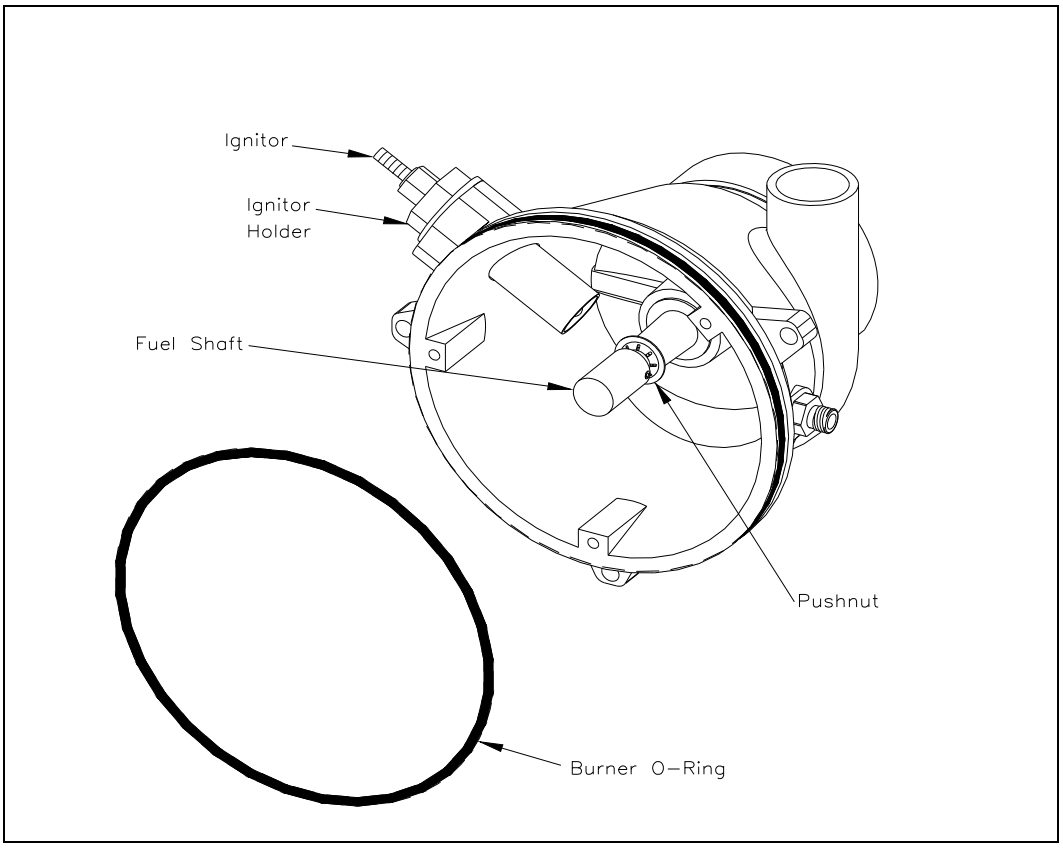


Figure 5.7-7 Burner Housing, Detail

Burner Chamber (continued)

NOTE: Take great care when handling the Burner Cartridge so as not to damage the Burner Wicks. Note: IF the wicks are greater than 50% deteriorated, replace the entire Burner Cartridge (ref. Figure 5.7-9 Burner Cartridge).

5.7.5.3 Installation

Note: When REPLACING the Burner Chamber, the Flame Tube MUST be replaced also.

1. Apply Nickel anti-seize, Loctite 77164 to the threads on the Ignitor Holder.

2. Insert the Burner Cartridge into the Burner Chamber, ensuring the two large side holes in each part line up.

3. Insert the Burner Cartridge with the Burner Chamber into the Burner Housing and at the same time screw in the Ignitor Holder ensuring the Ignitor Holder enters the large side hole in the other two parts.

Note: The Burner Cartridge is held in place by the Ignitor Holder passing into the large side hole.

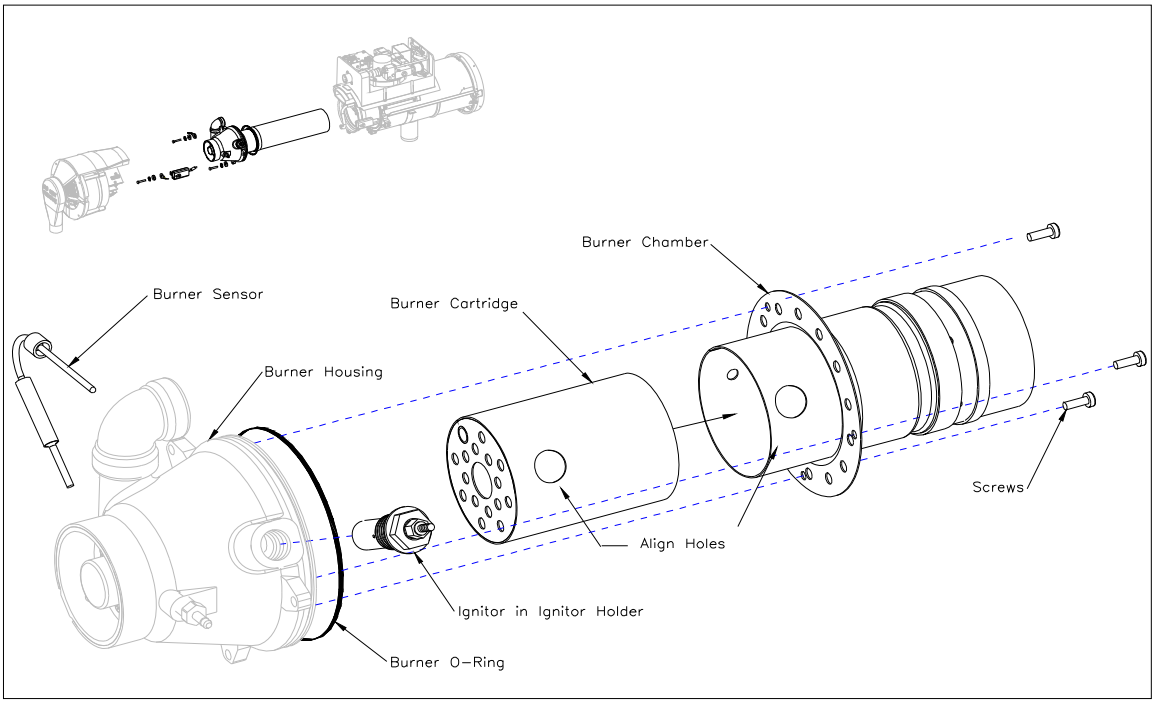


Figure 5.7-8 Burner Cartridge Alignment

4. Apply Loctite 243 (blue) to the three (3) screws, and using a #2 cross-tip screwdriver secure the Burner Chamber to the Burner Housing using the three (3) screws.

Burner Chamber (continued)

5. Secure the Ignitor Holder using a 3/4" deep socket.

6. Coat a new Burner O-Ring with common grease (GAA) and install the O-Ring onto the Burner Housing. (ref. Figure 5.7-11 Fuel Shaft & Pushnut).

7. Install Combustor Assembly (ref. 5.7.1).

8. Install Vent Fan Assembly (ref. 5.6.1).

9. Install Bottom Shell (ref. 5.4.3).

10. Install Top Shell (ref. 5.4.2).

5.7.6 Burner Cartridge (Applies to all Design Iterations)

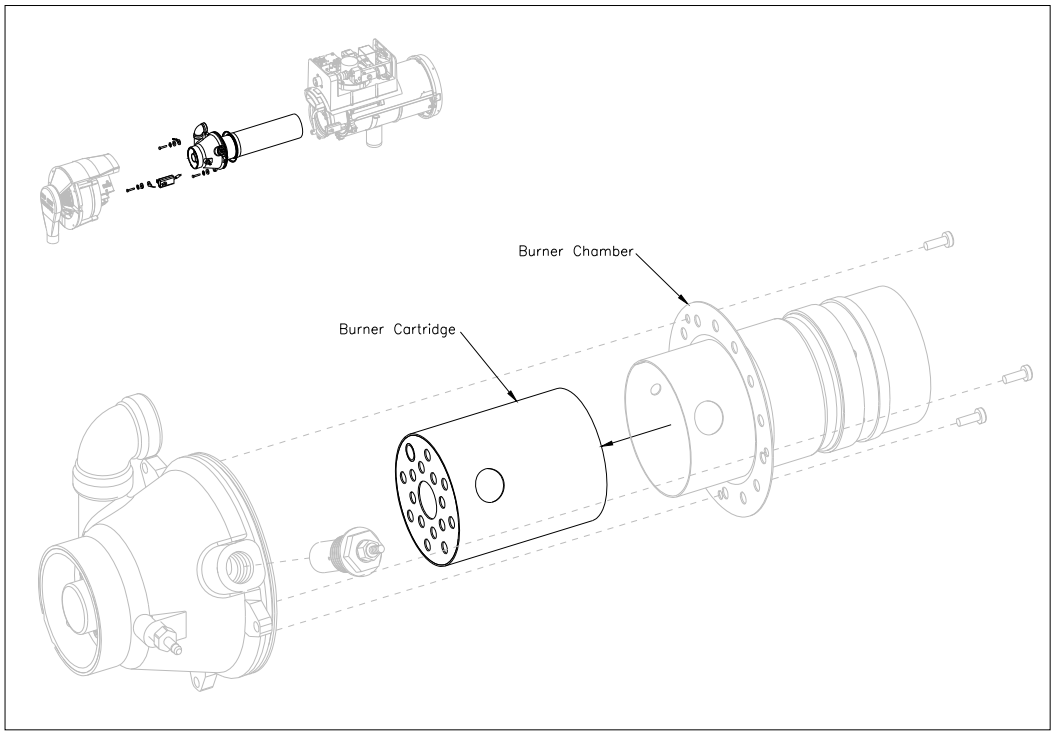


Figure 5.7-9 Burner Cartridge

5.7.6.1 Removal

1. Remove Top Shell (ref. 5.4.2).

2. Remove Bottom Shell (ref. 5.4.3).

3. Remove Vent Fan Assembly (ref. 5.6.1).

4. Remove Combustor Assembly (ref. 5.7.1).

Burner Cartridge (Continued)

5. Remove Burner Chamber (ref. 5.7.5).

!CAUTION!
Do NOT allow Burner Wick to fall from Burner Cartridge

6. Remove the burner Cartridge from inside the Burner Chamber.

Note: Take great care when handling the Burner Cartridge so as not to damage the Burner Wicks.

Note: IF the wicks are greater than 50% deteriorated, replace the entire Burner Cartridge.

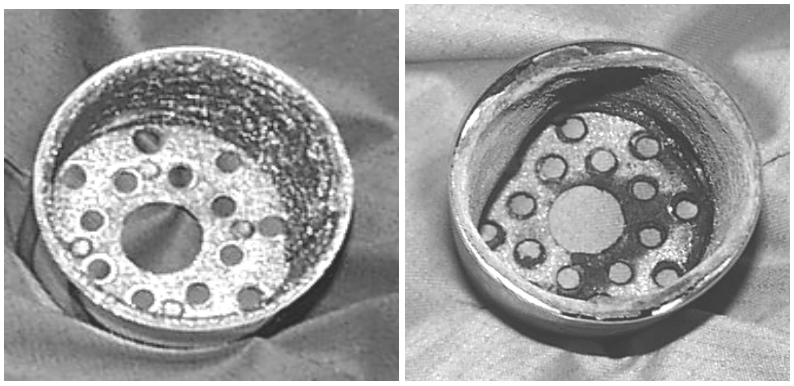


Figure 5.7-10 New Burner Wick (left); 50% deteriorated Burner Wick (right)

!CAUTION!
Do NOT use any metallic objects to clean the Push Nut or the Fuel Shaft.
Compressed air is permitted.
The use of a rifle bore cleaning brush is permitted.
Gently wiping with a soft cloth is permitted.

7. Carefully remove any carbon deposits from the Burner components by gently wiping or brushing away the deposits taking care not to damage the Fuel shaft and the Push Nut on the Fuel Shaft. Do not clean Burner Wick except with compressed air. Do not use solvents for the cleaning of the Burner Wick.

Burner Cartridge (Continued)

5.7.6.2 Installation

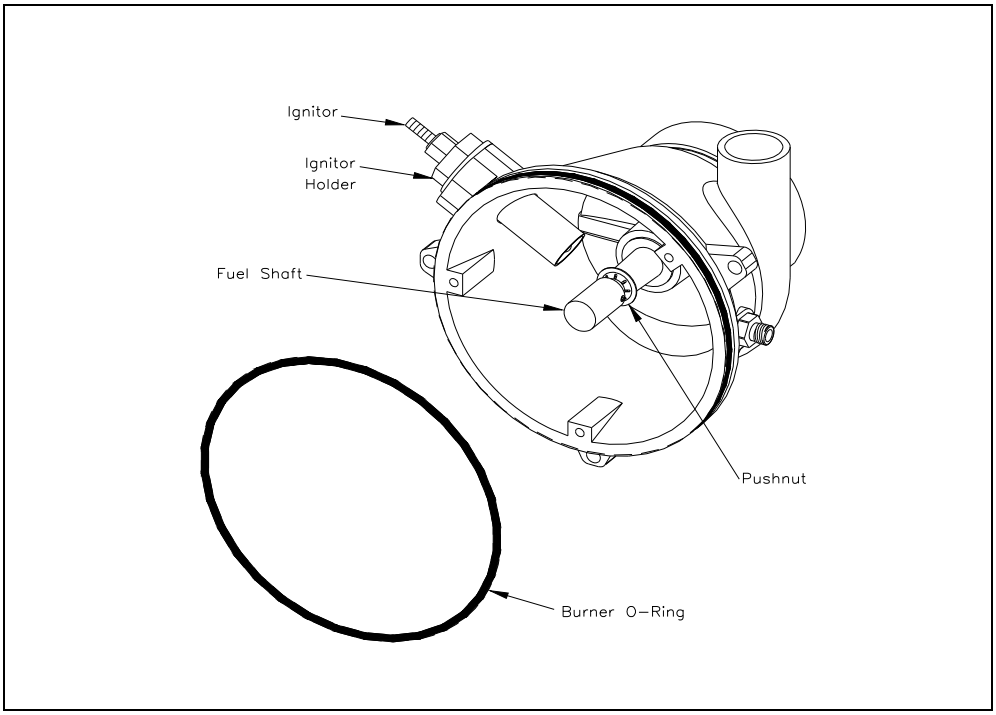


Figure 5.7-11 Fuel Shaft & Pushnut

1. Install Burner Chamber (ref. 5.7.5).
2. Install Burner Assembly (ref. 5.7.1).
3. Install Vent Fan Assembly (ref. 5.6.1).
4. Install Bottom Shell (ref. 5.4.3).
5. Install Top Shell (ref. 5.4.2).

5.7.7 Burner Housing (Applies to all Design Iterations)

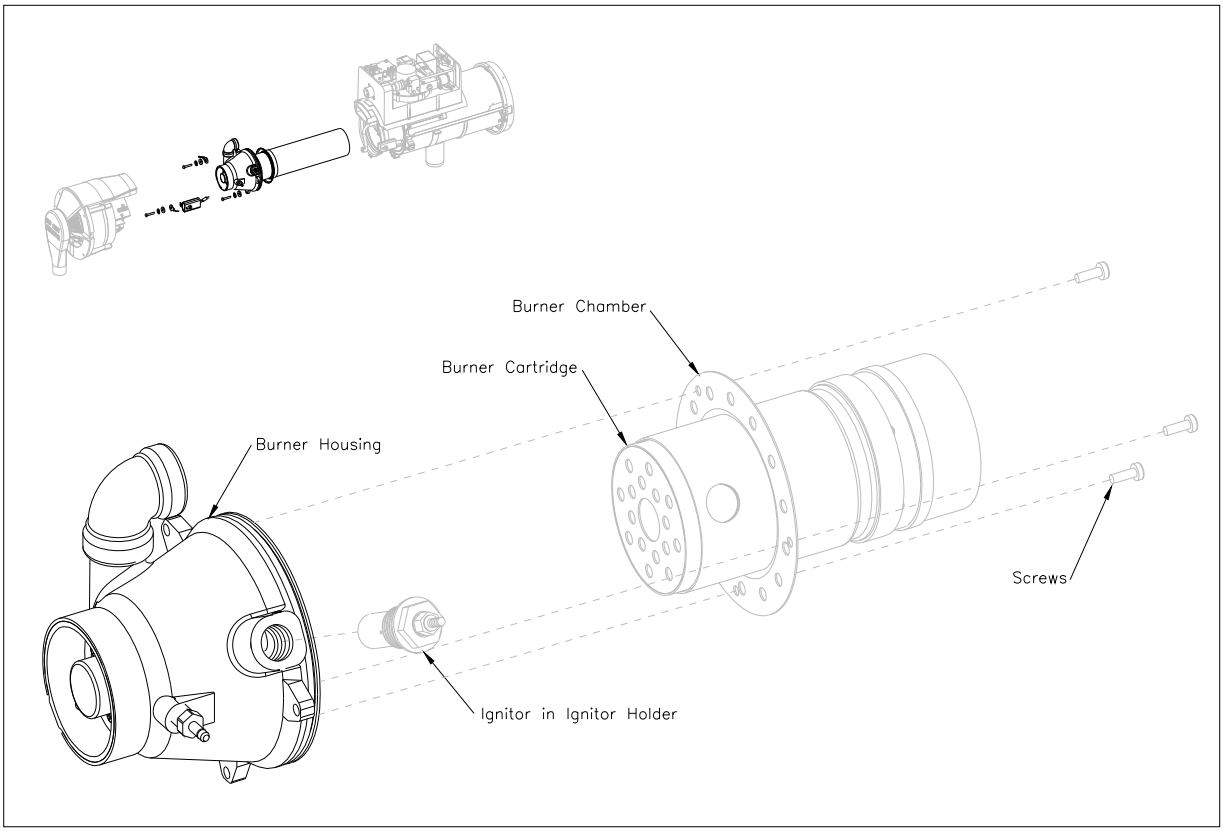


Figure 5.7-12 Burner Housing

5.7.7.1 Removal

1. Remove Top Shell (ref. 5.4.2).
2. Remove Bottom Shell (ref. 5.4.3).
3. Remove Vent Fan Assembly (ref. 5.6.1).
4. Remove Combustor Assembly (ref. 5.7.1).
5. Remove the Burner Chamber (ref. 5.7.5).

NOTE: The Burner Wick located inside the Burner Cartridge is made from a fragile metallic material. Take great care when handling the Burner Cartridge so as not to damage the Burner Wicks.

NOTE: IF the wicks are greater than 50% deteriorated, replace the entire Burner Cartridge (ref. Figure 5.7-9 Burner Cartridge).

Burner Housing (Applies to all Design Iterations) (Continued)

5.7.7.2 Cleaning

1. Carefully remove any carbon deposits from the Burner components by gently scraping away the deposits taking care not to damage the Fuel shaft and the Push Nut on the Fuel Shaft.

!CAUTION!
Do NOT use any metallic objects to clean the Push Nut.
Compressed air jets and/or cleaning spray (carburetor cleaner) is permitted.
The use of a rifle bore cleaning brush is also permitted.

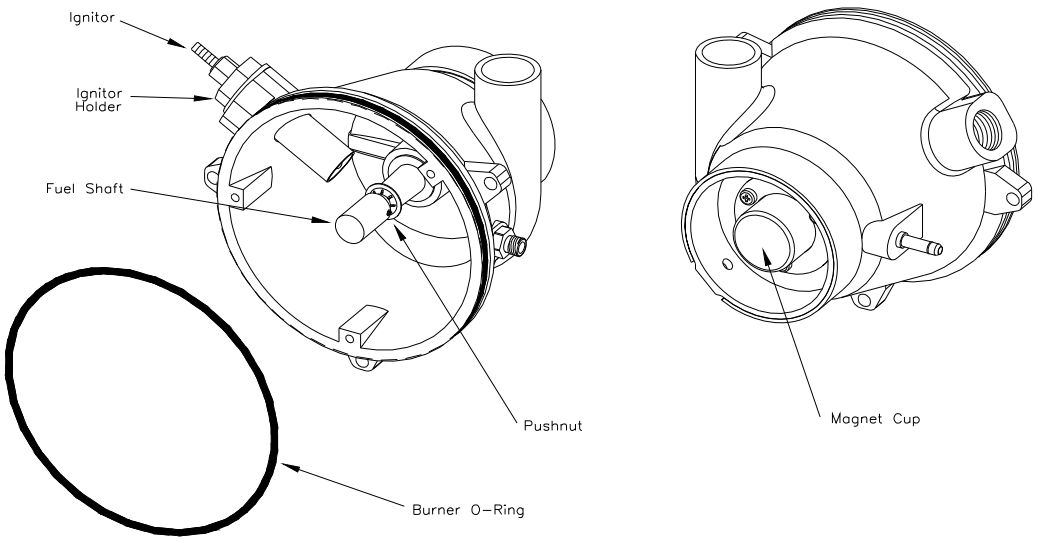


Figure 5.7-13 Detail, Fuel Shaft

NOTE: REPLACE the Burner Housing if any of the following conditions are noticed:

- **The Push Nut rotates freely on the fuel shaft**
- **The Fuel Shaft does NOT rotate freely**
- **The Fuel Shaft wobbles as it rotates**
- **The Magnet Cup leaks, or is badly scored**

NOTE: IF the Magnet Cup leaks or is badly scored, check the Motor Magnet for scoring and replace if necessary (ref. 5.6.2).

Burner Housing (Applies to all Design Iterations) (Continued)

5.7.7.3 Installation

1. Apply Nickel anti-seize, Loctite 77164 to the threads on the Ignitor Holder.
2. Install Burner Chamber (ref 5.7.5).
3. Install Combustor Assembly (ref. 5.7.1).
4. Install Vent Fan Assembly (ref. 5.6.1).
5. Install Bottom Shell (ref. 5.4.3).
6. Install Top Shell (ref. 5.4.2).

Heat Exchanger Assembly

5.8 Heat Exchanger (Applies to all Design Iterations)

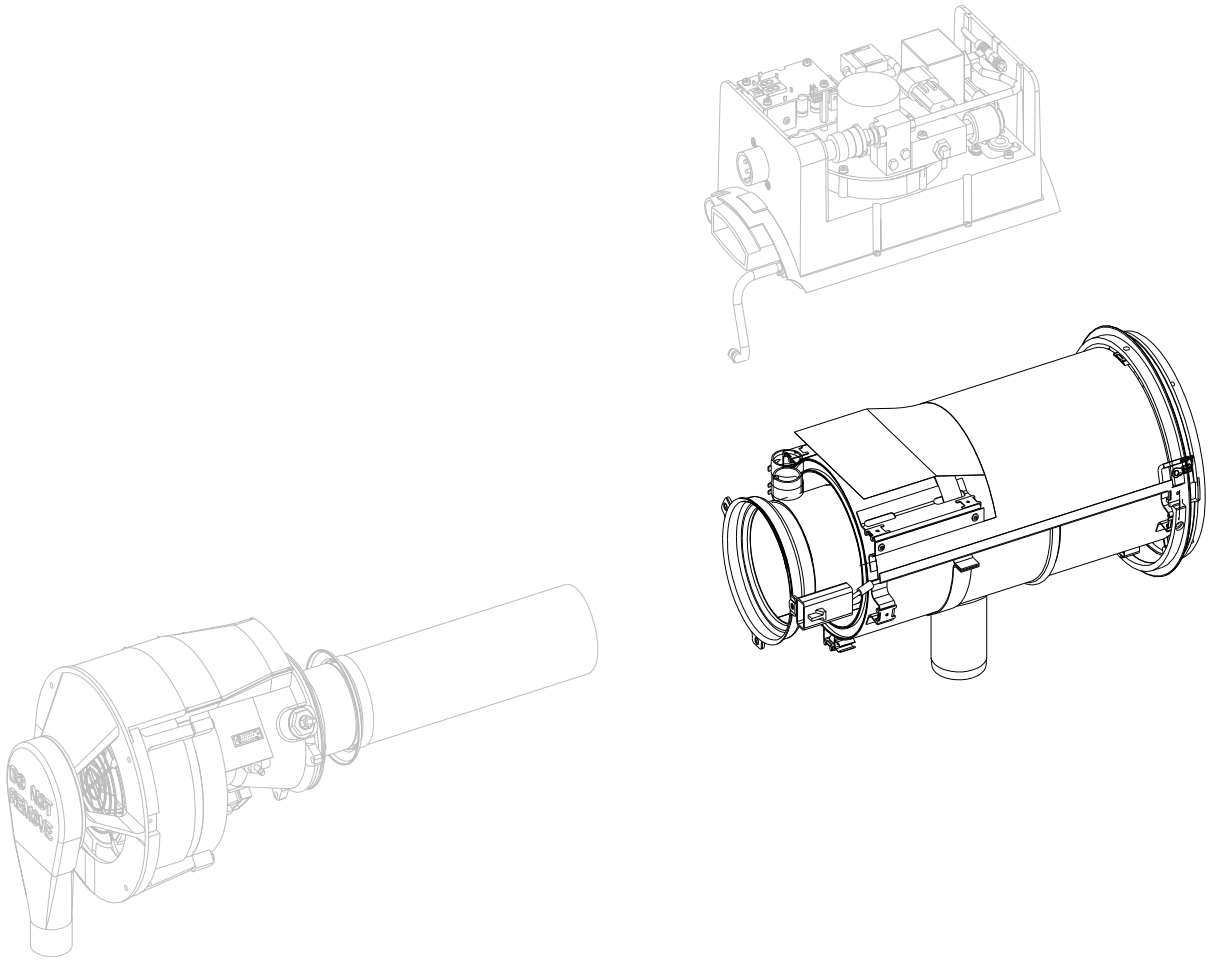


Figure 5.8-1 Heat Exchanger Assembly

Heat Exchanger (Continued)

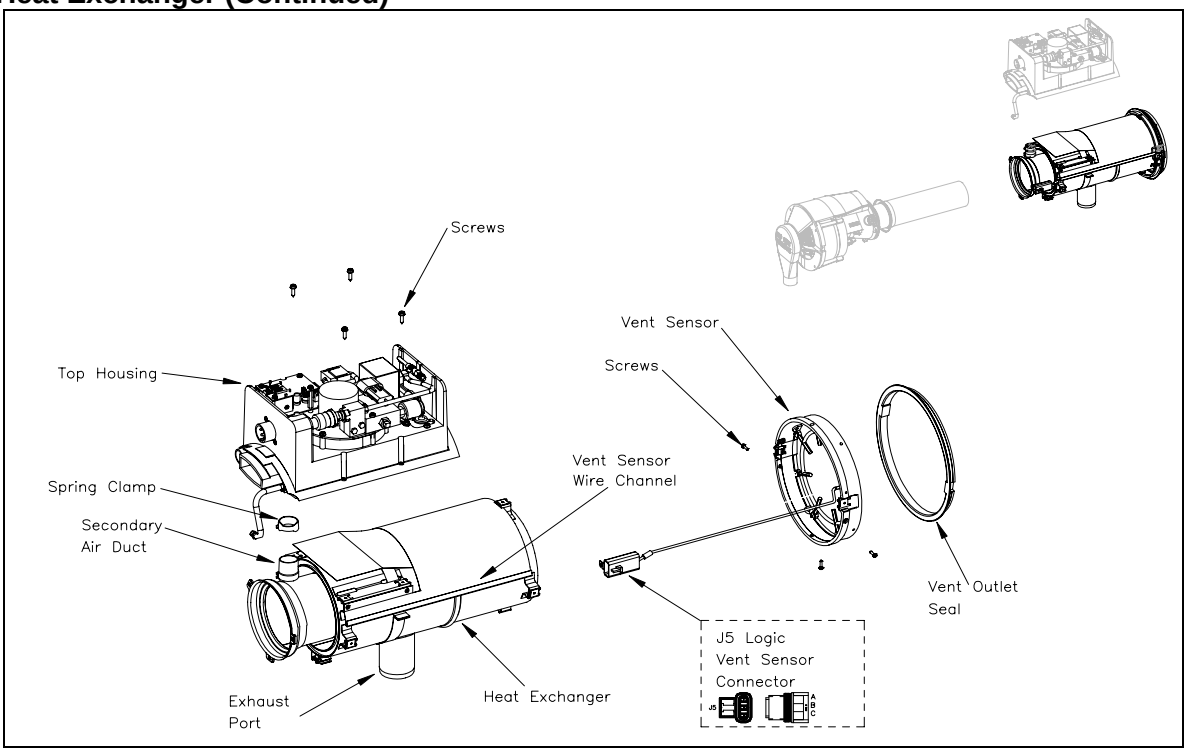


Figure 5.8-2 Heat Exchanger Assembly

5.8.1 Removal

Note: For Steps 1-5, set the heater on the Vent Sensor end. If fuel has collected in the Heat Exchanger, it must be properly disposed of in accordance with the local regulations.

For Steps 6-12, the heater can be set with the Diagnostic Label facing downwards.

1. Remove Top Cover (ref. 5.4.1).

2. Remove Top Shell (ref. 5.4.2).

3. Remove Bottom Shell (ref. 5.4.3).

4. Remove Vent Fan Assembly (ref. 5.6.1).

5. Remove Combustor Assembly (ref. 5.7.1).

6. Remove Flame Tube (ref. 5.7.2).

7. Using pliers, release the 1" metal spring clamp at the Secondary Air Duct from the Heat Exchanger End. Slide the spring clamp over the hose and release onto the Top Housing end so that Secondary Air Duct and two spring clamps are attached to Top Housing.

Heat Exchanger (Continued)

8. Disconnect the Vent Sensor connector (J5).

   Note: The Vent Sensor connector has a self locking tab that needs to be lifted to allow the two halves of the connector to come apart.

9. Using a 7/16" open ended wrench, loosen the nut at the Exhaust Sensor Fitting and remove the Exhaust Sensor from the Exhaust Port.

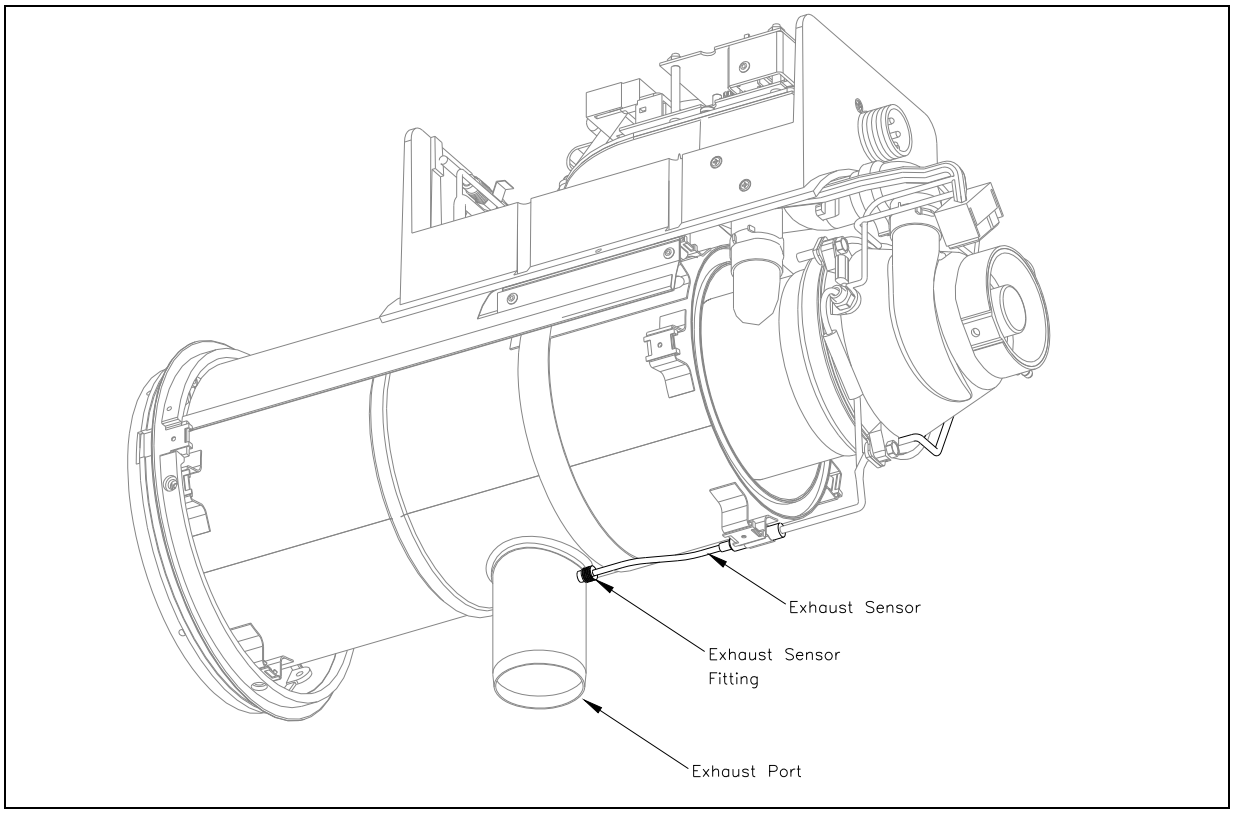


Figure 5.8-3 Exhaust Sensor Fitting Location

!CAUTION!
DO NOT set the Top Housing on the Secondary Air Duct Hose.
Place the Top Housing on it's side with the fuel inlet facing upwards.
Set the Heat Exchanger so that the Vent Sensor is facing upwards.

10. Using a #2 cross-tip screwdriver, remove the four (4) screws that hold the Top Housing to the Heat Exchanger. Lift the Top Housing away from the Heat Exchanger.

11. Gently pry open the channel on the side of the Heat Exchanger and remove the Vent Sensor wire.

12. Using a #2 cross-tip screwdriver, remove the three (3) screws from the Vent Sensor. Gently pull the Vent Sensor away from the Heat Exchanger.

Heat Exchanger (Continued)

5.8.2 Installation

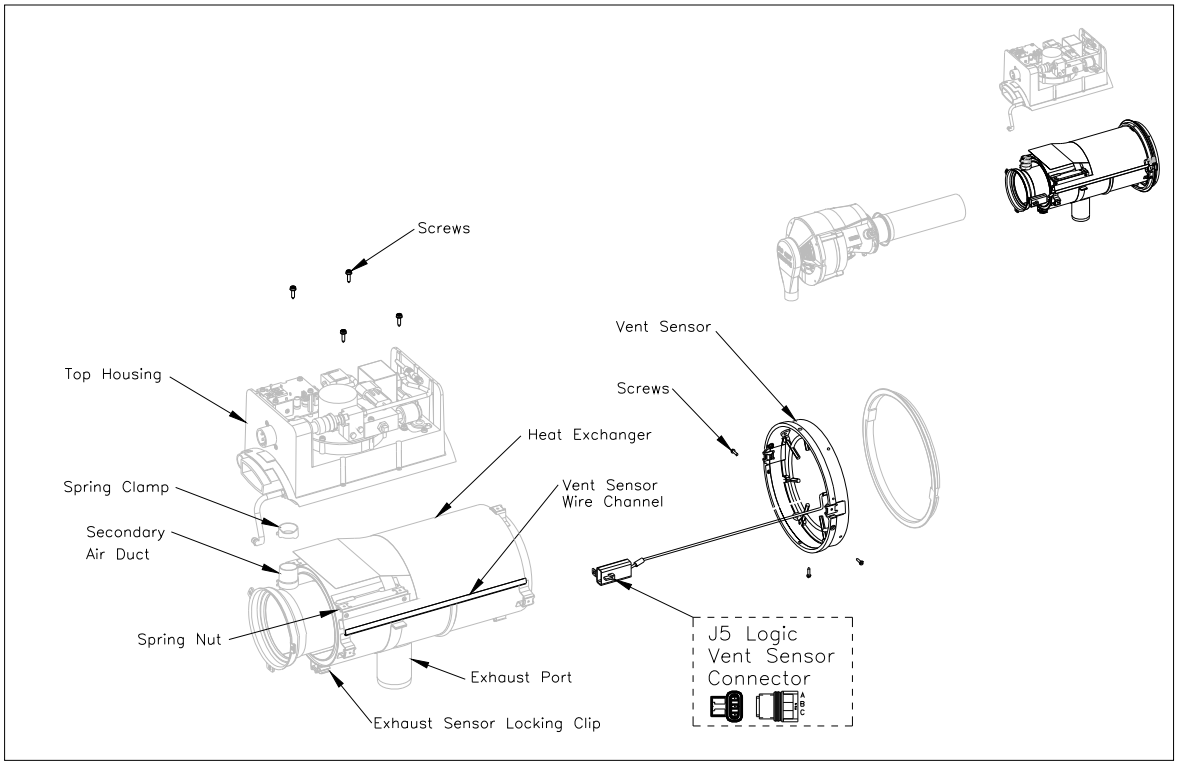


Figure 5.8-4 Heat Exchanger Assembly, Installation

1. Inspect the Heat Exchanger and check that it is fitted with eleven (11) #8 spring nuts.

2. Inspect Secondary Air duct and replace if necessary.

3. Install Vent Sensor onto the Heat Exchanger ensuring that the three (3) screw holes line up.

   Note: Heat Shield must be located on inside face of Vent Sensor.

4. Using a #2 cross-tip screwdriver, secure the Vent Sensor to the Heat Exchanger with three (3) screws.

5. Place the Vent Sensor wire into the channel on the side of the Heat Exchanger ensuring that there is no strain on the connections at the Vent Sensor end. Lightly re-crimp channel to secure Vent Sensor wire. Be careful not to damage the wire during this procedure.

   Note: Vent Sensor MUST be aligned as shown in Figure 5.8-5 Vent Sensor Assembly so that Vent Sensor wire lays in Wire Channel of Exchanger.

6. Place the Top Housing onto the Heat Exchanger taking care not to trap or damage the Wiring Harness. Line up Secondary Air Duct on underside of Top Housing over the air pipe of the Heat Exchanger.

7. Using pliers, move one of the 1" metal spring clamps from the Top Housing end along the Secondary Air Duct Hose and secure to the Heat Exchanger End.

8. Using a #2 cross-tip screwdriver, secure the Top Housing to the Heat Exchanger using four (4) screws using pliers, re-set the Secondary Air Duct with the 1" metal spring clamp so as to remove any kinks or bends in the hose.

9. Using a 7/16" open ended wrench, install the Exhaust Sensor. Snap the wide end of the Exhaust Sensor into the locking clip located on the Heat Exchanger.

10. Connect the Vent Sensor connector (J5) to the Wiring Harness. Ensure the locking tab is engaged.

11. Insert Flame Tube (ref. 5.7.2).

12. Install Combustor Assembly (ref. 5.7.1).

13. Install Vent Fan Assembly (ref. 5.6.1).

14. Install Bottom Shell (ref. 5.4.3).

15. Install Top Shell (ref. 5.4.2).

16. Install Top Cover (ref. 5.4.1).

5.8.3 Vent Sensor Assembly (Applies to all Design Iterations)

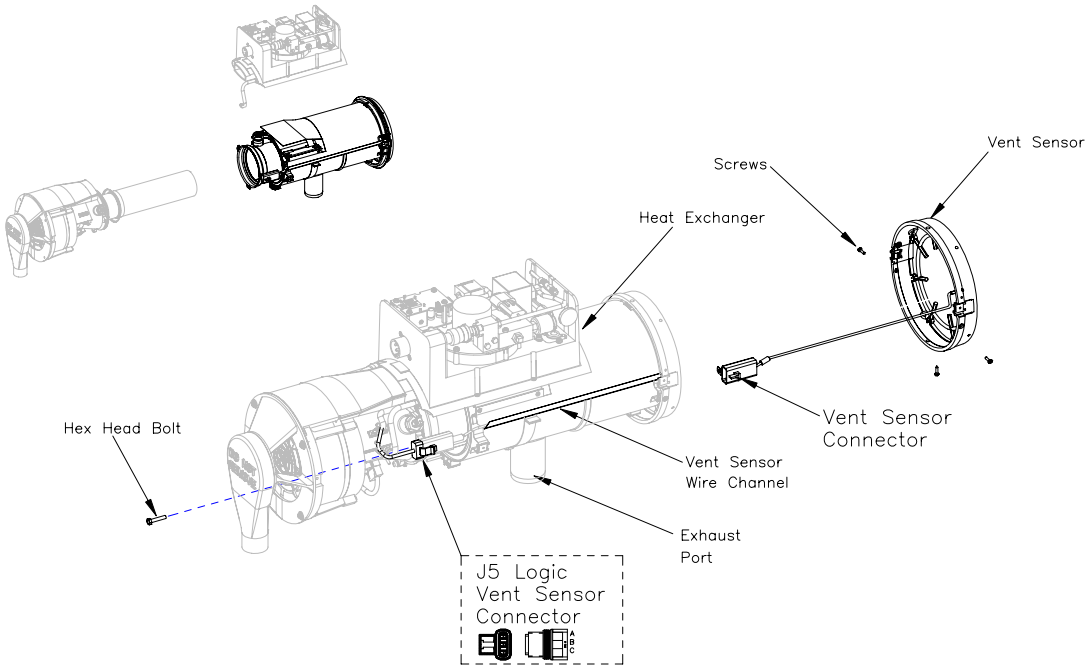


Figure 5.8-5 Vent Sensor Assembly

5.8.3.1 Removal

Note: For Steps 1-5, set the heater on the Vent Sensor End. If fuel has collected in the heat exchanger, it must be properly disposed of in accordance with the local regulations.

1. Remove Top Shell (ref. 5.4.2).

2. Remove Bottom Shell (ref. 5.4.3).

3. Disconnect the Logic Harness end of the Vent Sensor Connector from the Vent Sensor Connector (J5).

   Note: The Vent Sensor Connector has a self locking tab that needs to be lifted to allow the two halves of the connector to come apart.

4. Using a 5/16" socket or nut driver, remove the single hex head bolt (from the Burner Housing to the Heat Exchanger) which secures the Vent Sensor Connector (J5) Clip.

5. Gently pry open the channel on the side of the Heat Exchanger and remove the Vent Sensor wire.

   Tip: Set the heater on its side with the Fuel Inlet facing Upwards. If possible have the Vent Sensor ONLY overhang the edge of the work bench.

6. Using a #2 cross-tip screwdriver, remove the three (3) screws from the Vent Sensor. Gently pull the Vent Sensor away from the Heat Exchanger.

Vent Sensor Assembly (Applies to all Design Iterations) (Continued)

5.8.3.2 Installation

Note: Vent Sensor MUST be aligned as shown in Figure 5.8-5 Vent Sensor Assembly so that Vent Sensor wire lays in the proper channel of the Heat Exchanger.

1. Install Vent Sensor onto the Heat Exchanger ensuring that the three (3) screw holes line up and the Vent Sensor wire is located on the proper side of the Heat Exchanger.

   Note: Heat Shield must be located on inside face of Vent Sensor.

2. Using a #2 cross-tip screwdriver, secure the Vent Sensor to the Heat Exchanger with three (3) screws.

3. Place the Vent Sensor wire into the channel on the side of the Heat Exchanger ensuring that there is no strain on the connections at the Vent Sensor end. Lightly re-crimp channel to secure Vent Sensor wire. Be careful not to damage the wire during this procedure.

4. Using a 5/16" socket or nut driver, secure the Vent Sensor connector (J5) clip to the Burner Housing with a hex head bolt. Note: this bolt also secures the Burner Housing to the Heat Exchanger.

5. Connect the Vent Sensor connector (J5) to the Wiring Harness. Ensure the locking tab is engaged.

6. Install Bottom Shell (ref. 5.4.3).

7. Install Top Shell (ref. 5.4.2).

5.8.4 Vent Outlet Seal (Applies to all Design Iterations)

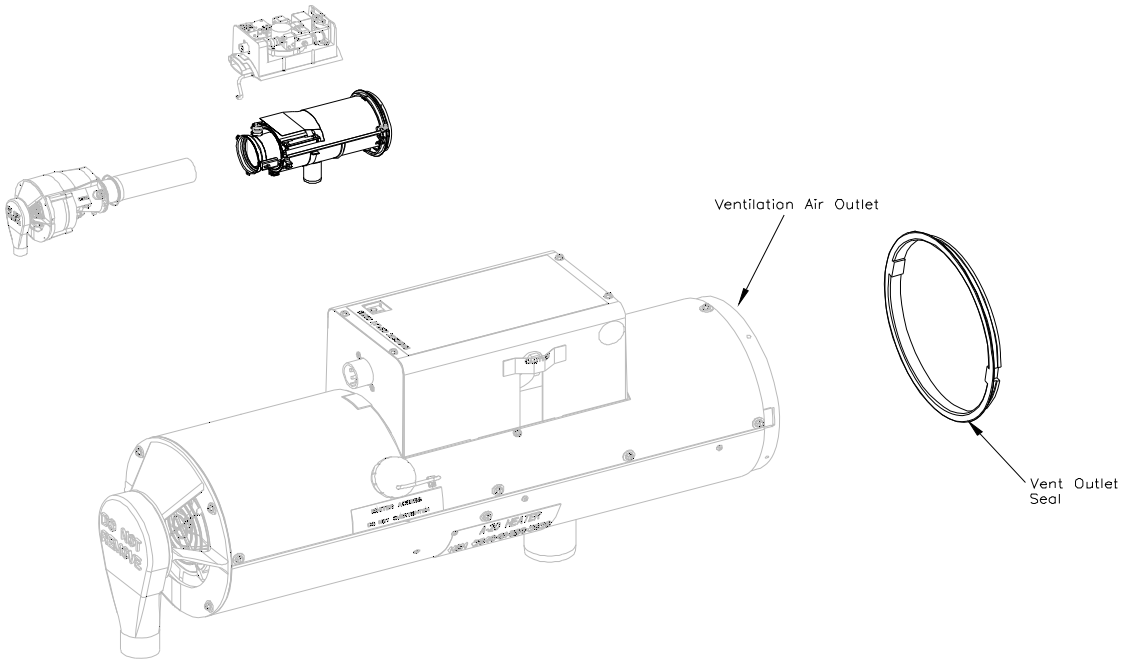


Figure 5.8-6 Vent Outlet Seal

Note: The Vent Outlet Seal MUST be replaced EVERY time the heater is re-installed into a vent ducting system.

5.8.4.1 Removal

1. Pull Vent Outlet Seal from Vent Outlet End of heater.

5.8.4.2 Installation

1. Position new Vent Outlet Seal over Vent Outlet end of heater so the foam side is out, and positioning notches on sides line up with notches in Vent Sensor.

2. Press Vent Outlet Seal over end of heater until the seal stops against the ends of the Top and Bottom Shells.

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5.9 Top Housing Assembly

5.9.1 Top Housing Assembly Repair (Design Iteration 1 & 2 Only; refer to section 5.2 for details regarding Design Iterations)

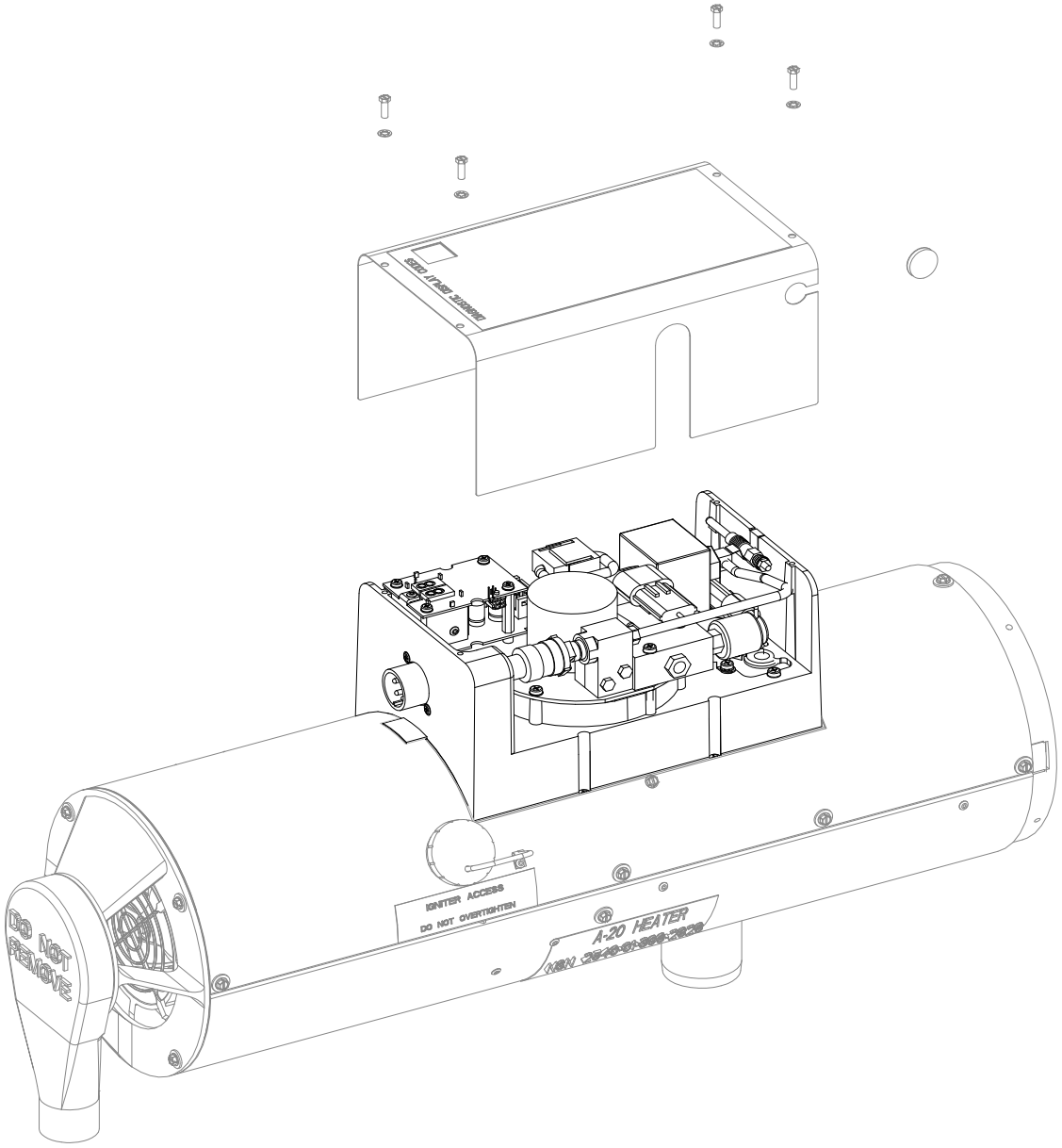


Figure 5-1. Top Housing Assembly (Design Iteration 1 & 2 Only)

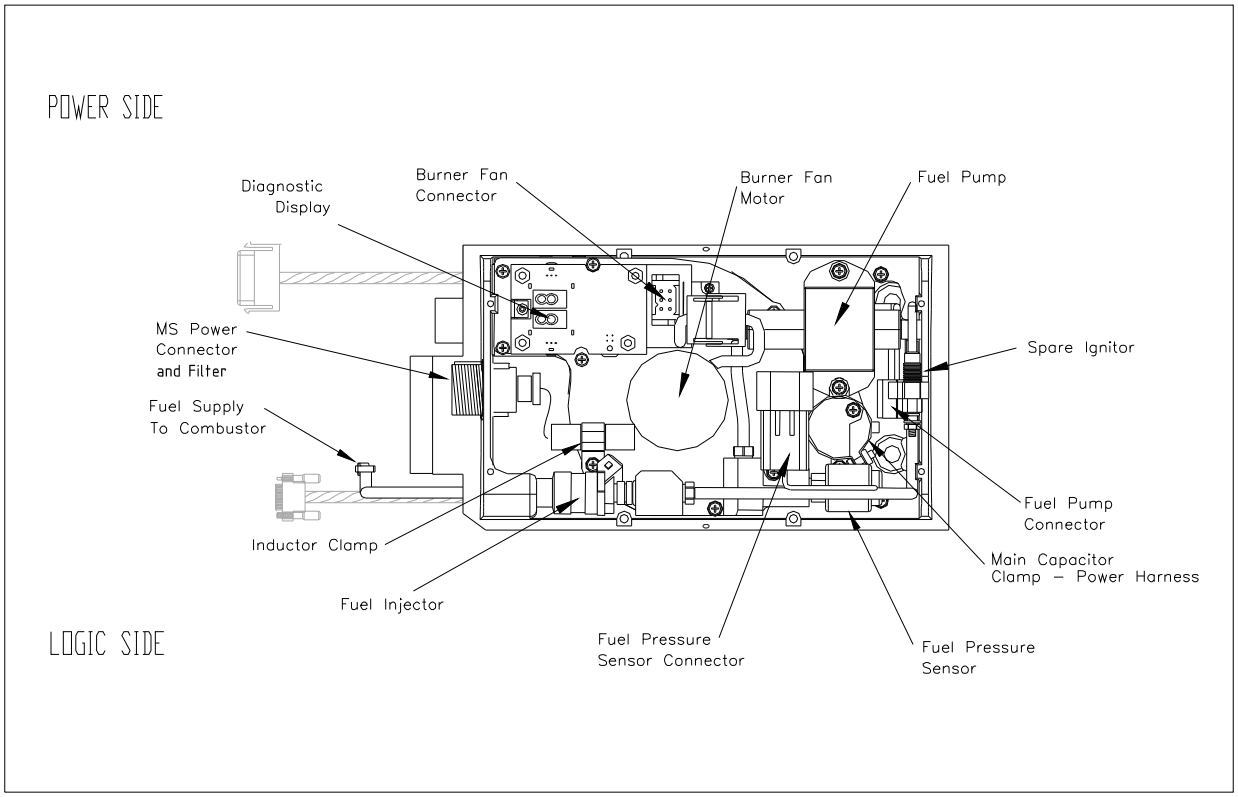


Figure 5-2. Top Housing, Top View

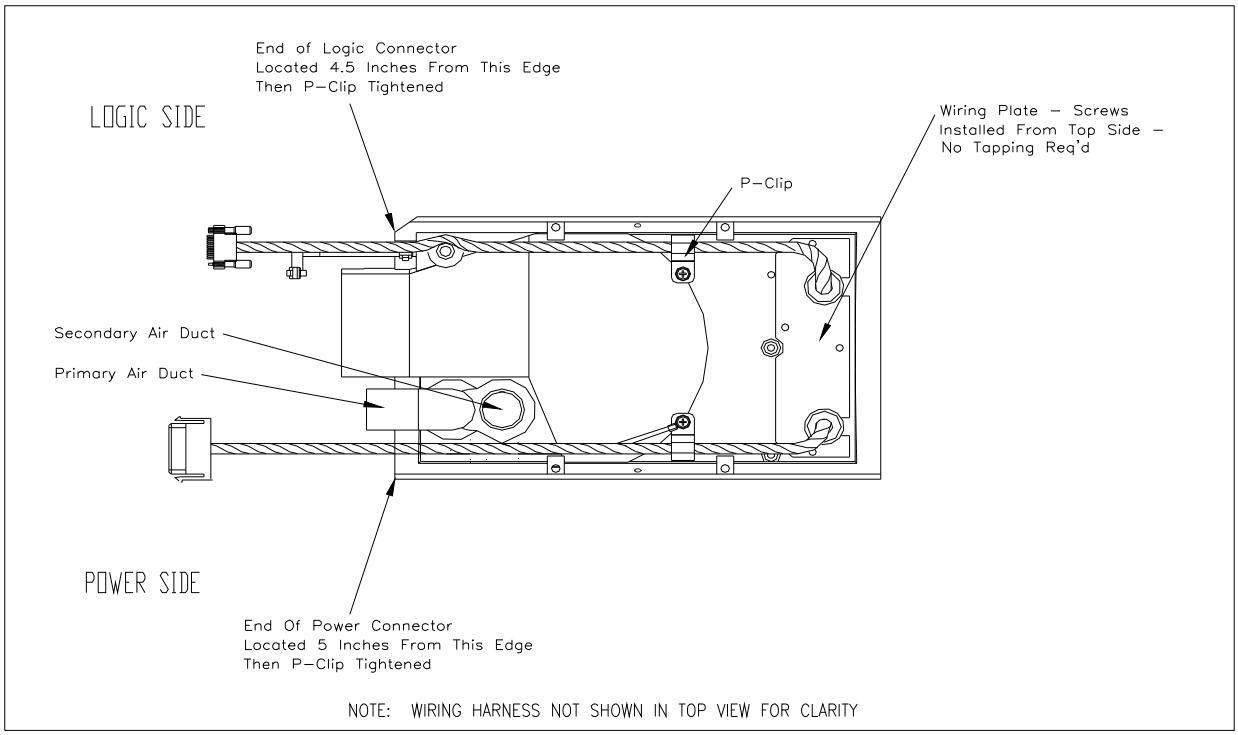


Figure 5-3. Top Housing, Bottom View

5.9.2 Top Housing Assembly Repair (Design Iteration 3 Only; refer to section 5.2 for details regarding Design Iterations)

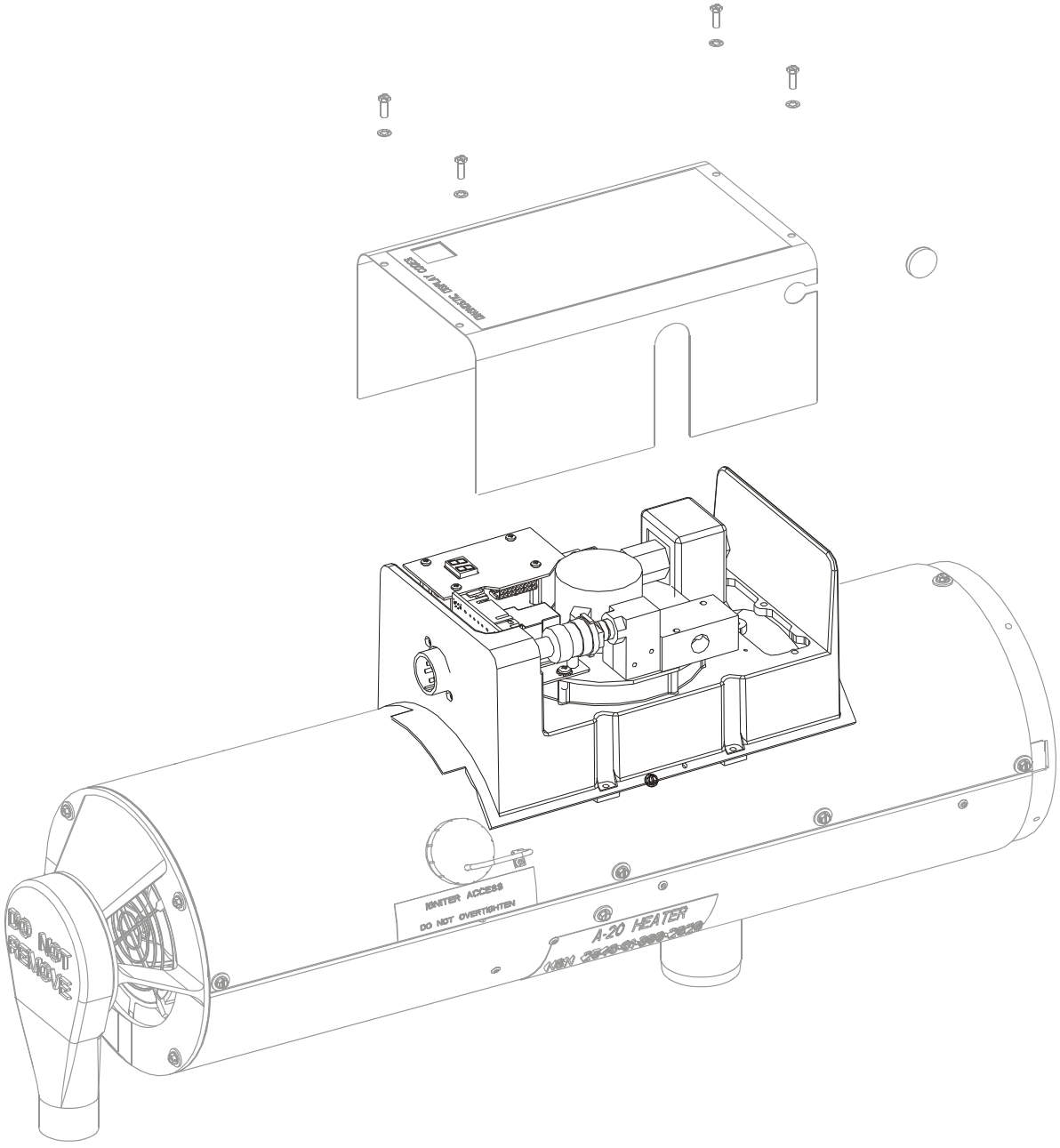
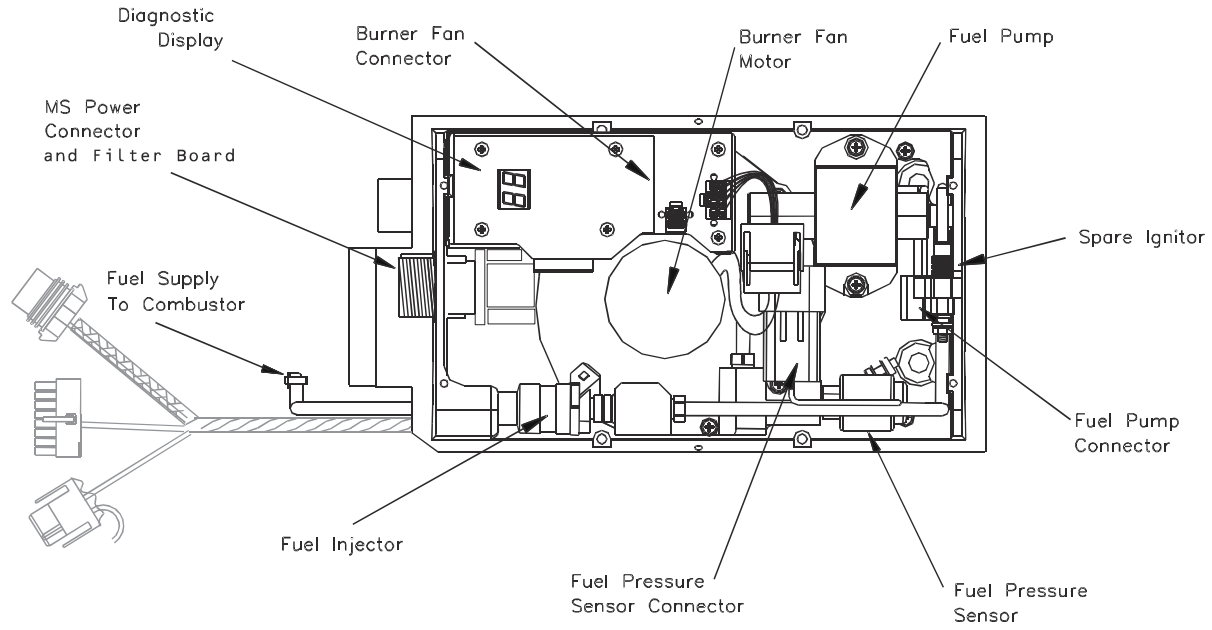


Figure 5-4. Top Housing Assembly (Design Iteration 3 Only)



NOTE: PORTION OF WIRING HARNESS INSIDE TOP HOUSING NOT SHOWN FOR CLARITY

Figure 5-5. Top Housing, Top View

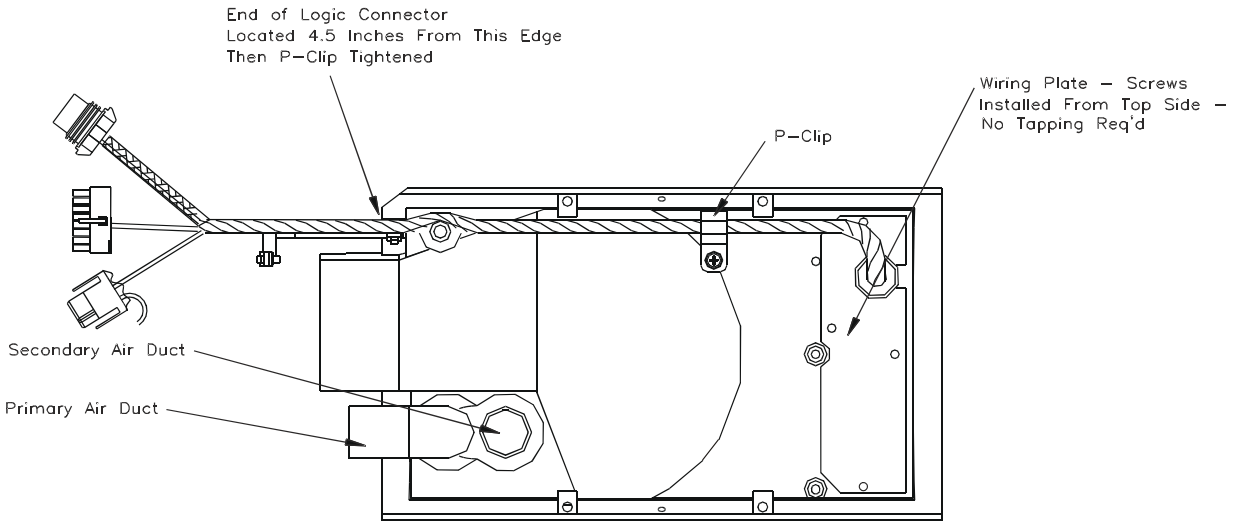


Figure 5-6. Top Housing, Bottom View

5.9.3 Fuel Pressure Sensor

5.9.3.1 Fuel Pressure Sensor (For All Design Iterations)

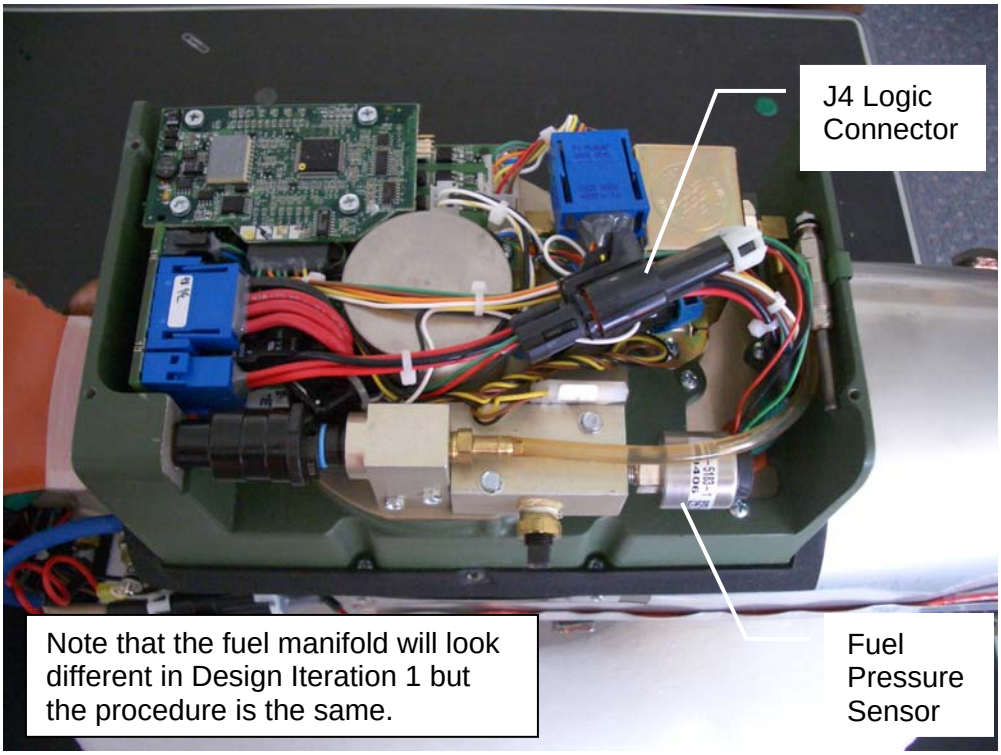


Figure 5-7. Fuel Pressure Sensor

5.9.3.1.1 Removal

1. Remove Top Cover (ref. 5.4.1).

   Note: The connector is released by gently lifting the locking tab with the blade of the small screwdriver, and then pulling apart the two halves.

2. Disconnect Fuel Pressure Sensor connector (J4) from the Wiring Harness.

! CAUTION !
If the Fuel Pressure Sensor is dropped, it may be damaged and should be replaced.

Fuel Pressure Sensor (continued)

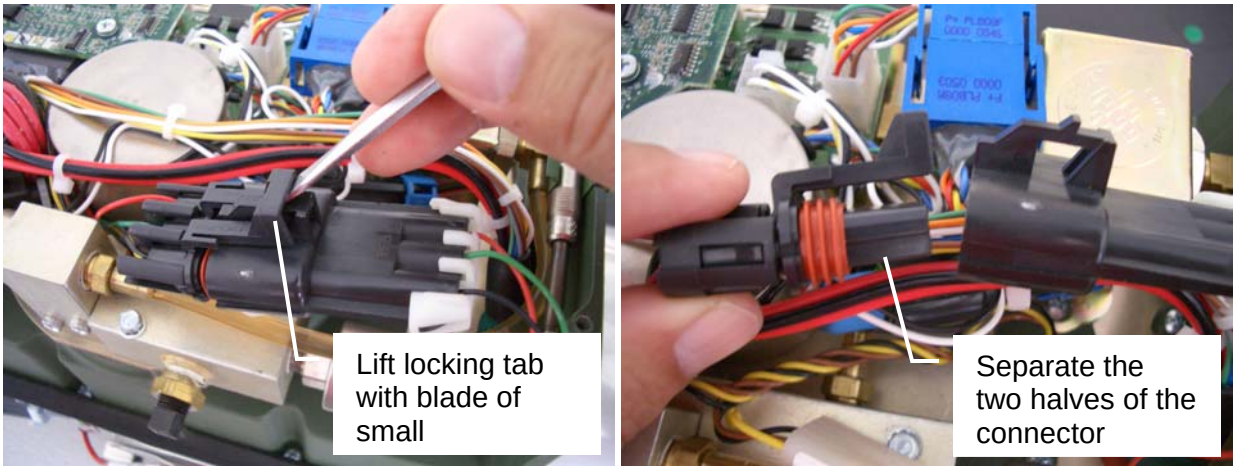


Figure 5-8. J4 Logic Connector detail

3. Using a 9/16" open ended wrench, remove Fuel Pressure Sensor from the Fuel Inlet manifold.

4. Clean residual Loctite 592 thread sealant from inside threads of fuel manifold.

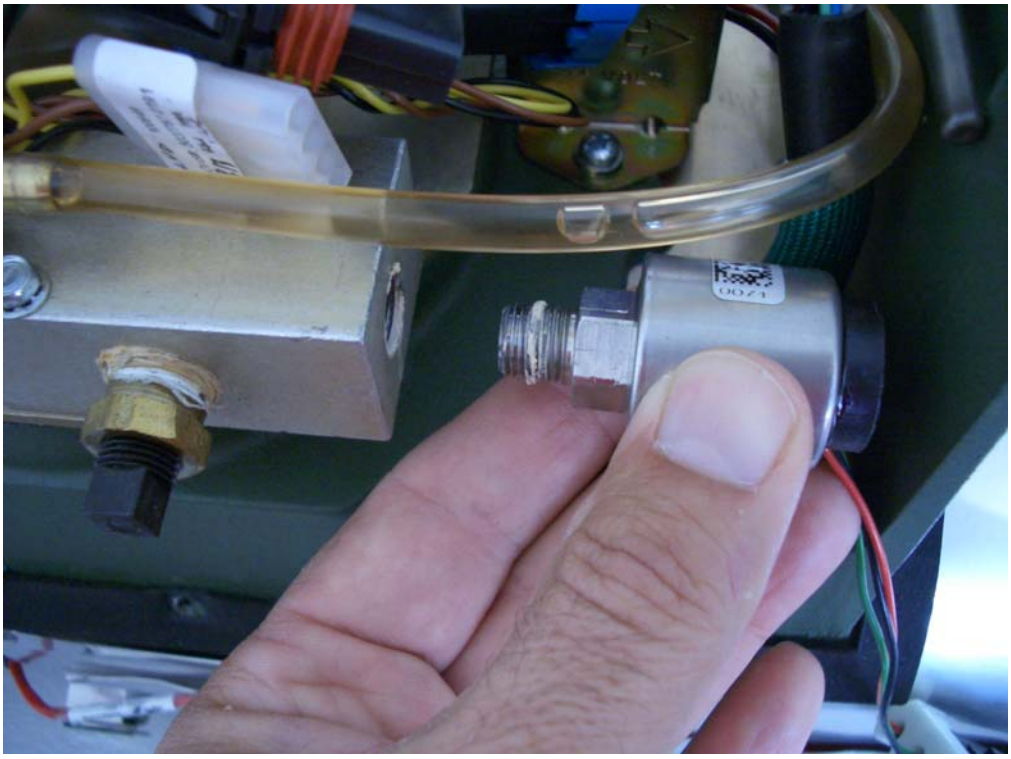


Figure 5-9. Removal of Fuel Pressure Sensor

Fuel Pressure Sensor (continued)

5.9.3.1.2 Installation

!CAUTION!
When replacing a Fuel Pressure Sensor, DO NOT remove the plastic protector cap from the Fuel Pressure Sensor until ready to install.

DO NOT insert any objects into the Fuel Pressure Sensor.

1. Apply Loctite 592 to the threads of the Fuel Pressure Sensor.

2. Using a 9/16" open ended wrench, install Fuel Pressure Sensor into the Fuel Inlet manifold. When tight, the wires of the sensor should be 180 degrees from the Fuel Inlet.

3. Connect the Fuel Pressure Sensor connector (J4) to the Wiring Harness.

4. Start the heater and check that there are NO fuel leaks from the fuel connections (ref. 5.5-9).

5. Install Top Cover (ref. 5.4.1).

5.9.4 Diagnostic Display

5.9.4.1 Diagnostic Display Repair (Design Iteration 1 & 2 Only)

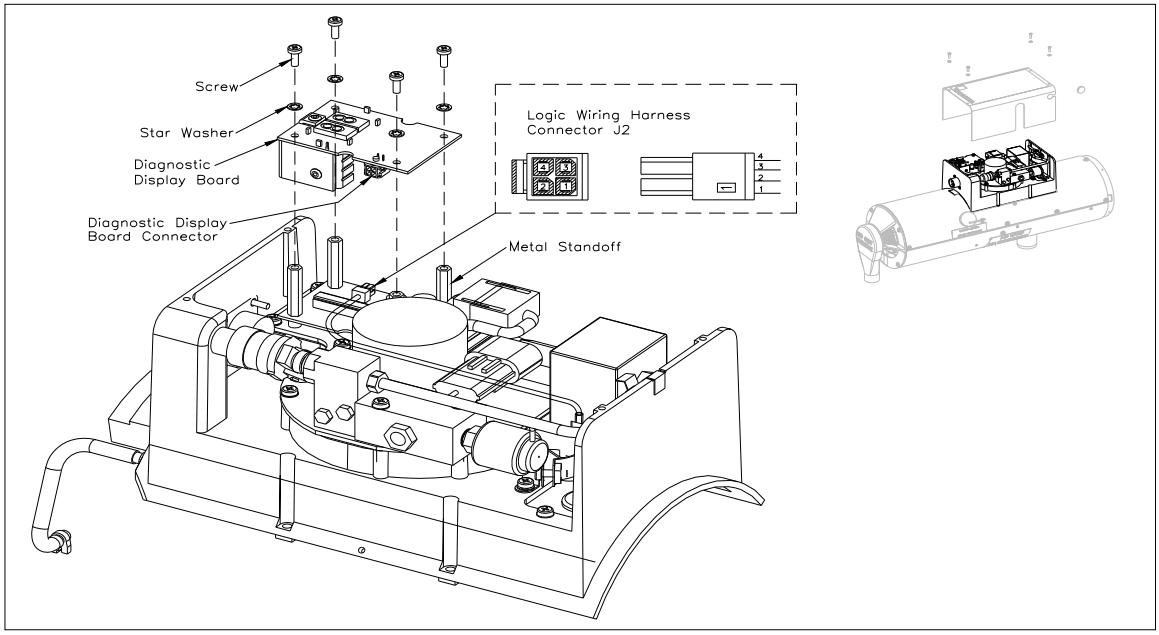


Figure 5-10. Diagnostic Display

Diagnostic Display (continued)

5.9.4.1.1 Removal

1. Remove Top Cover (ref. 5.4.1).

2. Disconnect the Wiring Harness Connector (J2) from the Diagnostic Display by pressing connector clip on underside of connector.

3. Using a 5/16" socket, remove Four (4) screws and star washers. Remove the Diagnostic Display Board taking care to leave the four (4) metal standoffs in place.

5.9.4.1.2 Installation

1. Place the Diagnostic Display Board onto the threaded posts.

   Note: The holes in the Diagnostic Display Board are offset so that the Board can only be placed in one direction on the posts.

2. Apply Loctite 243 (blue) to each of the four (4) mounting screws.

3. Install one (1) star washer and one (1) screw into each threaded post and finger tighten. When finger tight, use #2 cross-tip screwdriver to further tighten each screw ¼ turn. DO NOT OVER TIGHTEN.

4. Install Connector (J2) from the Wiring Harness to the Diagnostic Display Board.

5. Install Top Cover (ref. 5.4.1).

5.9.4.2 Diagnostic Display Repair (Design Iteration 3 Only)

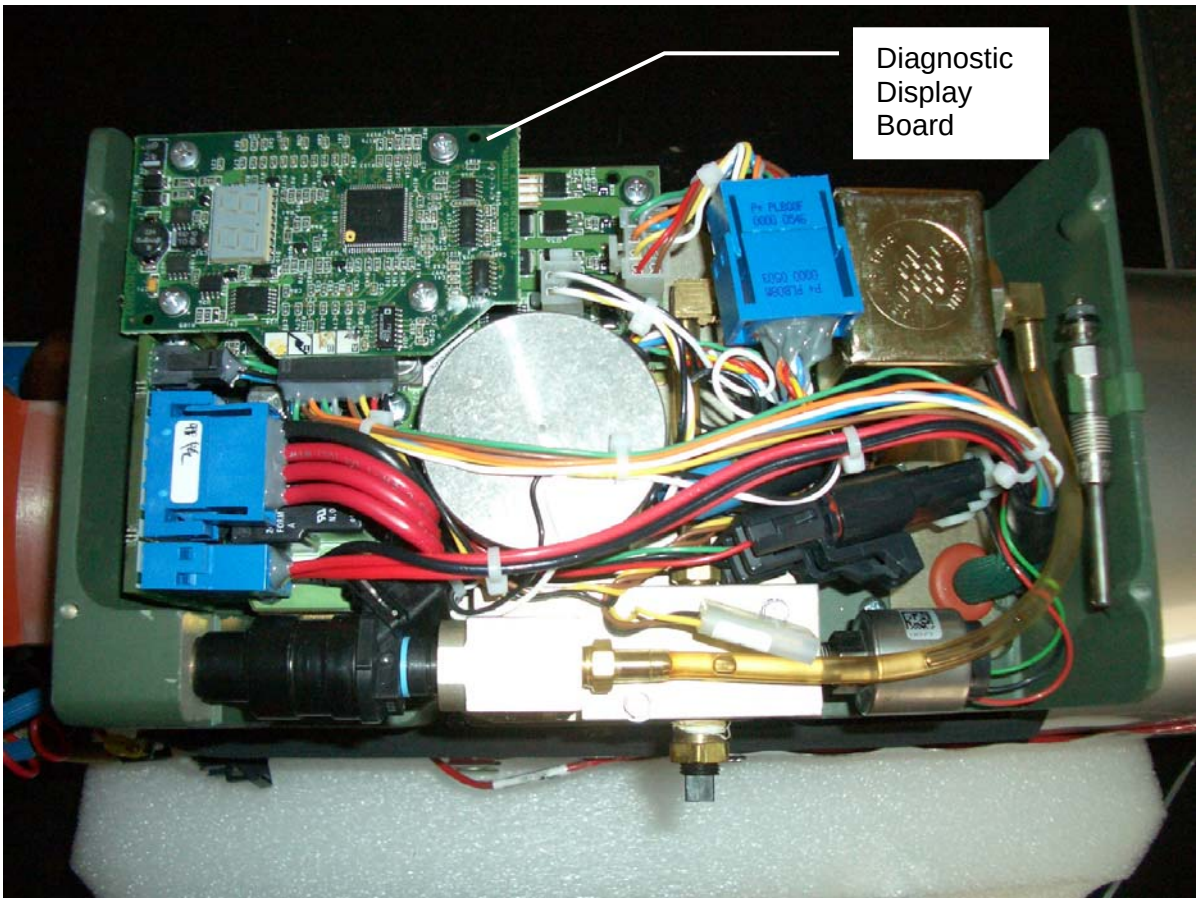


Figure 5-11. Diagnostic Display

5.9.4.2.1 Removal

1. Remove Top Cover (ref 5.4.1).

2. Using a #2 cross-tip screwdriver, remove four (4) screws and star washers taking care to leave the four (4) metal standoffs in place. Lift the Diagnostic Display Board separating the two halves of connector J1 on the underside of the board.

3. Disconnect the Wiring Harness Connector (J8) from the Diagnostic Display by pressing connector clip on underside of connector and gently separating the two halves.

5.9.4.2.2 Installation

1. Place the Diagnostic Display Board onto the threaded posts ensuring that the four (4) nylon standoffs are in place engaging the two halves of connector J1 on the underside of the board.

   Note: The holes in the Diagnostic Display Board are offset so that the Board can only be placed in one direction on the posts.

Diagnostic Display (continued)

2. Install Connector (J8) from the Wiring Harness to the Diagnostic Display Board.

3. Apply Loctite 243 (blue) to each of the four (4) screws.

4. Install one (1) star washer and one (1) screw on each post and tighten with a #2 cross-tip screwdriver. DO NOT OVER TIGHTEN.

5. Install Top Cover (ref. 5.4.1).

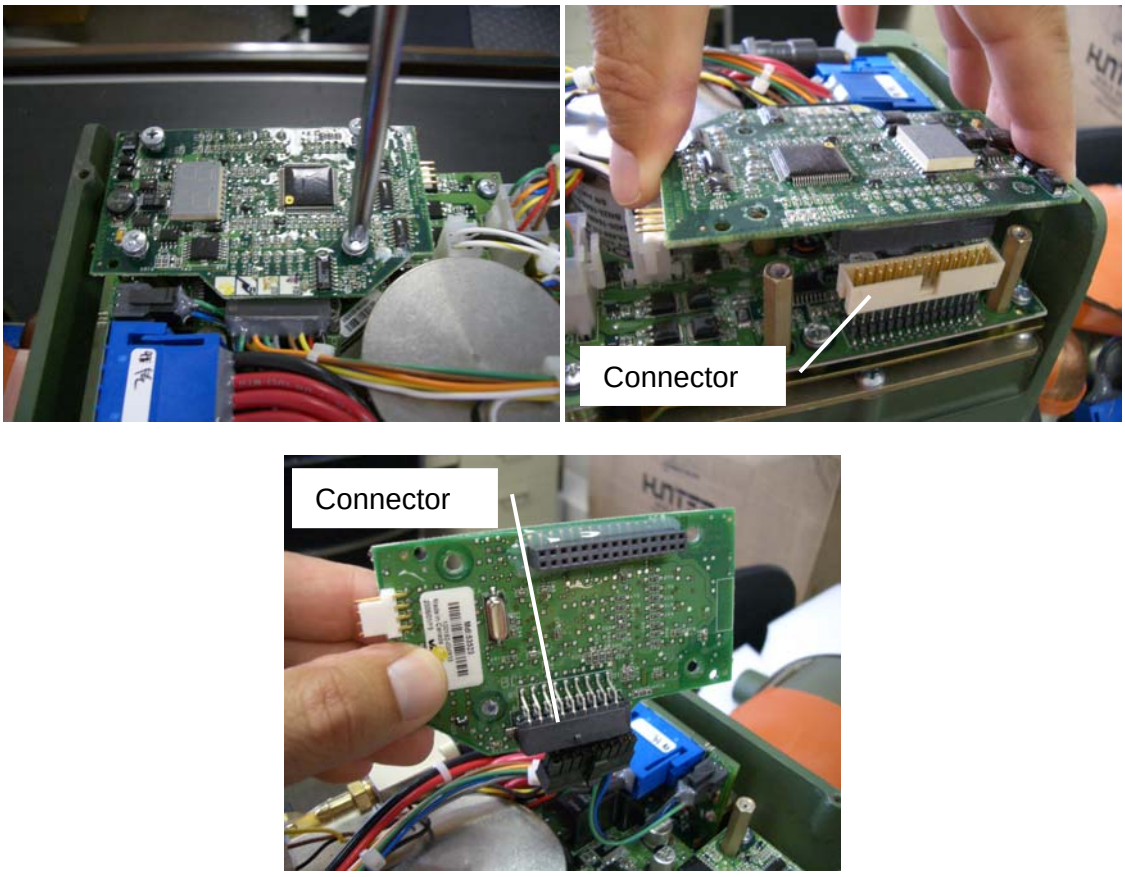


Figure 5-12. Diagnostic Display Board Details

5.9.5 Fuel Pump

5.9.5.1 Fuel Pump Repair (Design Iteration 1 & 2 Only)

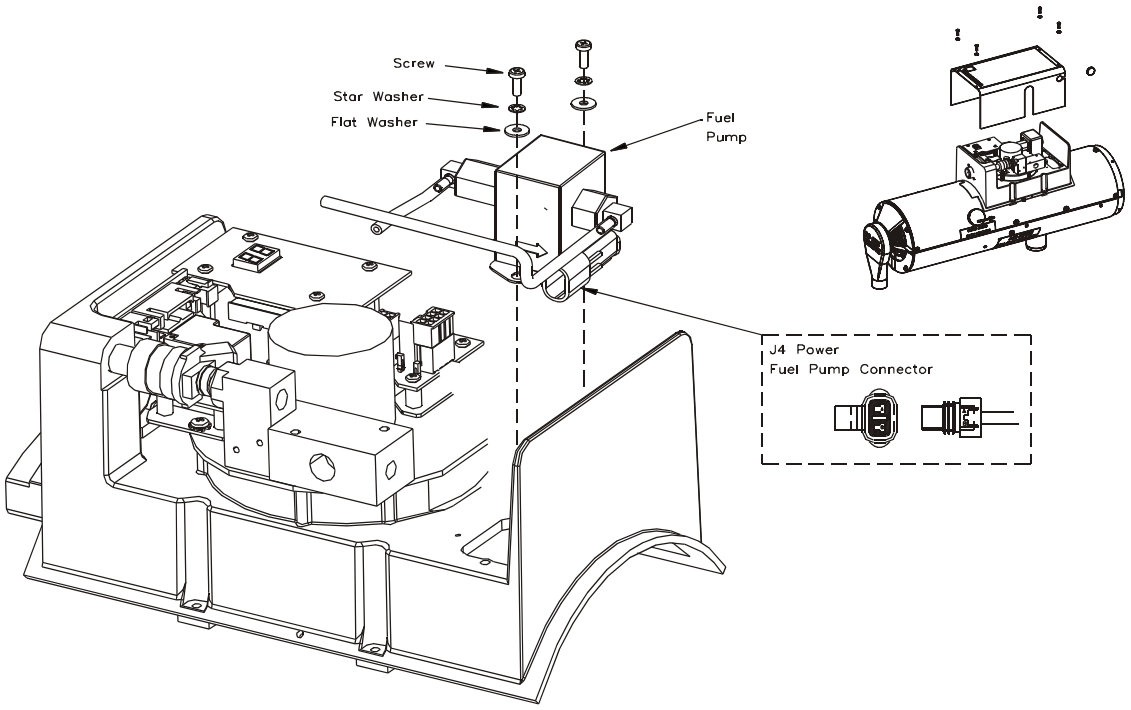


Figure 5-13. Fuel Pump

5.9.5.1.1 Removal

1. Remove Top Cover (ref. 5.4.1).

2. Disconnect Fuel Pump connector (J4) from the Wiring Harness.

   Note: The connector is released by lifting the locking tab and gently pulling apart the two halves.

!CAUTION!
Do not cut fuel line across hose barb!
This will cause leaks when the new fuel line is put on!

!WARNING!
Do not let fuel run down into heater.

3. Cut the fuel line about ½" from hose barb on the fuel manifold. Make sure to catch any fuel with a fuel absorbent mat.

4. Cut the fuel line length wise, up to the hose barb.

5. Grab half of the split hose with needle nose pliers and tear away from the hose barb. Do the same for the short hose on the fuel manifold.

Fuel Pump (continued)

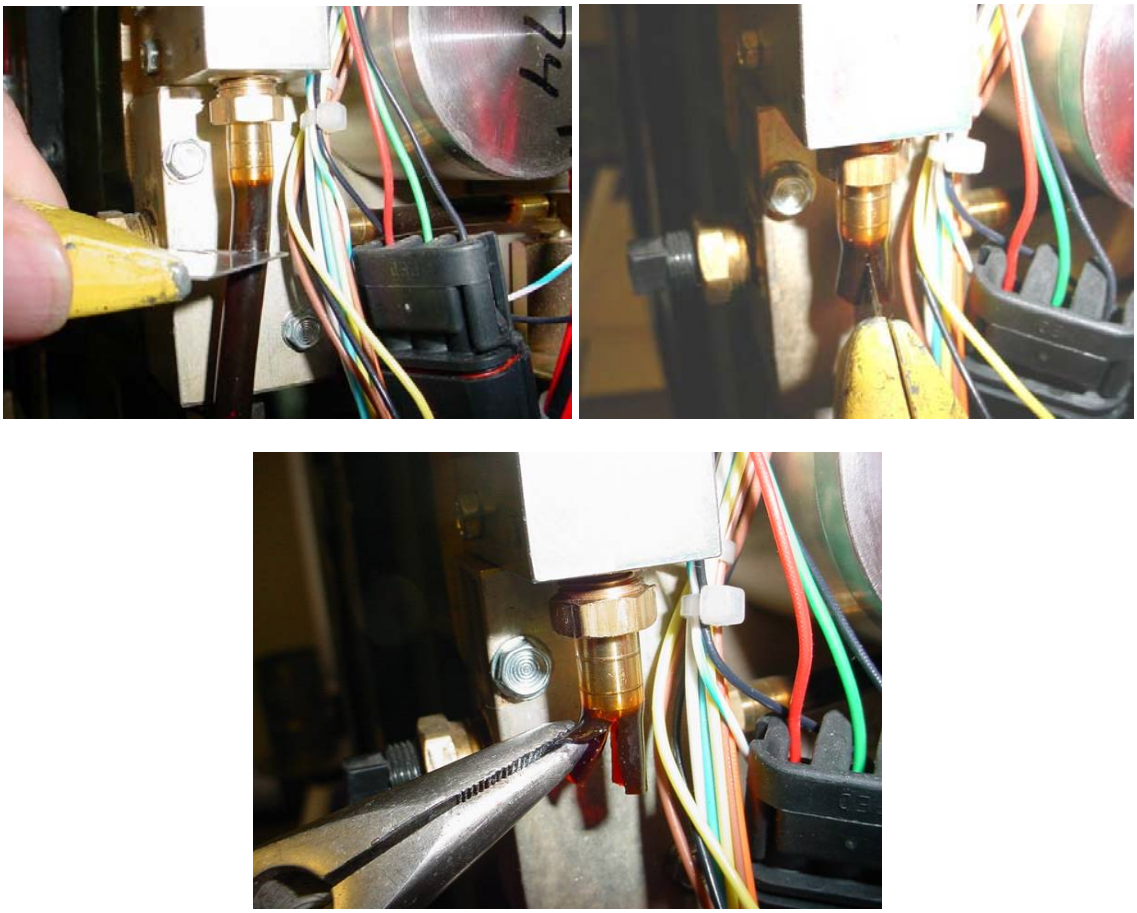


Figure 5-14. Fuel Pump Hoses

6. Using a #2 cross-tip screwdriver, unscrew the two (2) screws and star washers that hold the Fuel Pump onto the Top Housing.

   Note: The Fuel Pump shares a common machine screw with the Power Main Capacitor (C2) clamp. After the machine screw is removed, slide the Pump away from the Main Capacitor clamp.

7. Remove Fuel Pump.

Fuel Pump (continued)

5.9.5.1.2 Installation

!CAUTION!
Do not use any tool, such as needle nose pliers, to install the fuel line as the fuel line could be damaged and leak!

1. Place new Fuel Pump on a clean work surface and install new fuel lines on fuel pump hose barbs using fingers only. Start the new fuel line on to the hose barb of the fuel pump and push it all the way on. It will take some effort. Use P80, or DF2 to help the fuel lines go on easier.

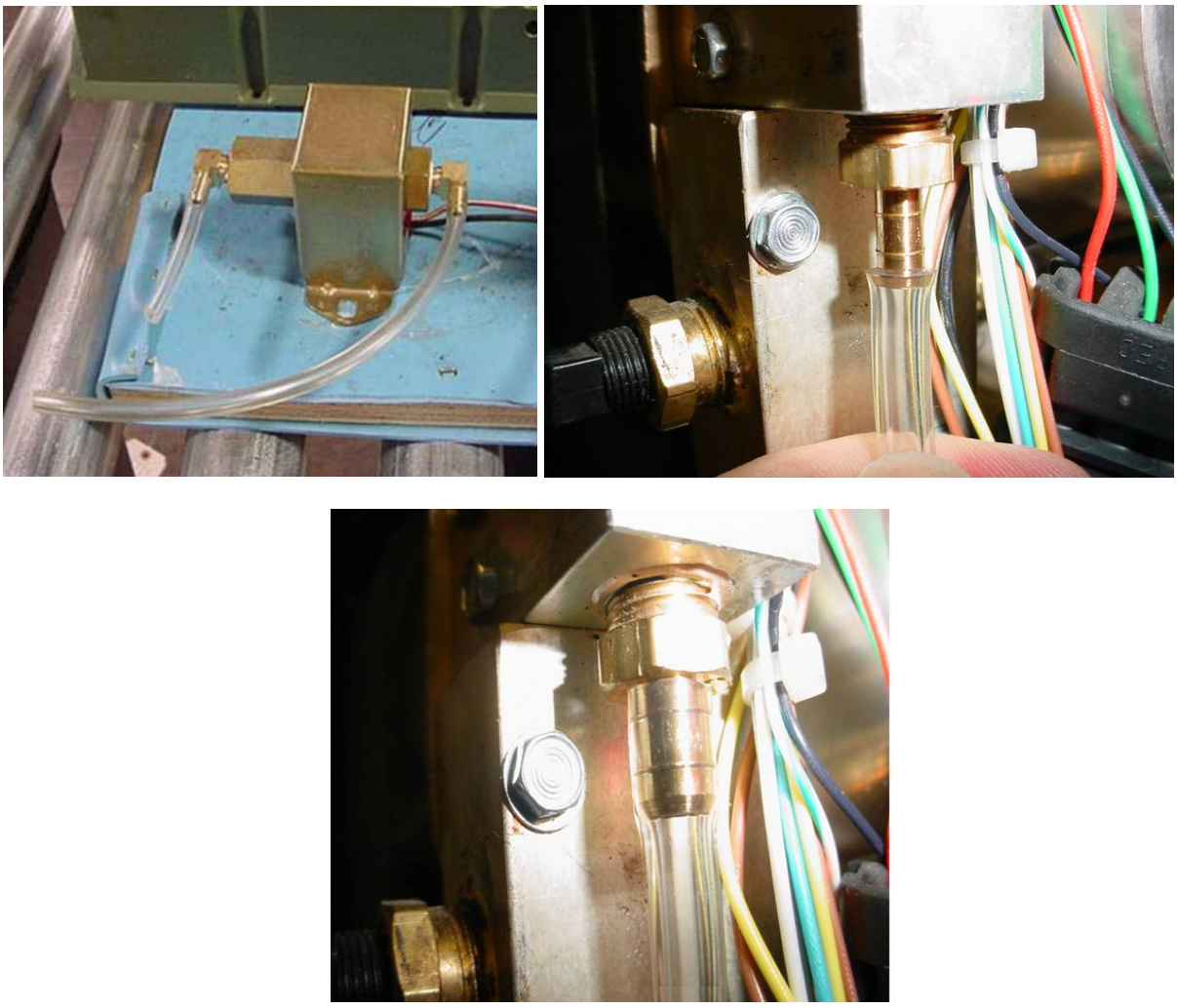


Figure 5-15. Installing New Fuel LInes

2. Position the Fuel Pump into the Top Housing and connect the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings in accordance with the previous step.

Fuel Pump (continued)

Note: The mounting leg of the Pump must slide UNDER the shared mounting leg of the Power Main Capacitor clamp.

Note: The fuel lines attached to the pump should be facing towards the center of the Top Housing.

3. Apply Loctite 243 (blue) to the two (2) machine screws.

4. Using a #2 cross-tip screwdriver, secure the Fuel Pump in place with the two (2) screws, flat washers, and star washers.

5. Attach Wiring Harness connector (J4) to the Fuel Pump ensuring the connector locking tab is properly engaged.

6. Using a 9/16" open ended wrench, connect the fuel supply to the heater.

7. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

8. Start the heater and check that there are NO fuel leaks from the fuel connections.

9. Install Top Cover (ref. 5.4.1).

5.9.5.2 Fuel Pump Repair (Design Iteration 3 Only)

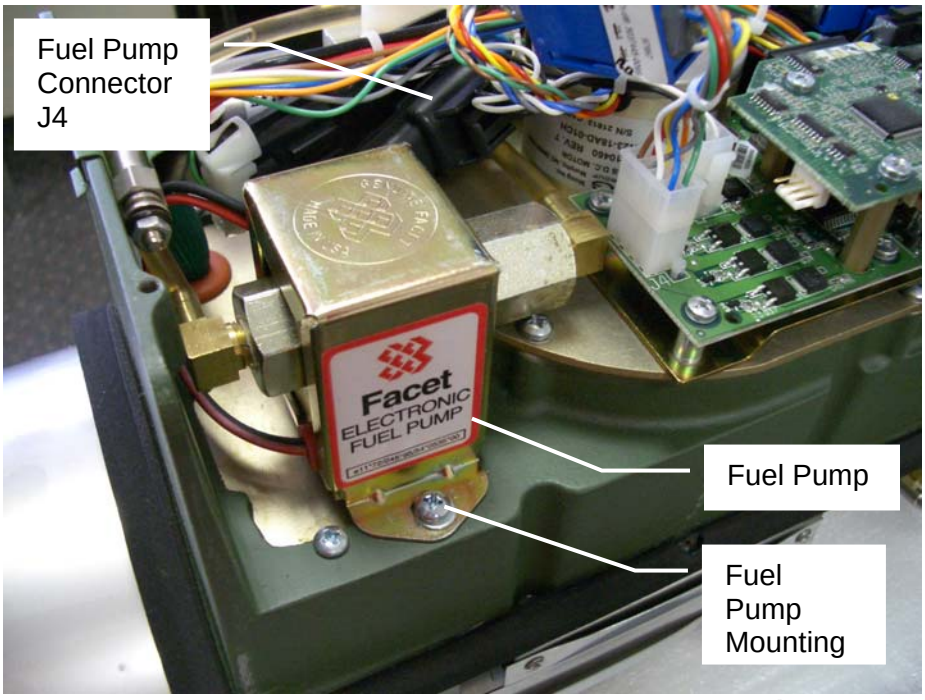


Figure 5-16. Fuel Pump

5.9.5.2.1 Removal

1. Remove Top Cover (ref. 5.4.1)

2. Disconnect Fuel Pump connector (J4) from the Wiring Harness.

   Note: The connector is released by lifting the locking tab and gently pulling apart the two halves.

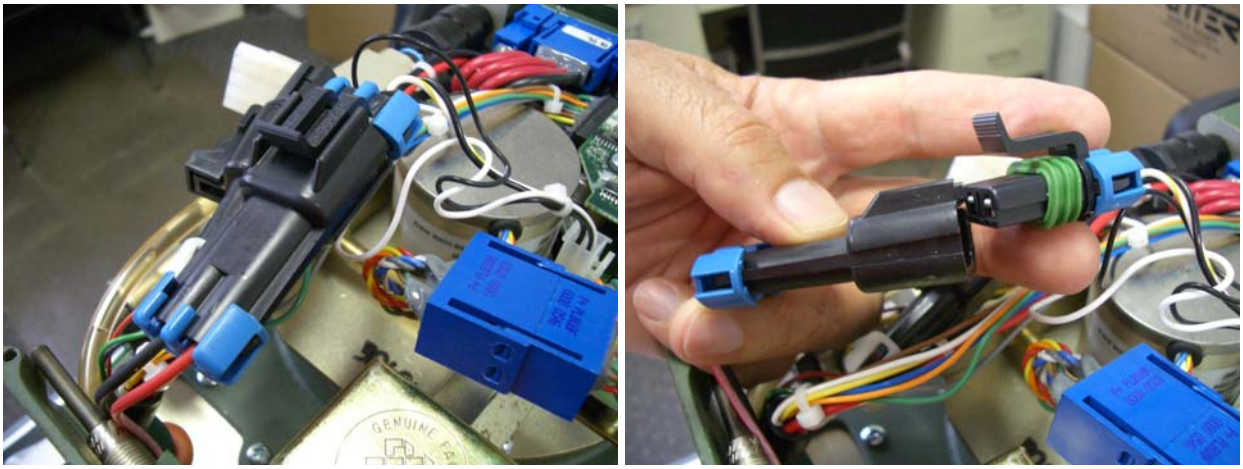


Figure 5-17. Fuel Pump Connector J4

!CAUTION!
Do not cut fuel line across hose barb!
This will cause leaks when the new fuel line is put on!

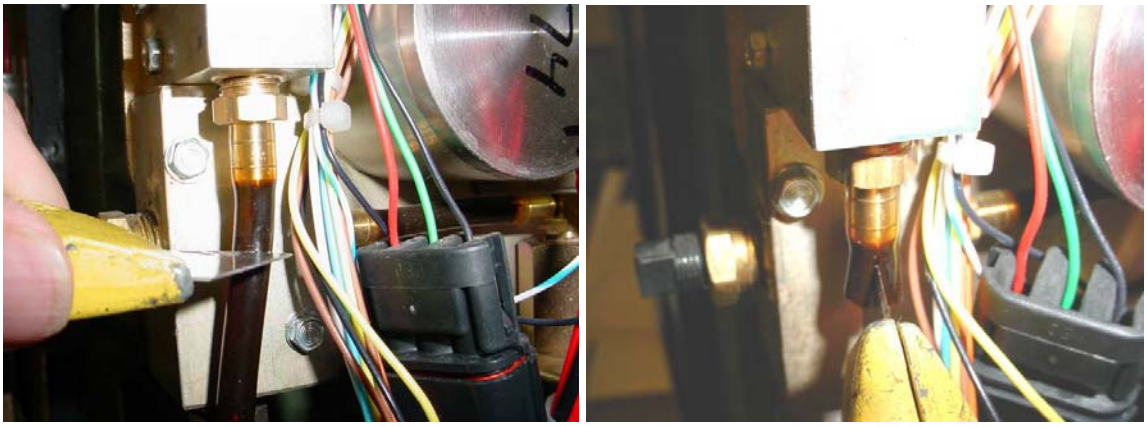
!WARNING!
Do not let fuel run down into heater.

3. Cut the fuel line about ½" from hose barb on the fuel manifold. Make sure to catch any fuel with a fuel absorbent mat.

4. Cut the fuel line length wise, up to the hose barb.

5. Grab half of the split hose with needle nose pliers and tear away from the hose barb. Do the same for the short hose on the fuel manifold.

Fuel Pump (continued)



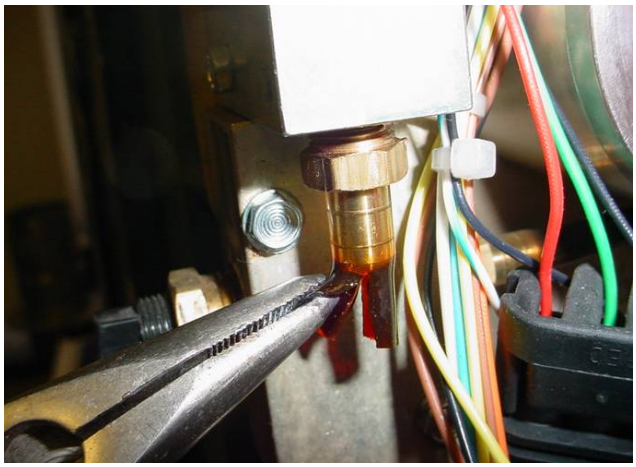


Figure 5-18. Fuel Pump Hoses

6. Using a #2 cross-tip screwdriver, unscrew the two (2) screws and star washers that hold the Fuel Pump onto the Top Housing.

7. Remove Fuel Pump.

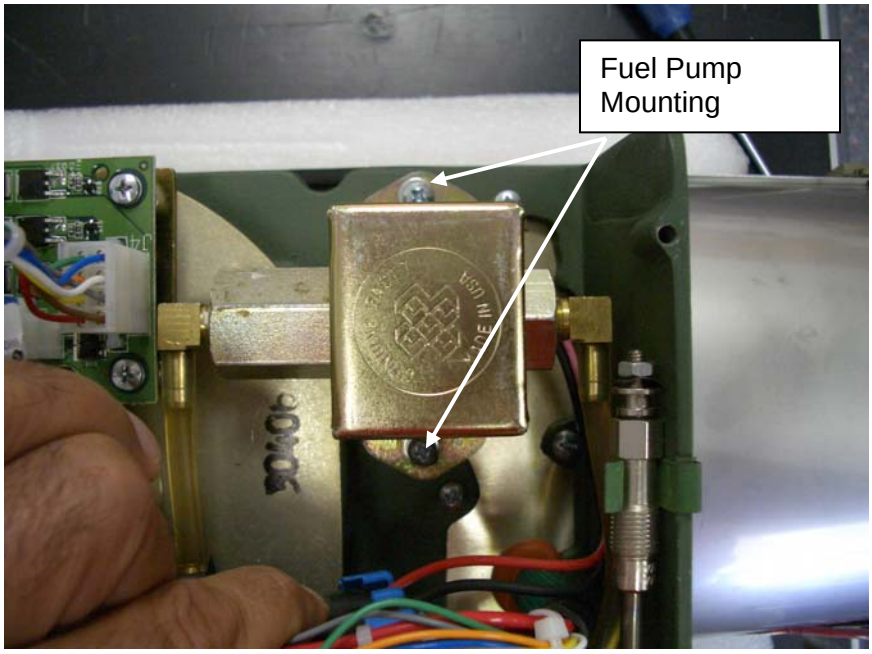
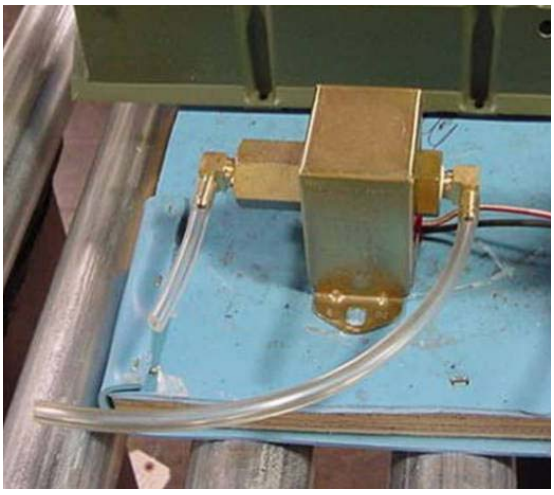


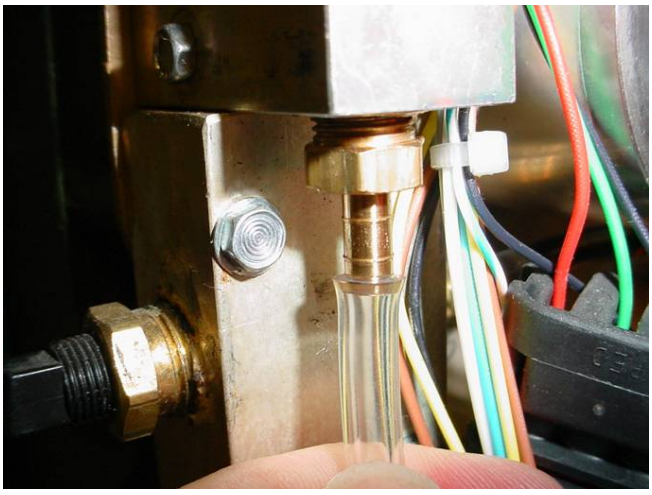
Figure 5-19. Fuel Pump Mounting Screws

5.9.5.2.2 Installation

!CAUTION!
Do not use any tool, such as needle nose pliers, to install the fuel line as the fuel line could be damaged and leak!

1. Place new Fuel Pump on a clean work surface and install new fuel lines on fuel pump hose barbs using fingers only. Start the new fuel line on to the hose barb of the fuel pump and push it all the way on. It will take some effort. Use P80, or DF2 to help the fuel lines go on easier.





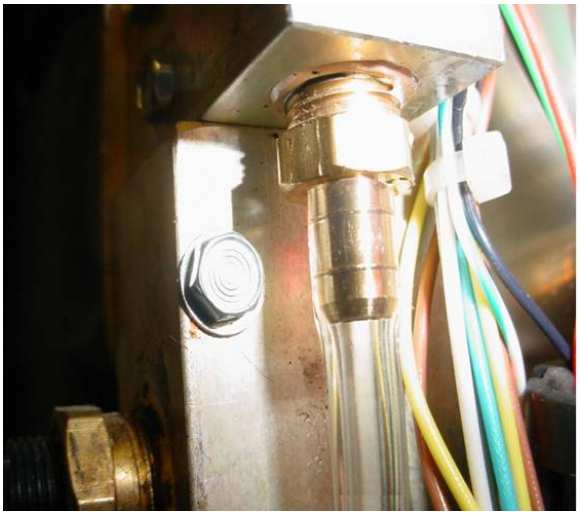


Figure 5-20. Installing New Fuel Lines

2. Position the Fuel Pump into the Top Housing and connect the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings in accordance with the previous step.

   Note: The fuel lines attached to the pump should be facing towards the center of the Top Housing.

   Note: P80, or DF2 may be used as a lubricant to aid installing the fuel lines.

3. Apply Loctite 243 (blue) to the two (2) machine screws.

4. Using a #2 cross-tip screwdriver, secure the Fuel Pump in place with the two (2) screws, flat washers, and star washers.

5. Attach Wiring Harness connector (J4) to the Fuel Pump ensuring the connector locking tab is properly engaged.

6. Using a 9/16" open ended wrench, connect the fuel supply to the heater.

7. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

8. Start the heater and check that there are NO fuel leaks from the fuel connections (ref. Figure 5.5-9).

9. Install Top Cover (ref. 5.4.1).

5.9.6 Burner Fan Plate Assembly

5.9.6.1 Burner Fan Plate Assembly Repair (Design Iteration 1 Only)

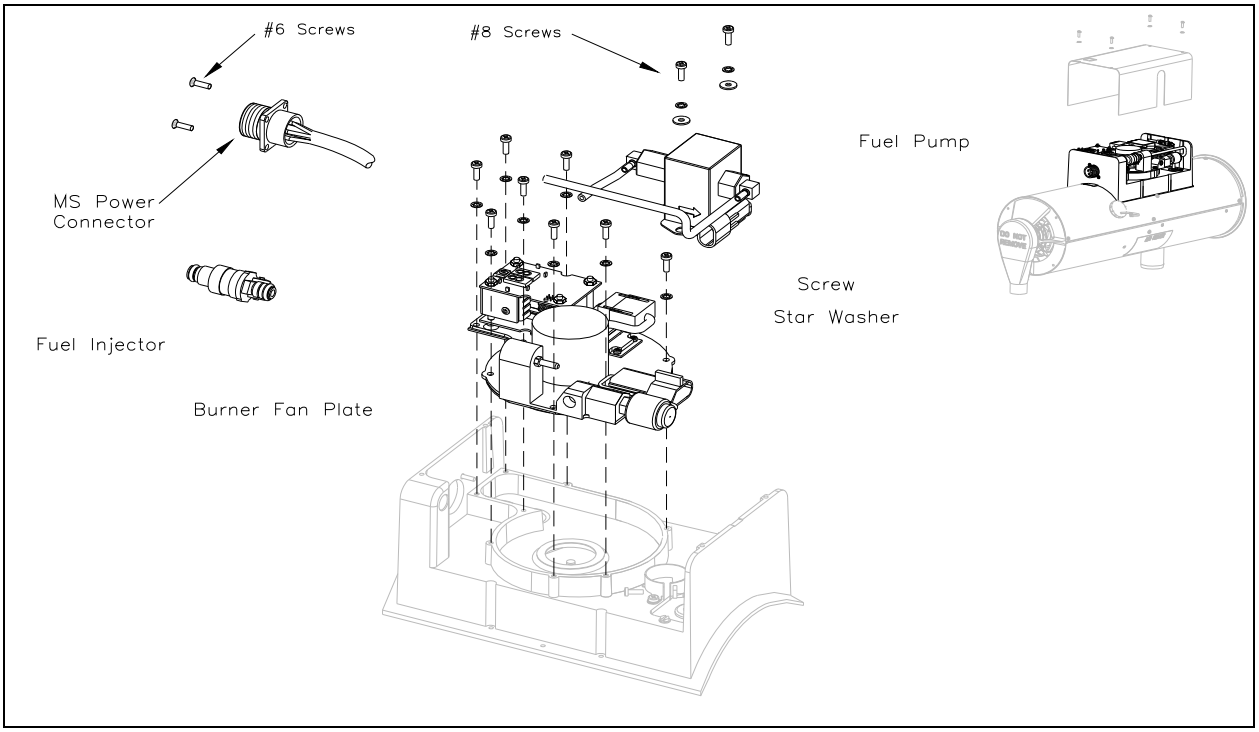


Figure 5-21. Burner Fan Plate Assembly

5.9.6.1.1 Removal

Note: For some installations, this procedure can be done without removing the heater from the vehicle, but require power and fuel to be disconnected from the heater.

1. Remove Top Cover (ref. 5.4.1).

2. Remove Wiring Harness connectors from the Fuel Pressure Sensor (J4) (ref. 5.9.1) and the Diagnostic Display (J2) (ref. 5.9.2).

3. Remove Wiring Harness connectors from the Fuel Injector (J5), (ref. 5.9.5) and the Burner Fan Driver Board (J3) (ref. 5.9.6).

   Note: All the connectors in the Top Housing are different in size and shape. All connectors have locking tabs, which can be released by finger pressure.

4. Remove the two (2) fuel lines from the Burner Fan Plate fuel fittings.

5. Remove Fuel Pump (ref. 5.9.3).

Burner Fan Plate Assembly (continued)

6. Using a #1 cross-tip screwdriver, unscrew the two (2) screws that hold the MS Power connector (J2) to the Top Housing.

!CAUTION!
Note screw sizes and locations for reassembly.

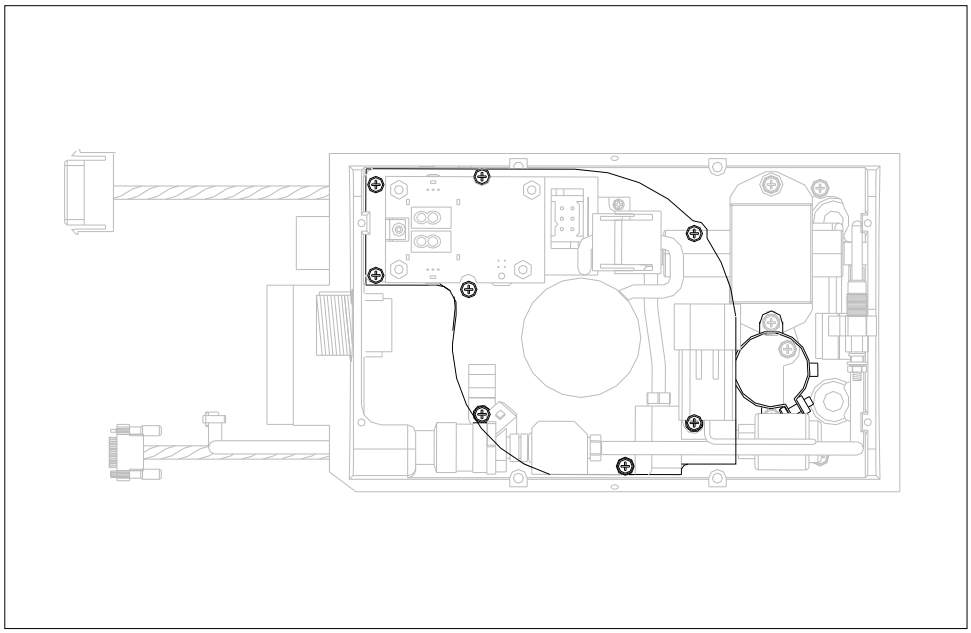


Figure 5-22. Burner Fan Plate, Screw Locations

! WARNING !
NEVER place Burner Fan Plate Assembly on the Burner Fan Impeller. This may cause warping of the Impeller.

7. Using a #2 cross-tip screwdriver, remove the eight (8) mounting screws securing the Burner Fan Plate to the Top Housing (Note: one screw is shared with the Inductor (L1) clamp). Free the Power Inductor (L1) from its clamp.

8. Free the Power Main Capacitor (C2) by loosening the bolt on the side of the Main Capacitor clamp.

9. Lift the Burner Fan Plate Assembly from the Top Housing while at the same time pushing the MS Power connector into the Top Housing. Take care not to damage the wires and connectors. Avoid fuel spills.

Note: The Fuel Injector will become loose and can be put aside for re-installation. Take care NOT to damage the Fuel Injector O-rings.

Burner Fan Plate Assembly (continued)

10. If replacing Burner Fan Plate, with redesigned assembly, remove the Diagnostic Display (ref. 5.9.2), Fuel Pressure Sensor (ref. 5.9.1), Burner Fan Driver Board (ref. 5.6.4) and Burner Fan Assembly (ref. 5.6.5) for re-installation.

5.9.6.1.2 Installation

!CAUTION!
Take care not to damage the O-rings while inserting Fuel Injector.

Note: Inspect Burner Fan Plate Gasket prior to installation. Replace if required. New gasket MUST be glued in place to the Burner Fan Plate using Loctite 770 and 401.

1. Place Burner Fan Plate Assembly into the Top Housing.

   Note: Always lubricate the O-Rings of the Fuel Injector with common grease (GAA) to aid insertion.

2. Insert the Fuel Injector into the fuel boss of the Top Housing, and the other end of the Fuel Injector into the fuel boss of the Burner Fan Plate Assembly. The wiring connector of the Fuel Injector should be pointing upwards and towards the fuel boss of the Burner Fan Plate Assembly.

3. Using a #1 cross-tip screwdriver, install MS Power Connector (J2) to the Top Housing.

4. Install Power Main Capacitor (C2) in Main Capacitor clamp and tighten bolt on side of the clamp.

5. Apply Loctite 243 (blue) to eight (8) screws and star washers, and use a #2 cross-tip screwdriver to secure the Burner Fan Plate Assembly to the Top Housing. Ensure the clamp for the Power Inductor (L1) is re-installed using the screw located under the Fuel Injector and the Inductor is re-installed under the clamp. Tighten all screws evenly.

6. Attach the Power Fuel Injector connector (J5) and rotate the Injector so that the connector faces downward between the Burner Fan Motor and the Burner Fan Plate.

7. Install Fuel Pump Assembly (5.9.3).

8. Install the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings.

9. Install Fuel Pressure Sensor (ref. 5.9.1).

   Note: When installing a new Burner Fan Plate Assembly, remove the four (4) nuts (used for shipping only) holding the Diagnostic Display standoffs in place.

Burner Fan Plate Assembly (continued)

10. Install Diagnostic Display (ref. 5.9.2).

11. Attach Wiring Harness connectors for the Fuel Pressure Sensor (J4), and the Diagnostic Display (J2). Ensure all connectors are properly engaged.
12. Attach the Wiring Harness connector for the Burner Fan Driver Board (J3), ensuring the connector is properly engaged.

13. Using a 9/16" open ended wrench, connect the fuel supply to the heater.

14. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

15. Start the heater and check that there are NO fuel leaks from the fuel connections.

16. Install Top Cover (ref. 5.4.1).

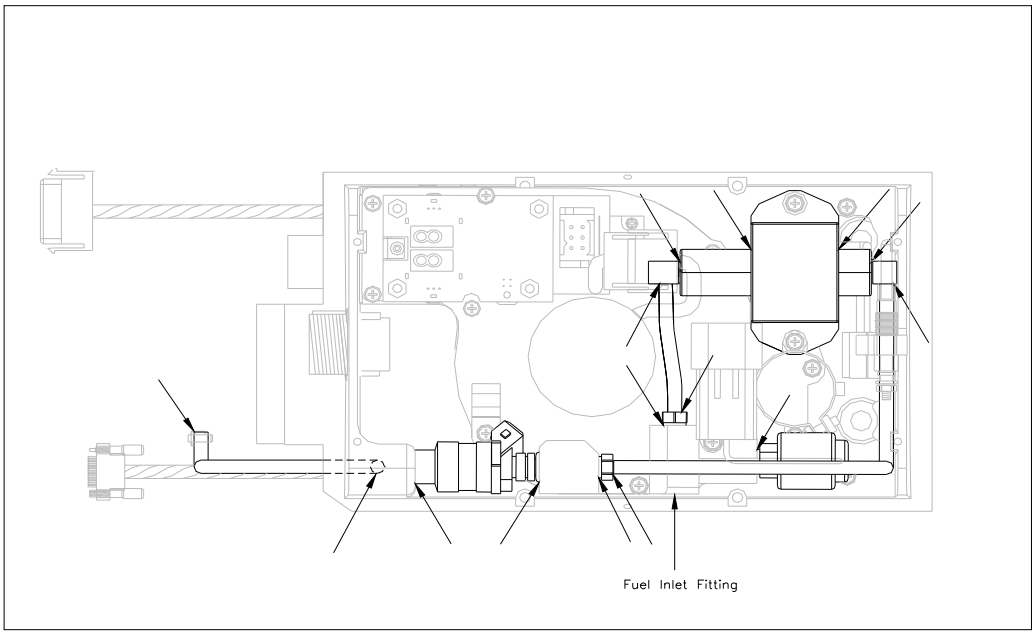


Figure 5-23. Fuel Leak Check Points

5.9.6.2 Burner Fan Plate Assembly Repair (Design Iteration 2 & 3 Only)

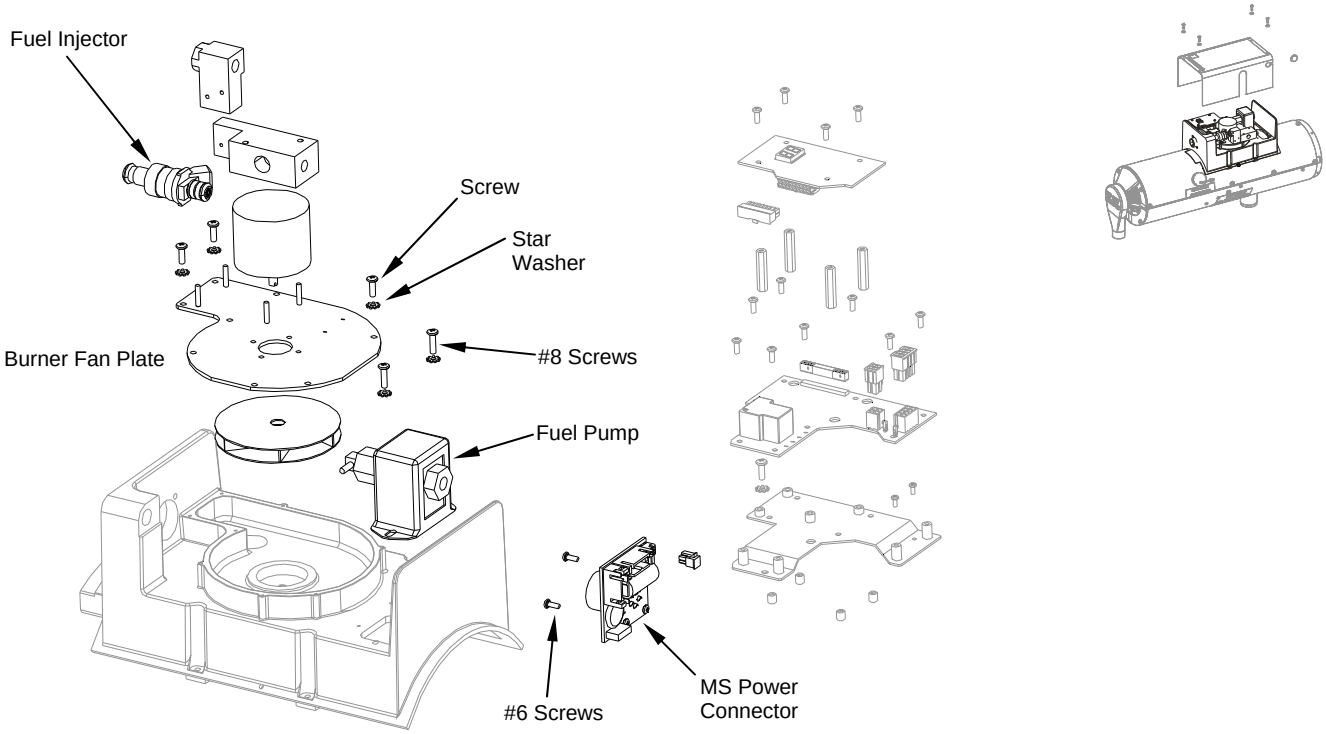


Figure 5-24. Burner Fan Plate Assembly

5.9.6.2.1 Removal

Note: For some installations, this procedure can be done without removing the heater from the vehicle, but require power and fuel to be disconnected from the heater.

1. Remove Top Cover (ref. 5.4.1).

2. Remove Wiring Harness connectors from the Fuel Pressure Sensor (J4) (ref. 5.9.1) and the Diagnostic Display (J2) (ref. 5.9.2).

3. Remove Wiring Harness connectors from the Fuel Injector (J5), (ref. 5.9.5) and the Burner Fan Driver Board (J3) (ref. 5.9.6).

   Note: All the connectors in the Top Housing are different in size and shape. All connectors have locking tabs, which can be released by finger pressure.

4. Remove the two (2) fuel lines from the Burner Fan Plate fuel fittings.

5. Remove Fuel Pump (ref. 5.9.3).

6. Using a #1 cross-tip screwdriver, unscrew the two (2) screws that hold the MS Power connector (J2) to the Top Housing.

Burner Fan Plate Assembly (continued)

!CAUTION!
Note screw sizes and locations for reassembly.

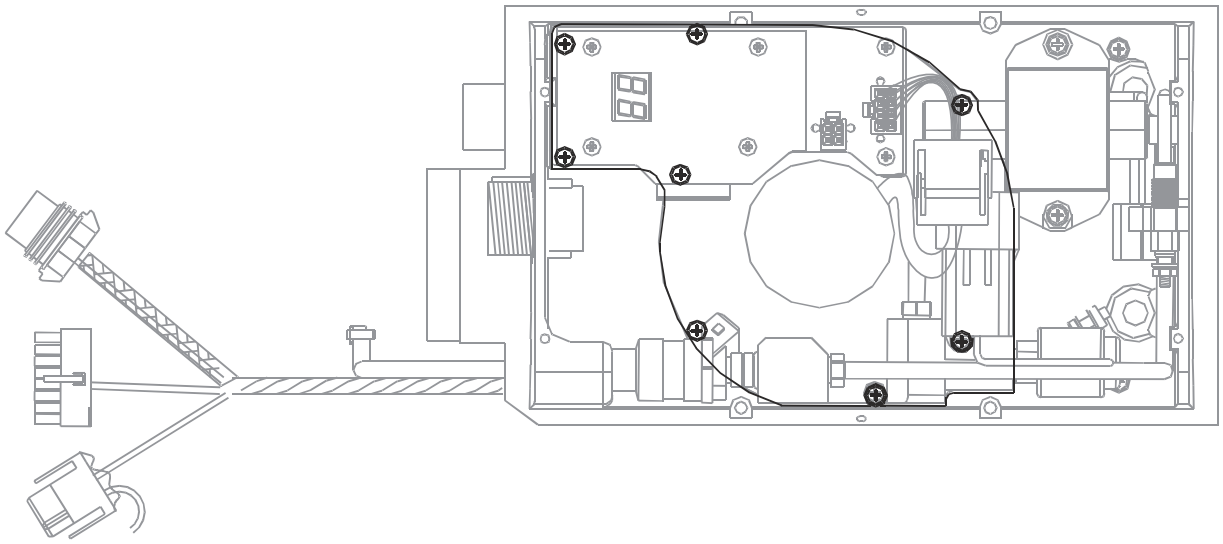


Figure 5-25. Burner Fan Plate, Screw Locations

! WARNING !
NEVER place Burner Fan Plate Assembly on the Burner Fan Impeller. This may cause warping of the Impeller.

7. Using a #2 cross-tip screwdriver, remove the eight (8) mounting screws securing the Burner Fan Plate to the Top Housing (Note: one screw is shared with the Inductor (L1) clamp). Free the Power Inductor (L1) from its clamp.

8. Free the Power Main Capacitor (C2) by loosening the bolt on the side of the Main Capacitor clamp.

9. Lift the Burner Fan Plate Assembly from the Top Housing while at the same time pushing the MS Power connector into the Top Housing. Take care not to damage the wires and connectors. Avoid fuel spills.

   Note: The Fuel Injector will become loose and can be put aside for re-installation. Take care NOT to damage the Fuel Injector O-rings.

10. If replacing Burner Fan Plate, with redesigned assembly, remove the Diagnostic Display (ref. 5.9.2), Fuel Pressure Sensor (ref. 5.9.1), Burner Fan Driver Board (ref. 5.6.4) and Burner Fan Assembly (ref. 5.6.5) for re-installation.

Burner Fan Plate Assembly (continued)

5.9.6.2.2 Installation

!CAUTION!
Take care not to damage the O-rings while inserting Fuel Injector.

Note: Inspect Burner Fan Plate Gasket prior to installation. Replace if required. New gasket MUST be glued in place to the Burner Fan Plate using Loctite 770 and 401.

1. Place Burner Fan Plate Assembly into the Top Housing.

   Note: Always lubricate the O-Rings of the Fuel Injector with common grease (GAA) to aid insertion.

2. Insert the Fuel Injector into the fuel boss of the Top Housing, and the other end of the Fuel Injector into the fuel boss of the Burner Fan Plate Assembly. The wiring connector of the Fuel Injector should be pointing upwards and towards the fuel boss of the Burner Fan Plate Assembly.

3. Using a #1 cross-tip screwdriver, install MS Power Connector (J2) to the Top Housing.

4. Install Power Main Capacitor (C2) in Main Capacitor clamp and tighten bolt on side of the clamp.

5. Apply Loctite 243 (blue) to eight (8) screws and star washers, and use a #2 cross-tip screwdriver to secure the Burner Fan Plate Assembly to the Top Housing. Ensure the clamp for the Power Inductor (L1) is re-installed using the screw located under the Fuel Injector and the Inductor is re-installed under the clamp. Tighten all screws evenly.

6. Attach the Power Fuel Injector connector (J5) and rotate the Injector so that the connector faces downward between the Burner Fan Motor and the Burner Fan Plate.

7. Install Fuel Pump Assembly (5.9.3).

8. Install the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings.

9. Install Fuel Pressure Sensor (ref. 5.9.1).

   Note: When installing a new Burner Fan Plate Assembly, remove the four (4) nuts (used for shipping only) holding the Diagnostic Display standoffs in place.

10. Install Diagnostic Display (ref. 5.9.2).

11. Attach Wiring Harness connectors for the Fuel Pressure Sensor (J4), and the Diagnostic Display (J2). Ensure all connectors are properly engaged.

12. Attach the Wiring Harness connector for the Burner Fan Driver Board (J3), ensuring the connector is properly engaged.

13. Using a 9/16" open ended wrench, connect the fuel supply to the heater.

14. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

15. Start the heater and check that there are NO fuel leaks from the fuel connections (ref. Figure 5.5-9).

16. Install Top Cover (ref. 5.4.1).

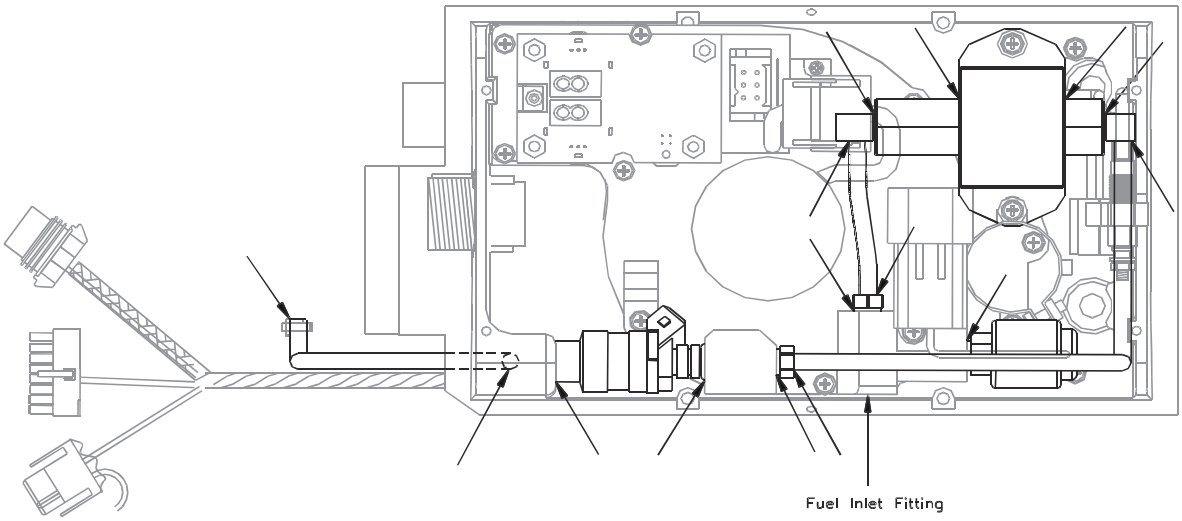


Figure 5-26. Fuel Leak Check Points

5.9.7 Fuel Injector

5.9.7.1 Fuel Injector Repair (Design Iteration 1 Only)

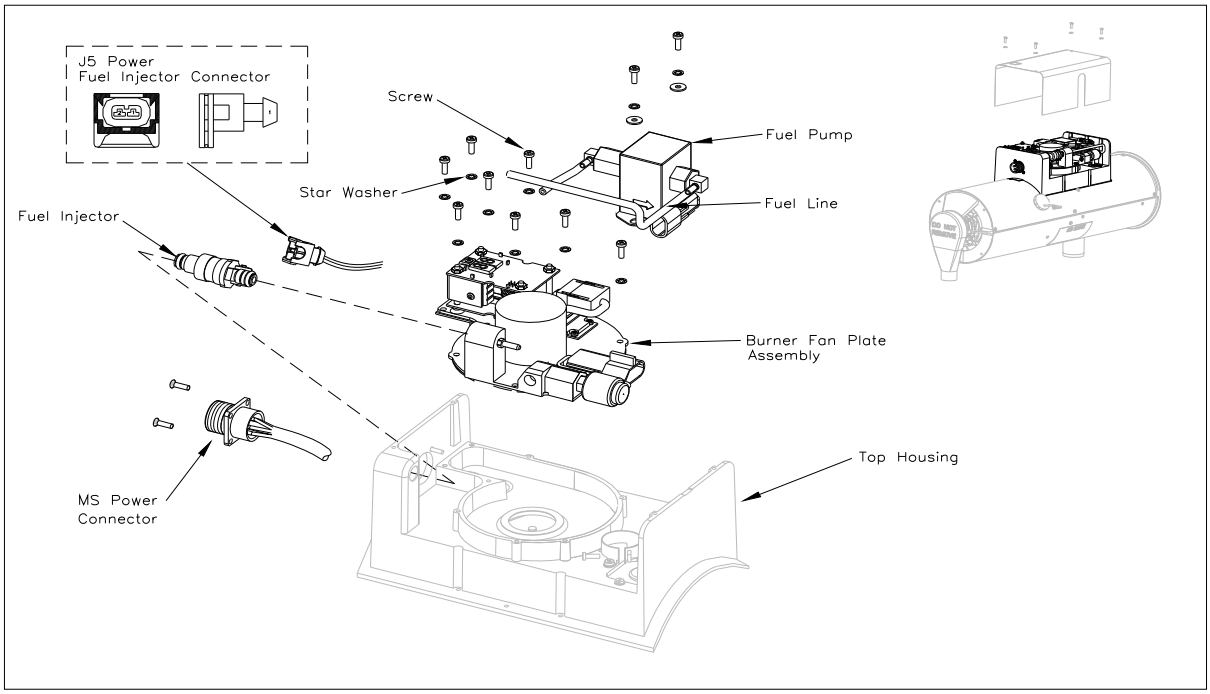


Figure 5-27. Fuel Injector

5.9.7.1.1 Removal

1. Remove vehicle power cable from the MS Power connector.

2. Remove Top Cover (ref. 5.1.1).

3. Rotate the Fuel Injector so that the wiring connector is facing upwards.

4. Remove Power Fuel Injector connector (J5).

   Note: Use fingers to press the metal clip connector, and release TOWARDS the Fuel Injector. Gently detach connector from Fuel Injector.

5. Remove the two (2) fuel lines at the Burner Fan Plate fuel fittings.

6. Remove the Fuel Pump Assembly (ref. 5.9.3).

7. Using a #1 cross-tip screwdriver, unscrew the two (2) screws that hold the MS Power connector (J2) to the Top Housing, and push the connector into the Top Housing.

8. Free the Power Main Capacitor (C2) by loosening the bolt on the side of the Main Capacitor clamp.

9. Using a #2 cross-tip screwdriver, remove the eight (8) screws from the Burner Fan Plate Assembly. Free the Power Inductor (L1) from its clamp.

Fuel Injector (continued)

10. Move the Burner Fan Plate upwards and towards the Fuel Pump to allow the Fuel Injector to disconnect from the Top Housing.

11. Remove the Fuel Injector.

! WARNING !
NEVER place Burner Fan Plate Assembly on the Burner Fan Impeller. This may cause warping of the Impeller.

5.9.7.1.2 Installation

!CAUTION!
Take care not to damage the O-rings while inserting Fuel Injector.

Note: Inspect Burner Fan Plate Gasket prior to installation. Replace if required. New gasket MUST be glued in place to the Burner Fan Plate using Loctite 770 and 401.

Note: Always lubricate the O-Rings of the Fuel Injector with common grease (GAA) to aid insertion.

1. Insert the Fuel Injector into the fuel boss of the Top Housing, and the other end of the Fuel Injector into the fuel boss of the Burner Fan Plate Assembly. The wiring connector of the Fuel Injector should be pointing upwards and towards the fuel boss of the Burner Fan Plate Assembly.

2. Using a #1 cross-tip screwdriver, install MS Power Connector (J2) into the Top Housing.

3. Install Power Main Capacitor (C2) in Main Capacitor clamp and tighten bolt on side of the clamp.

4. Apply Loctite 242 (blue) to eight (8) screws and star washers, and use a #2 cross-tip screwdriver to secure the Burner Fan Plate Assembly to the Top Housing. Ensure the clamp for the Power Inductor (L1) is re-installed using the screw located under the Fuel Injector and the Inductor is re-installed under its clamp. Tighten all screws evenly.

5. Attach the Power Fuel Injector connector (J5) and rotate the Injector so that the connector faces downward between the Burner Fan Motor and the Burner Fan Plate.

6. Install Fuel Pump Assembly(5.9.3).

7. Install the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings from the Fuel Pump Assembly.

8. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

9. Start the heater and check that there are NO fuel leaks from the fuel connections.

10. Install Top Cover (ref. 5.4.1).

5.9.7.2 Fuel Injector Repair (Design Iteration 2 & 3 Only)

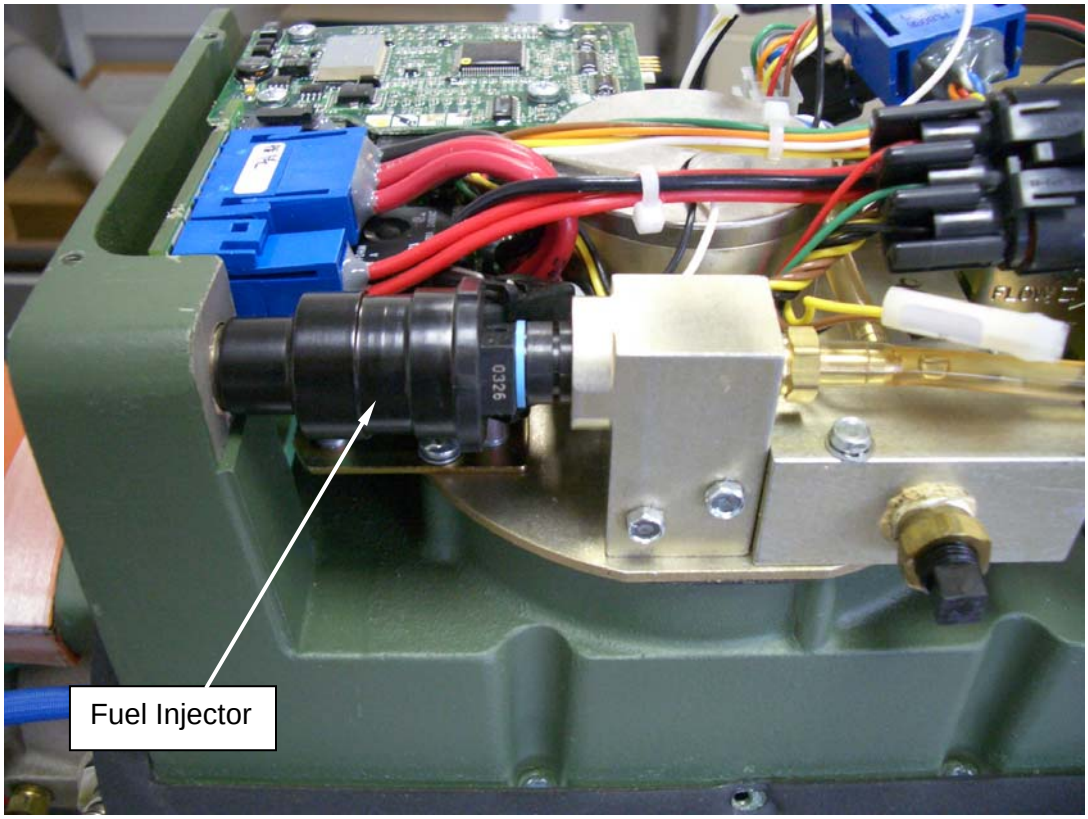


Figure 5-28. Fuel Injector

5.9.7.3 Removal

1. Remove vehicle power cable from the MS Power connector.

2. Remove Top Cover (ref. 5.4.1).

3. Remove the two screws on the top of the horizontal portion of the fuel manifold.

4. Move the fuel manifold assembly to the right, disengaging the right side of the fuel injectorfrom the left side of the vertical portion of the fuel manifold.

5. Disengage the left portion of the fuel injector from the top housing.

6. Rotate the Fuel Injector so that the wiring connector is facing upwards.

7. Remove Power Fuel Injector connector (J5) by depressing the metal clip and gently detaching the connector from the fuel injector.

Fuel Injector (continued)

8. Remove the Fuel Injector.

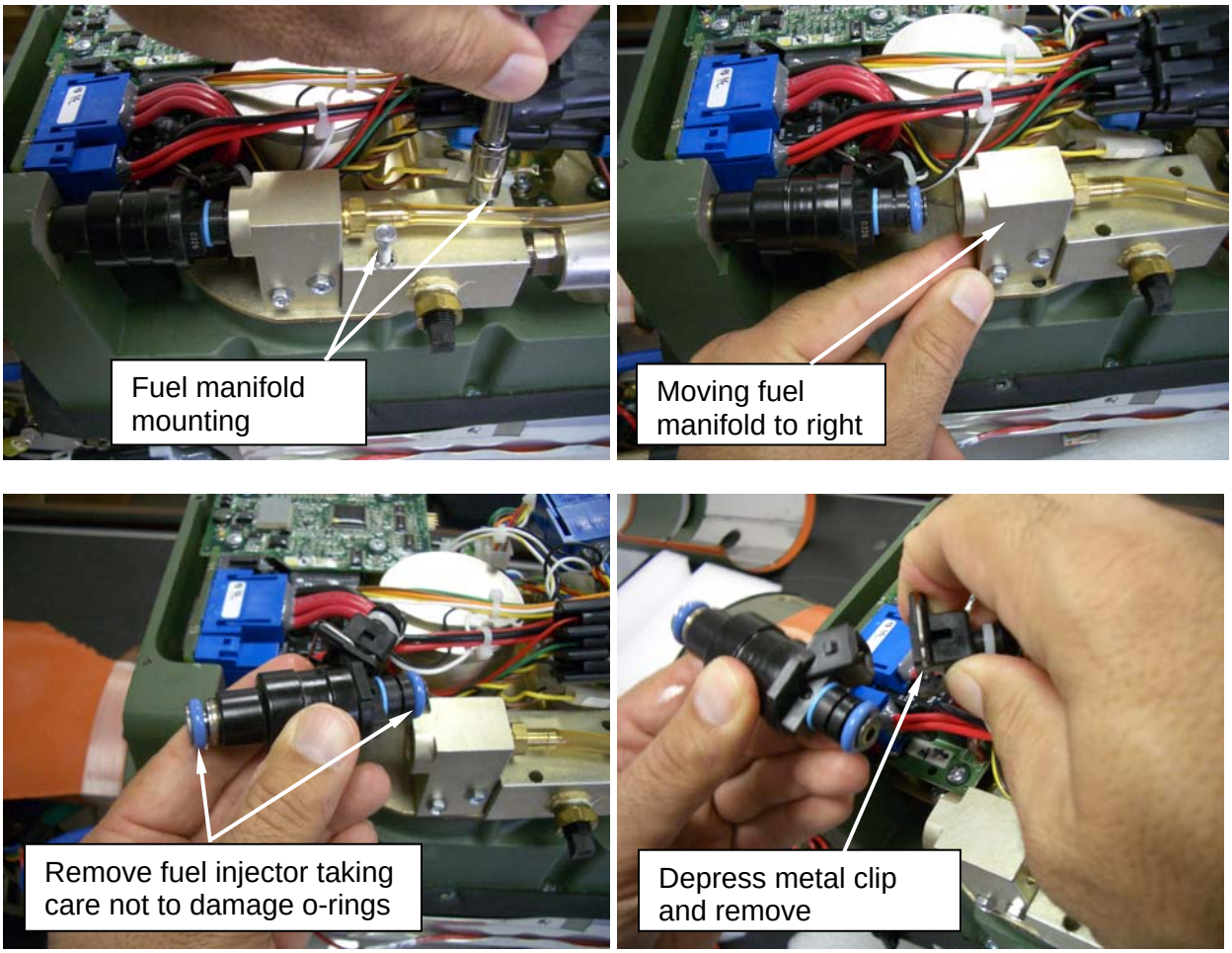


Figure 5-29. Fuel Injector Removal

Fuel Injector (continued)

5.9.7.4 Installation

!CAUTION!
Take care not to damage the O-rings while inserting Fuel Injector.

Note: Always lubricate the O-Rings of the Fuel Injector with common grease (GAA) to aid insertion.

1. Attach the Power Fuel Injector connector (J5) and rotate the Injector so that the connector faces downward between the Burner Fan Motor and the Burner Fan Plate.

2. Move the fuel manifold to the right and insert the Fuel Injector into the fuel boss of the Top Housing. Gently engage the left portion of the fuel injector into the fuel boss of the Top Housing. Press fuel injector in place.

3. Engage the right side of the fuel injector and o-ring into the left portion of the fuel manifold. Ensure that wiring connector of the Fuel Injector is pointing downward. Move fuel manifold to left and fully seat the fuel injector.

4. Install the two screws on the top of the horizontal portion of the fuel manifold. Tighten securely.

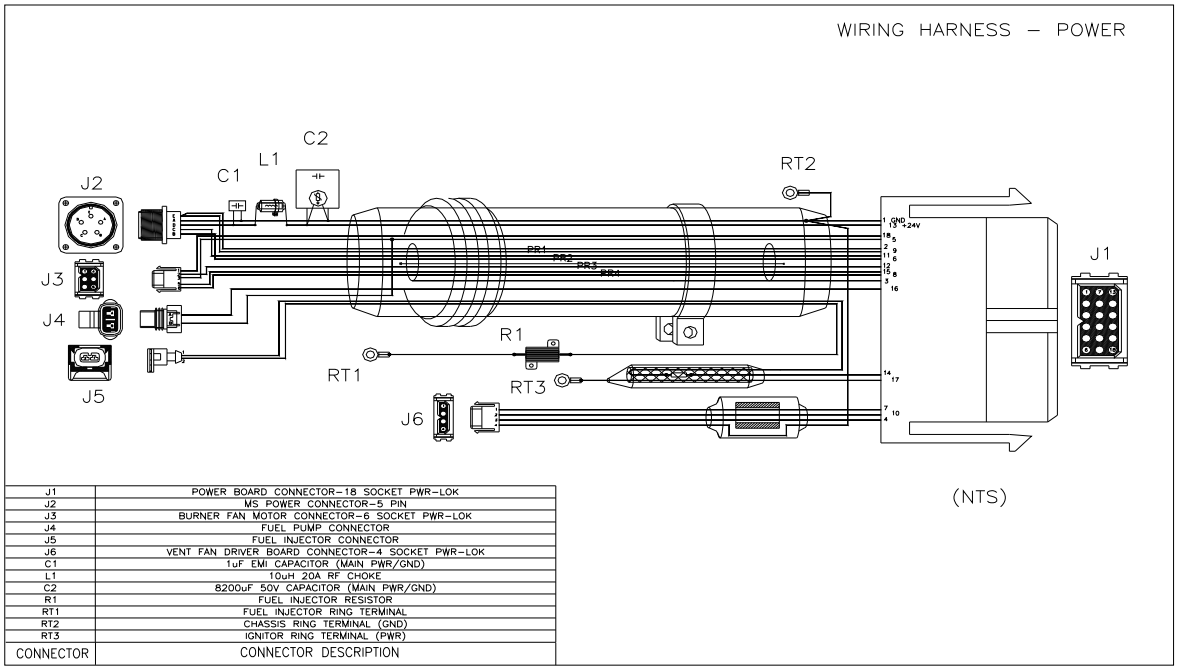
5. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

6. Start the heater and check that there are NO fuel leaks from the fuel connections.

7. Install Top Cover (ref. 5.4.1).

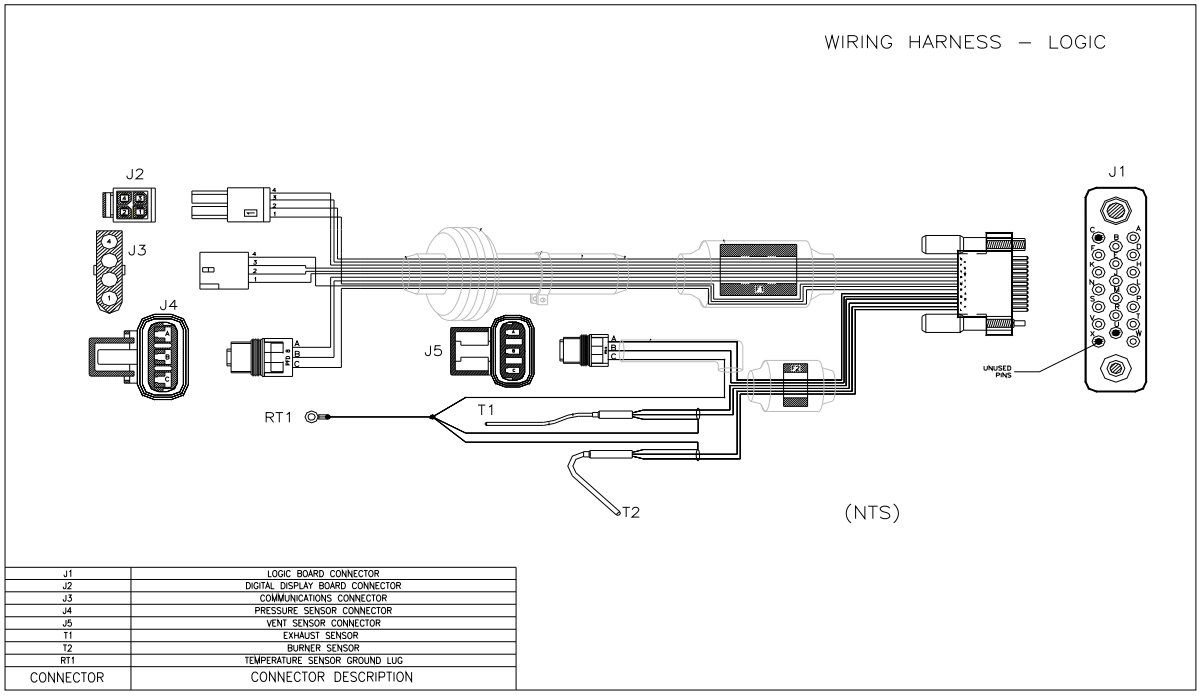
5.9.8 Wiring Harness

5.9.8.1 Wiring Harnesses (Design Iteration 1 & 2 Only)



CONNECTOR	CONNECTOR DESCRIPTION
J1	POWER BOARD CONNECTOR–18 SOCKET PWR–LOK
J2	MS POWER CONNECTOR–5 PIN
J3	BURNER FAN MOTOR CONNECTOR–6 SOCKET PWR–LOK
J4	FUEL PUMP CONNECTOR
J5	FUEL INJECTOR CONNECTOR
J6	VENT FAN DRIVER BOARD CONNECTOR–4 SOCKET PWR–LOK
C1	1uF EMI CAPACITOR (MAIN PWR/GND)
L1	10uH 20A RF CHOKE
C2	8200uF 50V CAPACITOR (MAIN PWR/GND)
R1	FUEL INJECTOR RESISTOR
RT1	FUEL INJECTOR RING TERMINAL
RT2	CHASSIS RING TERMINAL (GND)
RT3	IGNITOR RING TERMINAL (PWR)

Figure 5-30. Wiring Harness



CONNECTOR	CONNECTOR DESCRIPTION
J1	LOGIC BOARD CONNECTOR
J2	DIGITAL DISPLAY BOARD CONNECTOR
J3	COMMUNICATIONS CONNECTOR
J4	PRESSURE SENSOR CONNECTOR
J5	VENT SENSOR CONNECTOR
T1	EXHAUST SENSOR
T2	BURNER SENSOR
RT1	TEMPERATURE SENSOR GROUND LUG

Figure 5-31. Wiring Harness

Wiring Harnesses (continued)

5.9.8.1.1 Removal

1. Remove Top Cover (ref. 5.4.1).

2. Remove Top Shell (ref. 5.4.2).

3. Remove Bottom Shell (ref. 5.4.3).

4. Remove Vent Fan Assembly (ref. 5.6.1).

5. Remove Combustor Assembly (ref. 5.7.1).

6. Using a 7/16" open ended wrench, remove the Exhaust Sensor from the Exhaust Port.

7. Detach Wiring Harness connector (J5) from the Vent Sensor.

   Note: The Vent Sensor connector has a self locking tab that needs to be lifted to allow the two halves of the connector to come apart.

8. Using pliers, release the 1" metal spring clamp at the Secondary Air Duct from the Heat Exchanger end. Slide the spring clamp over the hose and release onto the Top Housing end so that the Secondary Air Duct and two spring clamps are attached to Top Housing. Be careful that the spring clamp does NOT damage the Secondary Air Duct.

!CAUTION!
DO NOT set the Top Housing on the Secondary Air Duct Hose.
Place the Top Housing on it's side with the fuel inlet fitting facing upwards.

9. Using a #2 cross-tip screwdriver, remove the four (4) screws that hold the Top Housing to the Heat Exchanger. Lift the Top Housing away from the Heat Exchanger.

10. Remove Wiring Harness connectors from the Fuel Injector (J5), (rotate the Injector upwards to release the connector), the Fuel Pump (J4), and the Burner Fan Driver Board (J3).

11. Using a #1 cross-tip screwdriver, unscrew the two (2) screws that hold the MS Power connector (J2) to the Top Housing. Using a screwdriver, remove the bolt holding down the Inductor (L1) clamp to the Burner Fan Plate. Using a screwdriver, loosen the bolt found on the side of the Main Capacitor (C2) clamp. Free the Capacitor and push the MS Power connector to the inside of the Top Housing.

12. Remove Logic Harness connectors from the Diagnostic Display (J2) and the Fuel Pressure Sensor (J4).

13. With the Top Housing on its side, use a #2 cross-tip screwdriver to remove the screws holding the Power and Logic P-clips attached to the underside of the Top Housing.

Wiring Harnesses (continued)

14. Using a #1 cross-tip screwdriver, remove two (2) screws (on the inside face of the Top Housing) holding Resistor (R1) to the underside of the Top Housing.

15. Remove the Fuel Pump (ref. 5.9.3) to allow access to Wiring Harness Plate.

16. Using a #2 cross-tip screwdriver, remove the four (4) self tapping screws from the Wiring Harness feed-thru plate by which it is fastened to the Top Housing. Remove the Plate.

17. Remove Wiring Harnesses from Wiring Harness Plate by sliding grommets out of keyed slot in Wiring Harness Plate.

18. Remove Wiring Harnesses by sliding them up through the Top Housing.

5.9.8.1.2 Installation

1. Inspect Secondary Air duct and replace if necessary. Ensure duct is attached to Top Housing end with two 1" metal spring clamps.

   Note: Ensure Wiring Harnesses are installed on their respective sides of the Top Housing.

2. Install Wiring Harness connectors J1, J6 and Resistor R1 down through the top of the Top Housing at the Fuel Pump end.

3. Install Wiring Harness connectors J1, J6 and Thermocouples T1 and T2 down through the top of the Top Housing at the Fuel Pump end.

4. Install MS Power connector (J2) by running it to the front of the Top Housing and inserting it through the hole in the Top Housing. Ensure that the MS Power connector keyway is positioned so that when the connector is secured, the key is located on the bottom side of the connector. Apply Loctite 243 (blue) to two (2) screws, place two (2) lock washers on these screws and secure the MS Power connector by inserting the screws into the connector from the front of the Top Housing. Tighten with a #1 cross-tip screwdriver.

5. With the Top Housing on its side, fuel inlet facing upwards, pull the Wire Harness tight, and re-install Logic Harness and Power Harness rubber grommets onto the Feed-Thru Plate. Seal around grommet with RTV.

6. Using a #2 cross tip screwdriver, secure the Feed-thru Plate to the Top Housing with four (4) self tapping screws installed from the top side of the Top Housing into the Feed-thru Plate which is on the underside of the Top Housing.

7. Re-install the Power Main Capacitor (C2) into the metal clamp located beside the Fuel Pump. Tighten the bolt found on the side of the Capacitor clamp.

8. Using Loctite 243 (blue) and a screwdriver, tighten the screw holding the Power Inductor (L1) clamp to the Burner Fan Plate.

Wiring Harnesses (continued)

9. Attach the Power Harness connectors as follows:
   - Connector J3 to the Burner Fan Driver Board
   - Connector J5 to the Fuel Injector and rotate the Fuel Injector so that the Connector is pointing downwards between the Burner Fan Motor and the Burner Fan Plate
   - Connector J4 to the Fuel Pump

10. Attach the Logic Harness connectors as follows:
    - Connector J2 to the Diagnostic Display Board
    - Connector J4 to the Fuel Pressure Transducer

11. Ensure Logic Connector J3 (Data Comm. connector) is tucked inside the Top Housing.

12. Install the wires in the Top Housing alongside the Burner Fan Motor. Tuck all wires and connectors neatly in the Top Housing using cable ties if necessary. Ensure the wires DO NOT extend out of the Top Housing.

13. Attach one P-Clip to the Power Harness wiring bundle and attach the Harness to the bottom of the Top Housing using Loctite 243 (blue), a #2 cross-tip screwdriver and a screw. Note: The Fuel Injector Resistor (R1) ground lug is secured with this screw (ref Figure 5.5-3). Do not tighten P-clip screw until following final length adjustments.

14. Attach one P-Clip to the Logic Harness wiring bundle and attach the Harness to the bottom of the Top Housing using Loctite 243 (blue), a #2 cross-tip screwdriver and a screw. Do not tighten P-clip screw until following final length adjustments.

15. Using a screwdriver and Loctite 243, tighten the two (2) screws holding the Fuel Injector Resistor (R1) to the underside of the Top Housing.

16. Install Fuel Pump Assembly(5.9.3).

17. Check that Power Harness connector J1 is at least 5" and Logic Harness connector J1 is at least 4.5" from the front edge of the Top Housing. Adjust to length by moving the wire bundles in their respective Harness sheathings and then securing them by tightening the screws on their respective P-clips.

!CAUTION!
Do NOT trap wires of the Wiring Harness when mounting Top Housing onto Heat Exchanger.

18. Place the Top Housing onto the Heat Exchanger taking care not to trap or damage the Wiring Harness. Line up Secondary Air Duct over the air pipe of the Heat Exchanger.

19. Using pliers, move one of the 1" metal spring clamps from the Top Housing end of the Secondary Air Duct along the Secondary Air Duct Hose and secure to the Heat Exchanger end of the Secondary Air Duct.

20. Using a #2 cross-tip screwdriver, secure the Top Housing to the Heat Exchanger using four (4) screws.

Wiring Harnesses (continued)

21. Using pliers, re-set the Secondary Air Duct with the spring clamp to ensure that hose is NOT kinked or bent.

22. Use a 7/16" open ended wrench to attach the Exhaust Sensor.

23. Install Combustor Assembly (ref. 5.7.1).

24. Using a 7/16" open ended wrench, install Burner Sensor. Ensure that the wire is properly routed to prevent any damage.

25. Connect the Vent Sensor Connector (J5) of the Wiring Harness to the Vent Sensor connector. Ensure that the locking tab is engaged.

26. Install Vent Fan Assembly (ref. 5.6.1).

27. Install Bottom Shell (ref. 5.4.3).

28. Install Top Shell (ref. 5.4.2).

29. Install Top Cover (ref. 5.4.1).

5.9.8.2 Wiring Harness Repair (Design Iteration 3 Only)

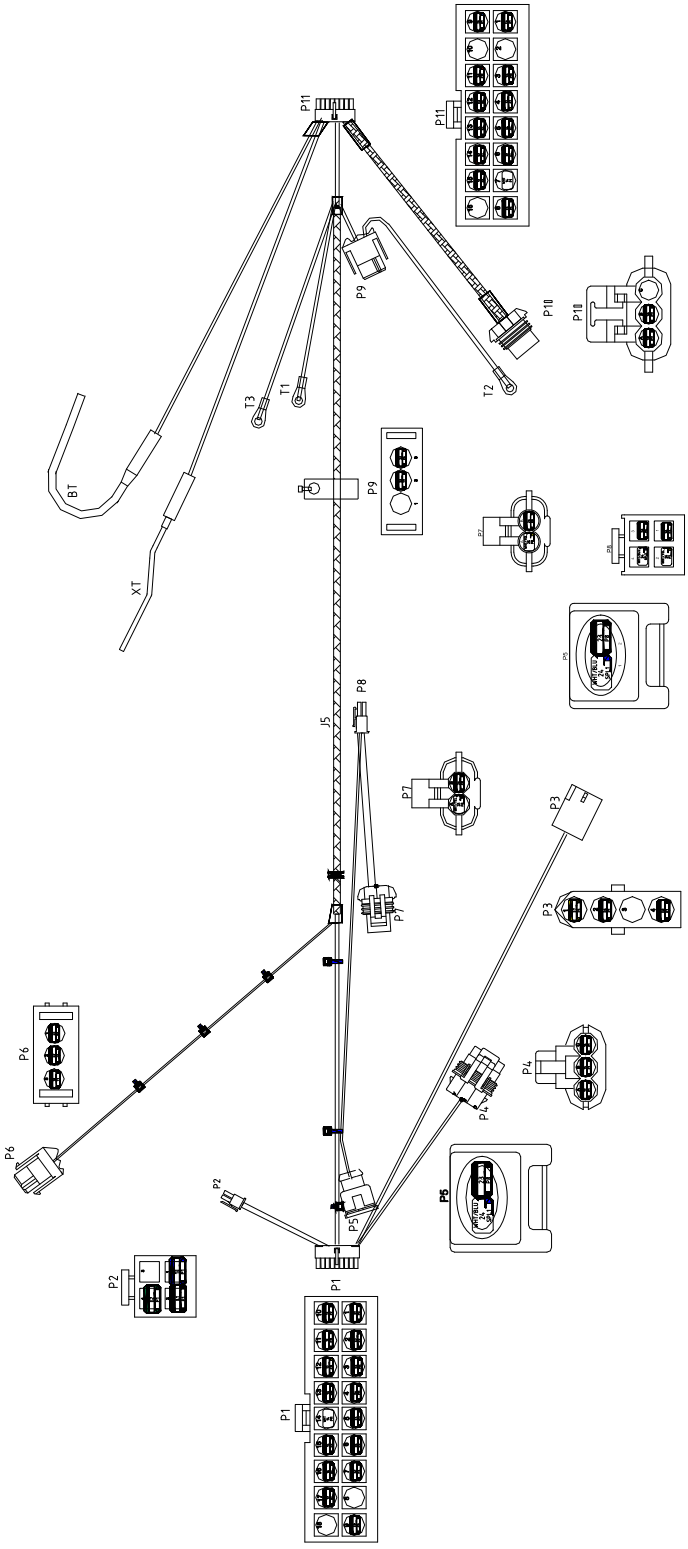


Figure 5-32. A20 Wiring Harness

Wiring Harness (continued)

5.9.8.2.1 Removal

1. Remove Top Cover (ref TM 5.4.1).

2. Remove Top Shell (ref. TM 5.4.2).

3. Remove Bottom Shell (ref.TM 5.4.3).

4. Disconnect the modular connectors (**1,2**) that attach to the Vent Fan Driver Board.

5. Disconnect the fuel line (**3**) to the burner.

6. Disconnect the modular connector (**4**) from the vent temp sensor.

7. Using a 7/16" open ended wrench, remove the Burner Sensor from the Port.

8. Using a 7/16" open ended wrench, remove the Exhaust Sensor from the Port.

9. Using pliers, release the 1" metal spring clamp at the Secondary Air Duct from the Heat Exchanger end. Slide the spring clamp over the hose and release onto the Top Housing end so that the Secondary Air Duct and two spring clamps are attached to Top Housing. Be careful that the spring clamp does NOT damage the Secondary Air Duct.

!CAUTION!
DO NOT set the Top Housing on the Secondary Air Duct Hose.
Place the Top Housing on it's side with the fuel inlet fitting facing upwards.

10. Using a #2 cross-tip screwdriver, remove the four (4) screws that hold the Top Housing to the Heat Exchanger. Lift the Top Housing away from the Heat Exchanger.

11. Remove Wiring Harness connectors from the Fuel Injector (**5**), (rotate the Injector upwards to release the connector), the Fuel Pump (**6**), EMI board (**7**), Diagnostic Display (**8**) and the Power Board (**9**).

12. With the Top Housing on its side, use a #2 cross-tip screwdriver to remove the screw holding the Power and Wiring Harness P-clip (**10**) attached to the underside of the Top Housing.

13. Remove the Fuel Pump (ref. TM 5.9.3) to allow access to Wiring Harness Plate.

14. Using a #2 cross-tip screwdriver, remove the four (4) self tapping screws from the Wiring Harness feed-thru plate by which it is fastened to the Top Housing. Remove the Plate.

15. Remove Wiring Harnesses from Wiring Harness Plate by sliding grommets out of keyed slot in Wiring Harness Plate.

16. Remove Wiring Harness by sliding it through the Top Housing.

Wiring Harness (continued)

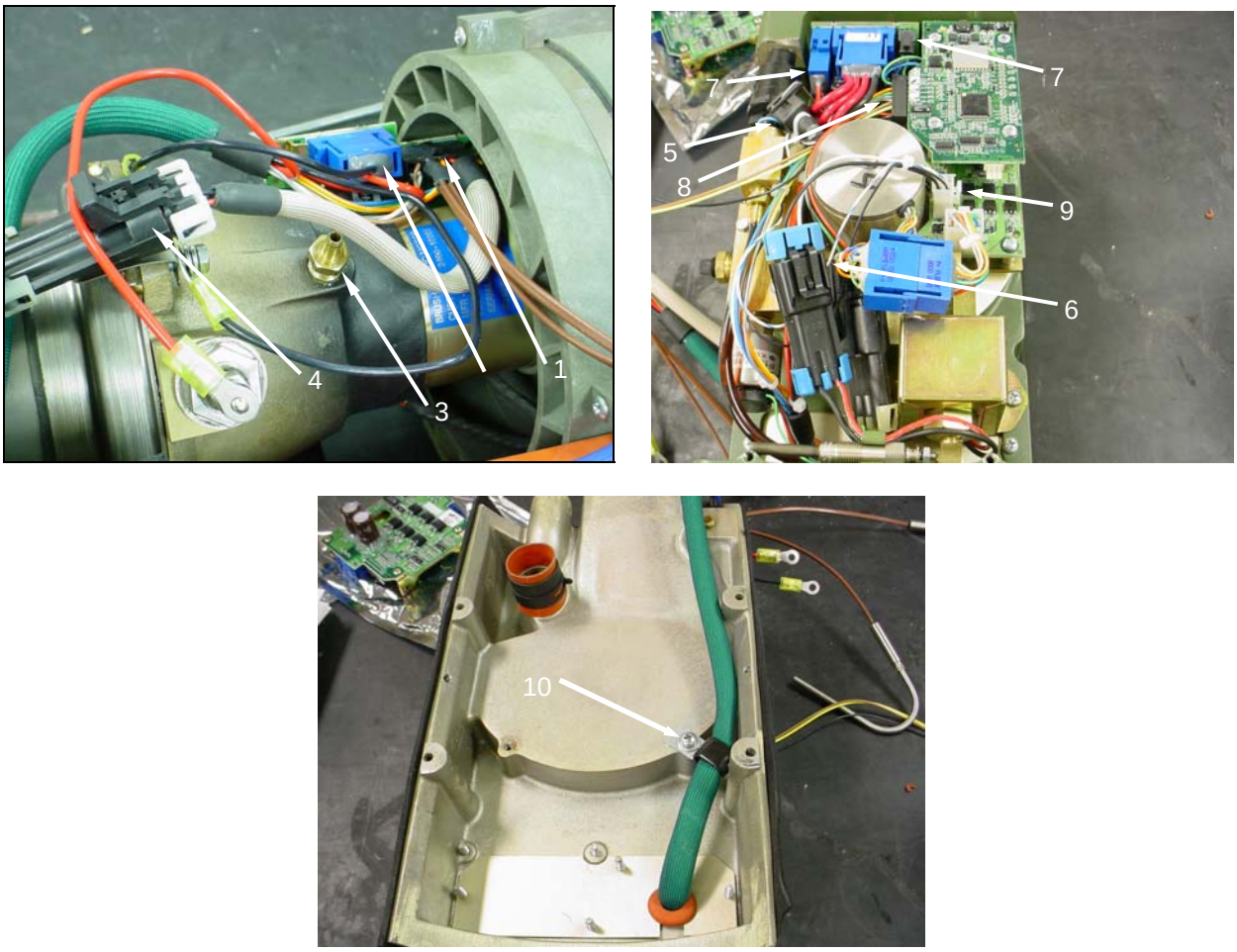


Figure 5-33. A20 Wiring Harness - Continued

Wiring Harness (continued)

5.9.8.2.2 Installation

1. Install Wiring Harness by sliding it through the Top Housing.

2. Install Wiring Harness to Wiring Harness Plate by installing grommets in keyed slot of Wiring Harness Plate.

3. Using a #2 cross-tip screwdriver, install the four (4) self tapping screws in the Wiring Harness feed-thru plate by which it is fastened to the Top Housing. Install the Plate.

4. Install the Fuel Pump (ref. TM 5.9.3) to Wiring Harness Plate.

5. With the Top Housing on its side, use a #2 cross-tip screwdriver to install the screw holding the Wiring Harness P-clip (**10**) attached to the underside of the Top Housing.

6. Install the Wiring Harness connectors to the Fuel Injector (5), (rotate the Injector upwards to engage the connector), the Fuel Pump (6), EMI board (7), Diagnostic Display (8) and the Power Board (9).

7. Place the Top Housing onto the Heat Exchanger taking care not to trap or damage the Wiring Harness. Line up Secondary Air Duct over the air pipe of the Heat Exchanger.

8. Using pliers, move one of the 1" metal spring clamps from the Top Housing end of the Secondary Air Duct along the Secondary Air Duct Hose and secure to the Heat Exchanger end of the Secondary Air Duct.

!CAUTION!
Do NOT trap wires of the Wiring Harness when mounting Top Housing onto Heat Exchanger.

9. Using a #2 cross-tip screwdriver, secure the Top Housing to the Heat Exchanger using four (4) screws.

10. Using pliers, re-set the Secondary Air Duct with the spring clamp to ensure that hose is NOT kinked or bent.

11. Use a 7/16" open ended wrench to attach the Exhaust Sensor.

12. Install Combustor Assembly (ref. 5.7.1).

13. Using a 7/16" open ended wrench, install Burner Sensor. Ensure that the wire is properly routed to prevent any damage.

14. Connect the Vent Sensor Connector (J5) of the Wiring Harness to the Vent Sensor connector. Ensure that the locking tab is engaged.

15. Install Vent Fan Assembly (ref. 5.6.1).

16. Install Bottom Shell (ref. 5.4.3).

17. Install Top Shell (ref. 5.4.2).

18. Install Top Cover (ref. 5.4.1).

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5.10 Repairs Using Redesigned Burner Fan Plate Assembly

If replacement parts are the redesigned assembly, follow these procedures for installation.

5.10.1 Redesigned Burner Fan Plate

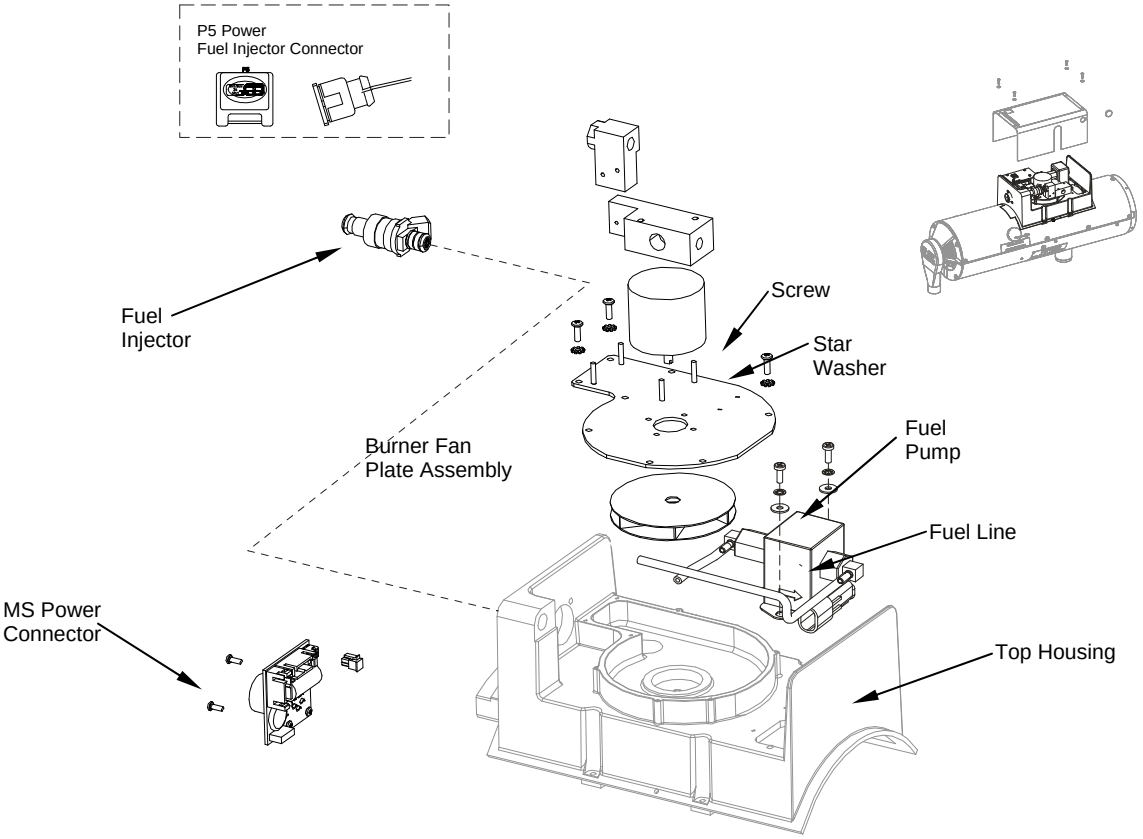

Figure 5.10-1. Redesigned Burner Fan Assembly

5.10.1.1 Removal

Note: The threaded bushing does not need to be removed unless it is damaged

1. Remove Top Cover (ref. 5.4.1).

2. Remove Wiring Harness connectors from the Fuel Pressure Sensor (J4) (ref. 5.9.1) and the Diagnostic Display (J2) (ref. 5.9.2).

3. Remove Wiring Harness connectors from the Fuel Injector (J5), (ref. 5.9.5) and the Burner Fan Driver Board (J3) (ref. 5.10.3).

Note: All the connectors in the Top Housing are different in size and shape. All connectors have locking tabs, which can be released by finger pressure.

4. Using an #1 cross-tip screwdriver, unscrew the two (2) screws that hold the MS Power connector (J2) to the Top Housing.

5. Using an 8-32 hex socket, remove the two bolts from the top of the fuel manifold. Using a #2 cross-tip screwdriver, remove the eight (8) mounting screws securing the Burner Fan Plate to the Top Housing.

   Note: One screw is shared with the Inductor (L1) clamp). Free the Power Inductor (L1) from its clamp.

6. Using a #2 cross-tip screwdriver, remove the eight (8) mounting screws securing the Burner Fan Plate to the Top Housing (Note: one screw is shared with the Inductor (L1) clamp). Free the Power Inductor (L1) from its clamp.

7. Free the Power Main Capacitor (C2) by loosening the bolt on the side of the Main Capacitor clamp.

8. Lift the Burner Fan Plate Assembly from the Top Housing while at the same time pushing the MS Power connector into the Top Housing. Take care not to damage the wires and connectors. Avoid fuel spills.

   Note: The Fuel Injector will become loose and can be put aside for re-installation. Take care NOT to damage the Fuel Injector O-rings.

9. If replacing Burner Fan Plate, remove the Diagnostic Display (ref. 5.9.2), Burner Fan Driver (ref. 5.10.3), Burner Fan Impeller (5.10.4), Burner Fan Motor (5.10.5) and Fuel Pressure Sensor (ref. 5.9.1) for re-installation.

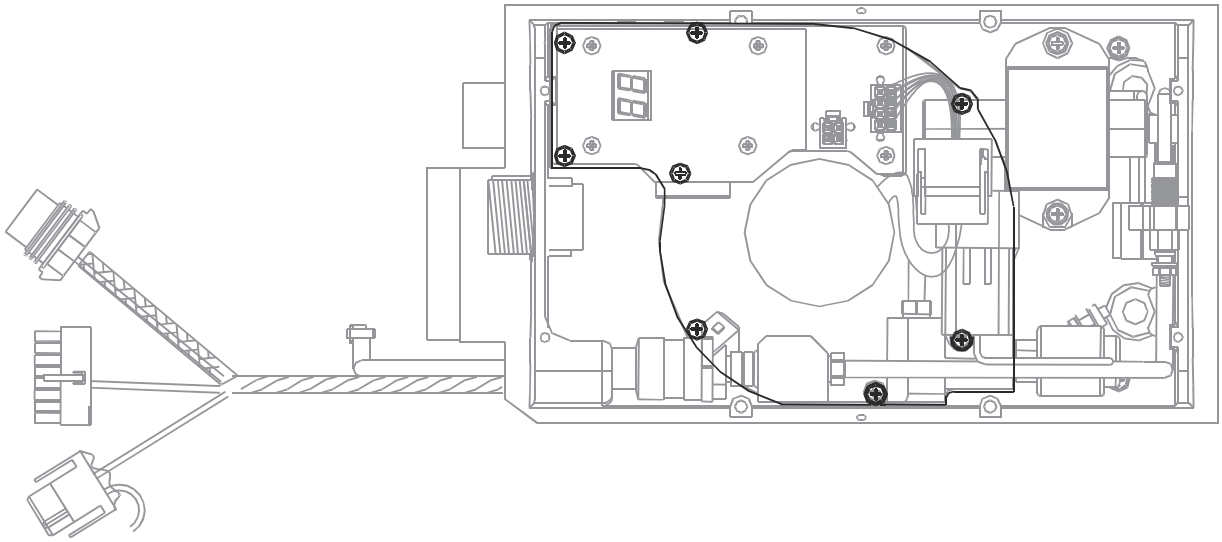

Figure 5.10-2. Burner Fan Plate Screw Locations.

Redesigned Burner Fan Plate Assembly (continued)

5.10.1.2 Installation

Note: Inspect Burner Fan Plate Gasket prior to installation. Replace if required. New gasket MUST be glued in place to the Burner Fan Plate using Loctite 770 and 401.

1. Place Burner Fan Plate Assembly into the Top Housing.

   Note: Always lubricate the O-Rings of the Fuel Injector with common grease (GAA) to aid insertion

2. Insert the Fuel Injector into the fuel boss of the Top Housing, and the other end of the Fuel Injector into the fuel boss of the Burner Fan Plate Assembly. The wiring connector of the Fuel Injector should be pointing upwards and towards the fuel boss of the Burner Fan Plate Assembly.

3. Using a #1 cross-tip screwdriver, install MS Power Connector (J2) to the Top Housing.

4. Install Power Main Capacitor (C2) in Main Capacitor clamp and tighten bolt on side of the clamp.

5. Apply Loctite 243 (blue) to eight (8) screws and star washers, and use a #2 cross-tip screwdriver to secure the Burner Fan Plate Assembly to the Top Housing. Ensure the clamp for the Power Inductor (L1) is re-installed using the screw located under the Fuel Injector and the Inductor is re-installed under the clamp. Tighten all screws evenly.

   Note: When installing a new Burner Fan Plate Assembly, remove the four (4) nuts (used for shipping only) holding the Diagnostic Display standoffs in place.

   Note: Two long bolts are to be used to bolt the fuel manifold assembly in place

6. Attach the Power Fuel Injector connector (J5) and rotate the Injector so that the connector faces downward between the Burner Fan Motor and the Burner Fan Plate.

7. Install Fuel Pressure Sensor (ref. 5.9.1).

8. Install Diagnostic Display (ref. 5.9.2).

9. Attach Wiring Harness connectors for the Fuel Pressure Sensor (J4), and the Diagnostic Display (J2). Ensure all connectors are properly engaged.

10. Attach the Wiring Harness connector for the Burner Fan Driver Board (J3), ensuring the connector is properly engaged.

11. Using a 9/16" open-ended wrench, connect the fuel supply to the heater.

Redesigned Burner Fan Plate Assembly (continued)

12. Connect vehicle power cable to the heater MS Power connector (Control Box Connection).

13. Start the heater and check that there are NO fuel leaks from the fuel connections (ref. Figure 5.5-9).

14. Install Top Cover (ref. 5.4.1).

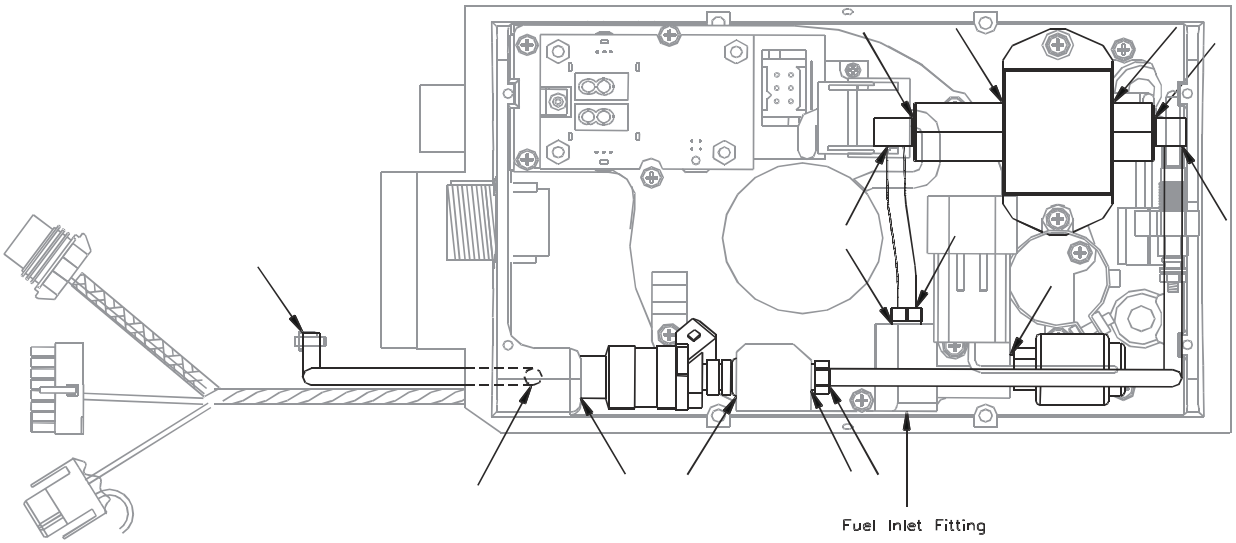

Figure 5.10-3. Fuel Leak Check Points.

5.10.2 Fuel Injector

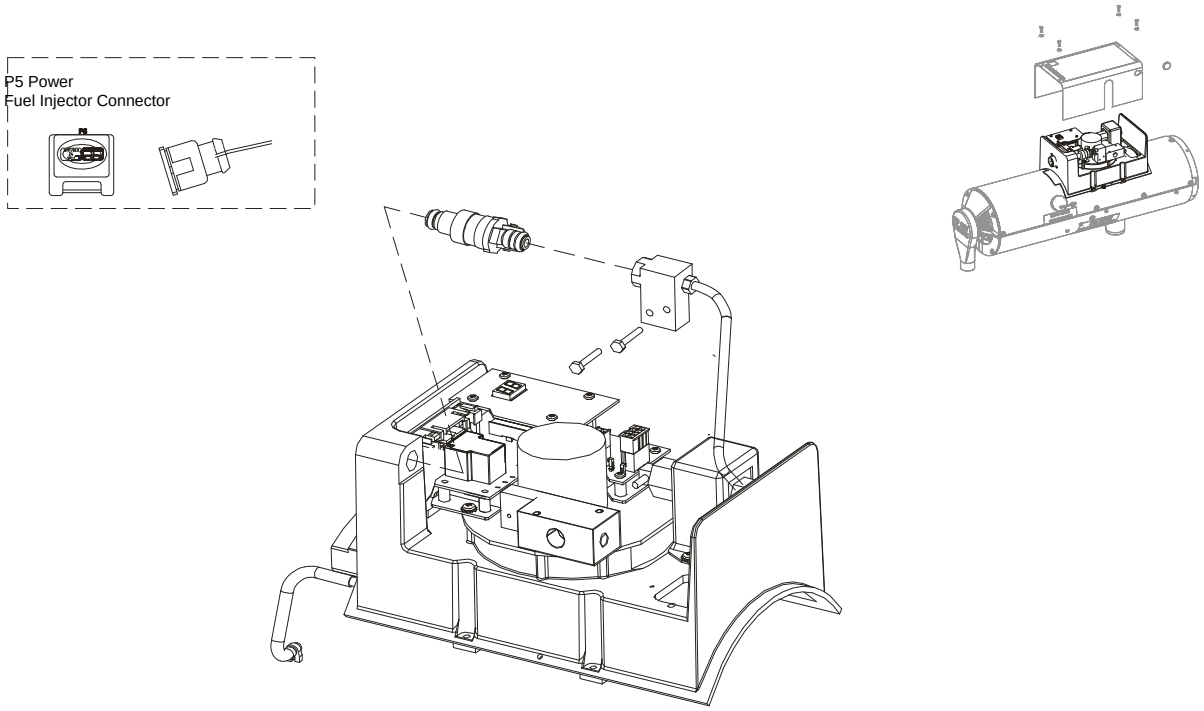

Figure 5.10-4. Fuel Injector.

5.10.2.1 Removal

1. Remove vehicle power cable from the MS Power connector.
2. Remove Top Cover (ref. 5.4.1).
3. Rotate the Fuel Injector so that the wiring connector is facing upwards.
4. Remove the fuel injector J5 connector.

   Note: Use fingers to press the metal clip connector, and release TOWARDS the fuel injector. Gently detach connector from Fuel Injector.

5. Using an 8-32 hex socket remove the bolts from the side of the fuel manifold.
6. Lift the manifold and injector by gently pulling away from the top housing assembly.
7. The injector can now be removed.

5.10.2.2 Installation

1. Insert the Fuel Injector into the fuel boss of the Top Housing, and the other end of the Fuel Injector into the fuel manifold. The wiring connector of the Fuel Injector should be angled upwards and towards the fuel boss of the Burner Fan Plate Assembly.

Fuel Injector (continued)

Note: Apply GAA to fuel injector o-rings prior to installation.

2. Apply Loctite 243 to the two bolts and using an 8-32 hex socket, secure the fuel manifold to burner plate.

3. Connect fuel injector to J5 connector.

4. Rotate the injector so that the connector is pointing downwards, toward the burner motor.

5.10.3 Burner Fan Driver Board (Design Iteration 3)

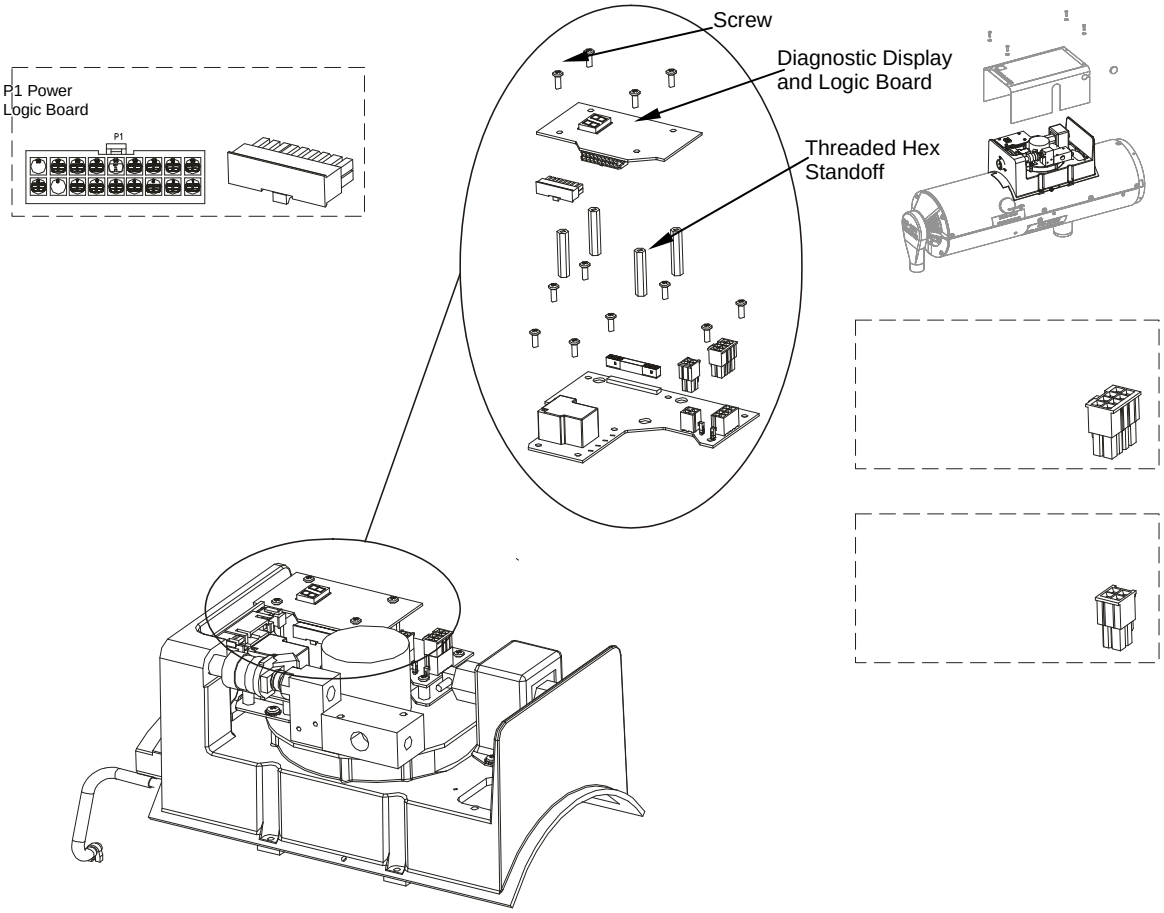

Figure 5.10-5. Burner Fan Driver Board. Design Iteration 3

5.10.3.1 Removal

1. Remove Top Cover (ref. 5.4.1).

Burner Fan Driver Board Removal (continued)

2. Disconnect the Burner Fan Motor J3 Power connector.

3. Remove Diagnostic Display (ref. 5.9.2).

4. Using a 3/8” open-ended wrench, remove the four (4) hex standoffs.

5. Using a #1 cross tip screwdriver remove the two (2) securing screws from the driver board heat sink. Gently remove the driver board, taking care to not damage the driver board or heat sink.

5.10.3.2 Installation

1. Apply Dow Corning 340 heat sink compound to the mating surface of the driver board heat sink.

   Note: Ensure there are no contaminates on the mating surface that will impede cooling of the heat sink to the Burner Fan Plate.

2. Place the driver board over the four (4) pem studs on the burner fan plate. Gently ease the board into place, ensure the screws for the connector board line up.

3. Using a 3/8” open-ended wrench, replace the four (4) hex standoffs.

4. Using a #1 cross tip screwdriver replace the two (2) securing screws into the connector board.

5. Connect the J2 Wiring Harness connector.

6. Connect the J3 Power connector.

7. Install Diagnostic Display (ref 5.9.2).

8. Replace the Top Cover (ref. 5.4.1).

9. Replace vehicle power cable from the MS Power connector.

5.10.4 Burner Fan Impeller

Burner Fan Impeller (continued)

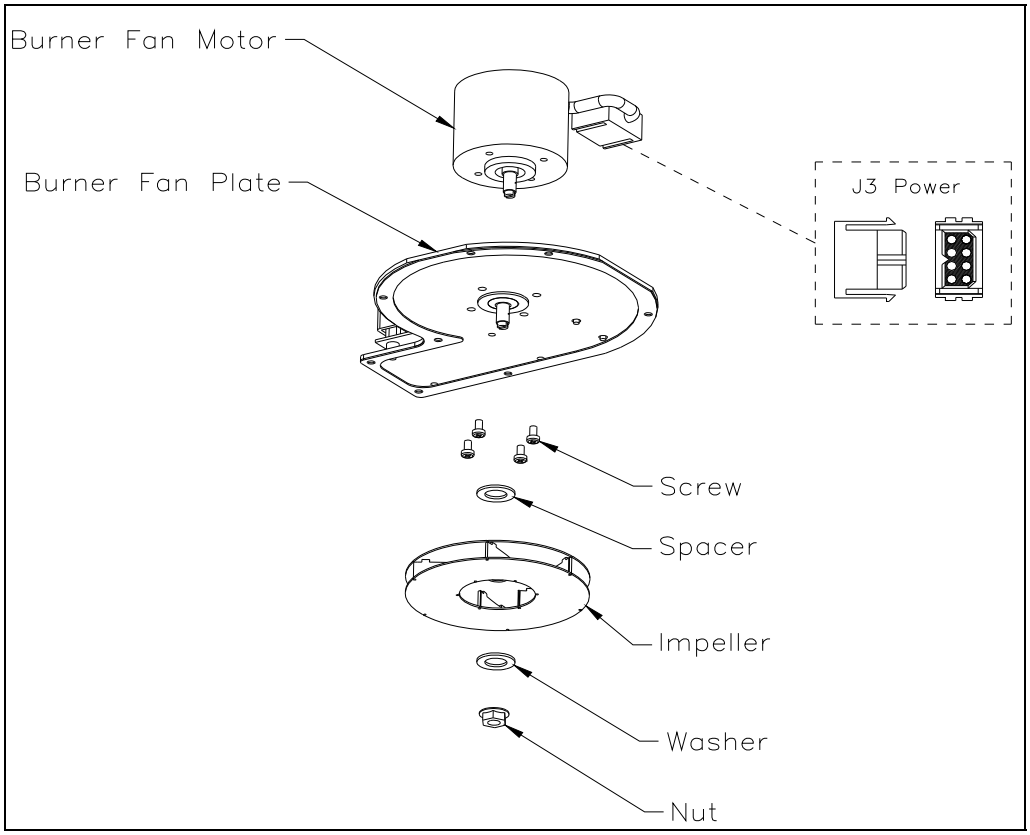

Figure 5.10-6. Burner Fan Impeller.

5.10.4.1 Removal

1. Remove the burner fan plate assembly from the top housing (ref 5.10.1).
2. Turn the plate upside over.
3. Using a 7/16” open wrench and a Philips #2 screwdriver, remove the nut. Place the wrench over the nut and use the screw drive to hold the bolt in place while turning the nut.
4. Remove the nut and the washer and the impeller can now be removed.

5.10.4.2 Installation

1. With the burner fan shaft pointing up, place the spacer over the burner fan motor shaft.
2. Place the impeller over the spacer, followed by the washer.

Burner Fan Impeller (continued)

3. Apply loctite 243 (blue) to the burner fan motor shaft. Using a 7/16" open wrench and a Philips #2 screw driver, place the wrench over the nut and use the screwdriver to hold the motor shaft in place while turning the nut.

4. Ensure the impeller nut is secure and that the impeller spins freely.

> **Note: When replacing an impeller, always ensure that a new impeller nut is used.**

5. Install Burner Fan Assembly on Top Housing (ref 5.10.1)

5.10.5 Burner Fan Motor

With reference to figure 5.10-6.

5.10.5.1 Removal

1. Remove the burner fan motor impeller (ref 5.10.3).

2. With the burner fan plate assembly upside down. Use a #1 cross tip screwdriver to remove the four (4) securing screws.

3. Gently pull the burner fan motor from the plate.

5.10.5.2 Installation

1. With the burner fan motor upside down, place the burner fan plate in position and align the four (4) securing screw holes. Apply loctite 243 (blue) to the four (4) screws and use a #1 cross tip screwdriver to tighten the four (4) securing screws.

> **Note: The Burner Fan Motor bolt pattern is keyed to align the motor wiring towards the burner fan driver board.**

2. Install the burner fan motor impeller (ref 5.10.3).

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6 TROUBLESHOOTING

This section explains the diagnostic system used by the A20 heater to aid in the determination and repair of heater malfunctions, as well as guiding the user through a step by step procedure to rectify problems based on the particular diagnostic code given.

> **Note: In some installations the diagnostic display is not visible. A remote display is available as an accessory. Contact manufacturer for details.**

6.1 Diagnostic Fault Codes

> **Note: Operating Codes 00 to 07, 14 and 99, as well as Data Codes D1, D2, and D3 are displayed as part of normal operation and do not require any maintenance actions.**

To assist heater maintenance, a diagnostic system has been developed to isolate the problem area. This section gives a brief explanation of the fault codes used by the A20 heater.

Three different types of Diagnostic Fault Codes are used: Component Failure Codes (”**C**”), Operating Error Codes (“**E**”), and Operating Faults (“**F**”).

> **Note: If the Diagnostic Display appears blank and the heater is operating, the Diagnostic Display circuit has failed, see 5.8.2.**

6.1.1 “C” Codes - Component Failures

Component Failure codes are designed to identify hardware faults.

- **C1** Ignitor Fault
- **C2** Ignitor Short
- **C3** Vent Fan Fault
- **C4** Burner Fan Fault
- **C5** Burner/Exhaust Sensor Fault
- **C6** Vent Sensor Fault
- **C7** Fuel Pressure Sensor Fault
- **C8** Controller Fault
- **C9** Fuel Pump Fault
- **CA** Fuel Injector Fault

6.1.2 "E" Codes - Operating Errors

Operating Error codes are used to display faults which have a direct effect on the heater but which are generally caused by the vehicle or testing system. (i.e. external to heater)

E1 Low Voltage
E2 Low Fuel Pressure
E3 Low Burner Air Flow
E4 Reverse Burner Air Flow
E5 Inlet Over Pressure
E6 System Voltage

6.1.3 "F" Codes - Operating Faults

Operating Faults are heater failures caused by operation of the heater outside the standard heater operating parameters.

F1 Ignition Overtime
F2 Burner Flame Out
F3 Heat Limit
F4 Vent Air Over Heat
F5 Over Current
F6 Ambient Over Temperature
F7 Exhaust Over Temperature
F8 Ignition Flame Out

6.2 Warning & Shutdown Faults

The three types of Fault Codes ("C", "E", and "F") can be broken into two categories: Warning Faults, and Shut-Down Faults. (ref. Table 6-1 and Table 6-2).

If the Control Box Lamp begins to flash, the heater is signaling that an abnormal condition is present. The appropriate maintenance technician can correct this condition by referencing the heater diagnostic display and instructions in Section 6 (TROUBLESHOOTING) of this manual.

If a Warning Fault in Table 6-1 is encountered, the heater will alternately display the fault code and the current run code (07 or 14) on the Diagnostic Display. If possible, the heater will adjust its operation to compensate for the condition. If the condition continues and operation is no longer possible, the heater will enter Purge mode, and steadily display the fault. With the exception of the Low Fuel Pressure and Fuel Pressure Sensor Fault warnings, the Control Box Lamp will not flash if a Warning fault is displayed. In the case of a Low Fuel Pressure Fault, the Control Box Lamp will flash in a cycle comprising two (2) quick flashes followed by a two (2) second delay. In the case of a Fuel Pressure Sensor Fault, the Control Box Lamp will flash in a cycle comprising three (3) quick flashes followed by a two (2) second delay.

If a Shut Down fault in Table 6-2 is encountered, the heater will automatically enter shutdown mode. In shutdown mode the heater will purge combustion and vent air for a period of 3 minutes to clear out combustible fumes and excess heat. During this time the control box controls are locked out; the Diagnostic Display will display the fault code; and the Control Box Lamp will flash in a cycle comprising one (1) flash followed by a two (2) second delay. Once the shutdown purge cycle is completed the heater will automatically switch off and can be restarted.

C7	Fuel Pressure Sensor Fault
C9	Fuel Pump Fault
E2	Low Fuel Pressure
E5	Inlet Over Pressure
E6	System Voltage
F3	Heat Limit
F6	Ambient Over Temperature

Table 6-1. Warning Faults

C1	Ignitor Fault
C2	Ignitor Short
C3	Vent Fan Fault
C4	Burner Fan Fault
C5	Exhaust Sensor Fault
C6	Vent Sensor Fault
C8	Controller Fault
CA	Fuel Injector Fault
E1	Low Voltage
E3	Low Burner Air Flow
E4	Reverse Burner Air Flow
F1	Ignition Overtime
F2	Burner Flame Out
F4	Vent Air Over Heat
F5	Over Current
F6	Ambient Over Temperature
F7	Exhaust Over Temperature
F8	Ignition Flame Out

Table 6-2. Shut Down Faults

6.3 Troubleshooting - General

!CAUTION!
Do NOT attempt to start heater more than three (3) times.

If the heater does not start, the Control Box Lamp is flashing, and/or a diagnostic fault code is noticed on the Diagnostic Display, attempt two more starts prior to initiation of heater maintenance.

- If the Control Box Lamp begins to flash, the heater is signaling that an abnormal condition is present and the diagnostic display should be viewed for the possible fault.
- If Ignition is not achieved in the allowable 3 ½ minutes, the heater will automatically shut down, flash the Control Box Lamp, and display the fault.
- When the heater is switched off by the operator the control box lamp will flash, in this case no maintenance is required and the heater can be restarted after shutdown is complete.

!CAUTION!
If black smoke is noticed during any mode of Heater Operation, shut down the heater, and check for airflow obstructions. It is possible that frost has built up in the combustion air intake or that debris has entered into the combustion system .

6.4 Troubleshooting Guidelines

Attached are a series of troubleshooting checklists to aid the user in resolving each specific fault code.

> **Note: Attempt to start the heater a total of three (3) times prior to the initiation of Heater Maintenance.**

Note: More than one action may be required to resolve a Heater Fault Code.

> **Note: If the heater alternately displays a Fault Code with one of the current Run settings (07 or 14), the heater is attempting to compensate for an abnormal operating condition. If the condition remains, the heater will continue to operate as long as possible. If safe heater operation is no longer possible, the heater will shut down and display the appropriate Fault Code.**

6.5 TROUBLESHOOTING FAULT CODES

6.5.1 C1 - IGNITOR FAILURE (Design Iteration 1 & 2 Only)

	IGNITOR CIRCUIT IS NOT WORKING		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL IGNITOR HATCH RESTART HEATER
2	CHECK THAT WIRE IS CONNECTED TO IGNITOR	4.1.1	CHECK SPRING WASHER ON IGNITOR POST. PLACE WIRE ON POST REPLACE HATCH COVER RESTART HEATER
3	DEFECTIVE IGNITOR	4.1.1	REPLACE IGNITOR RESTART HEATER
4	CHECK CONNECTOR TO ELECTRONIC CONTROLLER BOARD IS PROPERLY SEATED.	5.2-13	CHECK LOCKING TABS ARE FULLY ENGAGED.
5	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER
6	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

6.5.2 C1 – IGNITOR FAILURE (Design Iteration 3 Only)

	IGNITOR (GLOW PLUG) CIRCUIT IS NOT WORKING PROPERLY OR OPEN		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL IGNITOR HATCH RESTART HEATER
2	CHECK THAT WIRE IS CONNECTED TO IGNITOR	4.1.1	CHECK SPRING WASHER ON IGNITOR POST. PLACE WIRE ON POST REPLACE HATCH COVER RESTART HEATER
3	CHECK FOR DEFECTIVE IGNITOR	4.1.1	MEASURE THE IGNITOR RESISTANCE, IF IT IS NOT BETWEEN 1.6 TO 1.8 OHMS, REPLACE IGNITOR RESTART HEATER
4	CHECK CONNECTOR TO FILTER BOARD IS PROPERLY SEATED.		CHECK LOCKING TABS ARE FULLY ENGAGED. RESTART HEATER
5	CHECK FOR BROKEN WIRE		CHECK CONTINUITY OF IGNITOR WIRE FROM TERMINAL RING TO PIN 2 OF CONNECTOR P6. IF NO CONTINUITY, REPLACE WIRING HARNESS RESTART HEATER
6	CHECK POWER IS SUPPLIED TO THE POWER BOARD		MEASURE SUPPLY VOLTAGE BETWEEN PINS J2 AND J7 ON THE POWER BOARD. IF SUPPLY VOLTAGE IS NOT PRESENT, REPLACE THE FILTER BOARD. RESTART HEATER
7	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
8	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.3 C2 - IGNITOR SHORT (Design Iteration 1 & 2 Only)

	IGNITOR IS NOT PROPERLY CONNECTED OR IS SHORTED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL IGNITOR HATCH REPLACE IGNITOR WIRE ON IGNITOR RESTART HEATER
2	CHECK THAT IGNITOR WIRE IS CONNECTED TO IGNITOR	4.1.1	CHECK SPRING WASHER ON IGNITOR POST PLACE WIRE ON POST REPLACE HATCH COVER RESTART HEATER
3	DEFECTIVE IGNITOR	4.1.1	REPLACE IGNITOR RESTART HEATER
4	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER
5	DEFECTIVE POWER WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

6.5.4 C2 – IGNITOR SHORT (Design Iteration 3 Only)

	IGNITOR (GLOW PLUG) IS NOT PROPERLY CONNECTED OR IS SHORTED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL IGNITOR HATCH REPLACE IGNITOR WIRE ON IGNITOR RESTART HEATER
2	CHECK THAT IGNITOR WIRE IS CONNECTED TO IGNITOR	4.1.1	CHECK SPRING WASHER ON IGNITOR POST PLACE WIRE ON POST REPLACE HATCH COVER RESTART HEATER
3	CHECK FOR DEFECTIVE IGNITOR	4.1.1	MEASURE THE IGNITOR RESISTANCE, IF IT IS NOT BETWEEN 1.6 TO 1.8 OHMS, REPLACE IGNITOR RESTART HEATER
4	CHECK FOR WIRE SHORTED TO CASE		CHECK THE IGNITOR WIRE FOR FRAYING OR DAMAGE TO THE COATING IF DAMAGED REPLACE WIRING HARNESS RESTART HEATER
5	CHECK FOR ADEQUATE POWER SUPPLY		POWER SUPPLY SHOULD BE A MINIMUM OF 30 AMPS AT 23 VDC
6	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
7	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.5 C3 - VENT FAN FAULT (Design Iteration 1 & 2 Only)

	VENT IMPELLER SPEED IS BELOW NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	WITH HEATER OFF, CHECK FOR FREE ROTATION OF THE VENT IMPELLER BY SPINNING BY HAND	5.2.6 5.2.4	IF VENT IMPELLER DOES NOT ROTATE FREELY, AND AMBIENT TEMPERATURE IS GREATER THAN 32°F (0°C), REPLACE VENT FAN MOTOR AND IMPELLER RESTART HEATER IF THE AMBIENT TEMPERATURE IS BELOW 32°F (0°C), CHECK FOR AND REMOVE FROST OR OTHER OBSTRUCTIONS AROUND THE VENT IMPELLER RESTART HEATER
2	CHECK WIRE CONNECTOR FROM THE VENT FAN MOTOR TO THE ELECTRONIC VENT FAN DRIVER BOARD	5.2.5	RECONNECT TO THE ELECTRONIC VENT FAN DRIVER BOARD RESTART HEATER
3	CHECK WIRE CONNECTOR FROM THE ELECTRONIC VENT FAN DRIVER BOARD TO WIRING HARNESS	5.2.5 5.5.6	RECONNECT TO WIRING HARNESS RESTART HEATER
4	CHECK ALL WIRING CONNECTIONS TO ELECTRONIC BOARDS INCLUDING THE TWO CONTROLLER BOARDS (2 CONNECTORS)	5.2.5	RECONNECT ALL WIRING TO CORRECT ELECTRONIC BOARDS OR COMPONENTS RESTART HEATER
5	DEFECTIVE ELECTRONIC VENT FAN DRIVER BOARD	5.2.5	REPLACE ELECTRONIC VENT FAN DRIVER BOARD RESTART HEATER
6	DEFECTIVE VENT FAN MOTOR	5.2.6	REPLACE VENT FAN MOTOR RESTART HEATER
7	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

6.5.6 C3 – VENT FAN FAULT (Design Iteration 3 Only)

	VENT IMPELLER SPEED IS BELOW NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	LOOSE CONNECTIONS ON THE VENT FAN BOARD	5.2.6 5.2.4	CHECK AND RECONNECT CONNECTORS J11, J10, AND J13 ON THE VENT FAN BOARD RESTART HEATER
2	WITH HEATER OFF, CHECK FOR FREE ROTATION OF THE VENT IMPELLOR BY SPINNING BY HAND	5.2.6 5.2.4	CHECK FOR OBSTRUCTIONS IF VENT IMPELLOR DOES NOT ROTATE FREELY, AND AMBIENT TEMPERATURE IS GREATER THAN 32°F (0°C), REPLACE VENT FAN MOTOR AND IMPELLOR RESTART HEATER IF THE AMBIENT TEMPERATURE IS BELOW 32°F (0°C), CHECK FOR AND REMOVE FROST OR OTHER SUBSTANCES AROUND THE VENT IMPELLOR RESTART HEATER.
3	VENT FAN GROUND WIRE IMPROPERLY CONNECTED	5.2.5	RECONNECT TO THE GROUND WIRE TO THE BURNER HOUSING BOLT RESTART HEATER
4	DEFECTIVE VENT FAN BOARD	5.2.5 5.5.6	REPLACE VENT FAN BOARD RESTART HEATER

5	DEFECTIVE VENT FAN MOTOR	5.2.6	REPLACE VENT FAN MOTOR RESTART HEATER
6	DEFECTIVE WIRING HARNESS	5.5.6	CHECK THREE WIRES; P1-PIN 5 TO P11-PIN8; P1-PIN11 TO P11-PIN 15; P1-PIN14 TO P11-PIN 7 IF ANY FAIL THE CONTINUITY CHECK REPLACE WIRING HARNESS RESTART HEATER
7	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
8	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.7 C4 - BURNER FAN FAULT (Design Iteration 1 & 2 Only)

	BURNER FAN SPEED IS BELOW NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	WITH HEATER IN PURGE MODE, CHECK AIRFLOW AT EXHAUST PORT, OR SUCTION AT AIR INLET. BE CAREFUL NEAR THE EXHAUST SYSTEM. EXHAUST GASES ARE HOT.		IF AIR IS **NOT** CIRCULATING THROUGH THE HEATER, CHECK ALL ELECTRICAL CONNECTIONS FROM THE BURNER FAN MOTOR TO THE BURNER FAN DRIVER. ALSO CHECK ALL ELECTRICAL CONNECTIONS ON BOTH WIRING HARNESSES RESTART HEATER
2	DEFECTIVE BURNER FAN PLATE	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER
3	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER
4	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER
5	DEFECTIVE BURNER FAN MOTOR	5.6.6	REPLACE BURNER FAN MOTOR RESTART HEATER
6	DEFECTIVE BURNER FAN DRIVER BOARD	5.6.4	REPLACE BURNER FAN DRIVER BOARD RESTART HEATER

6.5.8 C4 – BURNER FAN FAULT (Design Iteration 3 Only)

	BURNER FAN SPEED IS BELOW NORMAL LIMITS; BURNER POWER DRIVER STATUS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK BURNER FAN MOTOR CONNECTIONS TO THE POWER BOARD		RECONNECT THE BURNER FAN MOTOR TO THE POWER BOARD RESTART HEATER

2	CHECK SHORTS AND CONTINUITY OF BURNER CABLE ASSEMBLY		CHECK 8 WIRES FROM PLUG J4 TO PLUG P1 FOR CONTINUITY J4-PIN1 TO P1-PIN6 J4-PIN2 TO P1-PIN8 J4-PIN3 TO P1-PIN7 J4-PIN4 TO P1-PIN1 J4-PIN5 TO P1-PIN2 J4-PIN6 TO P1-PIN3 J4-PIN7 TO P1-PIN4 J4-PIN8 TO P1-PIN5 ALSO CHECK FOR SHORTS BETWEEN WIRES IF ANY CHECK FAILS REPLACE BURNER CABLE ASSEMBLY RESTART HEATER
3	CHECK IMPELLOR FOR OBSTRUCTION OR DAMAGE		REMOVE OBSTRUCTION IF DAMAGED REPLACE IMPELLOR RESTART HEATER
4	CHECK BURNER FAN MOTOR SHAFT FOR FREE ROTATION		IF MOTOR DOESN'T ROTATE FREELY REPLACE BURNER FAN MOTOR RESTART HEATER
3	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
4	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.9 C5 - BURNER SENSOR FAULT (Design Iteration 1 & 2 Only)

	BURNER SENSOR SIGNAL IS OUTSIDE NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER
2	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE PROGRAMMED CONTROLLER BOARD RESTART HEATER

6.5.10 C5 - BURNER SENSOR FAULT (Design Iteration 3 Only)

	BURNER TEMPERATURE OR EXHAUST TEMPERATURE SENSOR SIGNAL IS OUTSIDE NORMAL LIMITS; BT SENSOR SHORT OR C5 - XT SENSOR SHORT OR C5 - BT SENSOR OPEN OR C5 - XT SENSOR OPEN		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK BOTH CHASSIS AND VENT FAN BOARD GROUND WIRES FOR PROPER CONNECTION		RETIGHTEN CONNECTIONS RESTART HEATER
2	CHECK FOR DAMAGED WIRES FROM THERMOCOUPLE TO THE P11 WIRE HARNESS PLUG		IF WIRES ARE DAMAGED REPLACE WIRE HARNESS RESTART HEATER
3	CHECK FOR LOOSE CONNECTIONS BETWEEN THE VENT FAN BOARD AND THE LOGIC BOARD		RECONNECT THE P11 PLUG INTO THE VENT FAN BOARD AND THE P1 PLUG INTO THE LOGIC BOARD RESTART HEATER

4	CHECK WIRE HARNESS FOR CONTINUITY AND SHORTS		CHECK 2 WIRES FROM THE VENT FAN BOARD TO THE LOGIC BOARD FOR CONTINUITY: P11-PIN12 TO P1-PIN3 P11-PIN4 TO P1-PIN12 CHECK FOR MV SIGNAL BETWEEN P11-PIN13 AND P11-PIN5 FOR BT SENSOR P11-PIN14 AND P11-PI N 6 FOR XT SENSOR CHECK FOR A MINIMUM OF 150K RESISTANCE OR OPEN LINE BETWEEN P11-PIN13 TO CHASIS GROUND AND P11-PIN14 TO CHASIS GROUND IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER COMPLETE THE FOLLOWING CHECKS AT ROOM TEMPERATURE AND WITH THE SENSOR HEATED TO GREATER THAN 600C. CHECK FOR MV SIGNAL BETWEEN P11-PIN13 AND P11-PIN5 FOR BT SENSOR P11-PIN14 AND P11-PIN6 FOR XT SENSOR CHECK FOR GREATER THAN 10K RESISTANCE BETWEEN; P11-PIN13 TO CHASIS GROUND AND P11-PIN14 TO CHASIS GROUND IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER
4	CHECK VENT FAN BOARD FOR LOOSE SOLDER JOINTS		REPLACE VENT FAN BOARD RESTART HEATER
5	CHECK LOGIC BOARD FOR LOOSE SOLDER JOINTS		REPLACE LOGIC BOARD RESTART HEATER

NOTE: THIS FAULT MAY OCCUR ONLY WHEN THE SENSOR IS HEATED TO OPERATING TEMPERATURES. AFTER COOLING THE FAULT CAN CLEAR ALLOWING THE UNIT TO BE STARTED, OPERATING BREIFLY UNTIL THE SENSOR IS HEATED.

6.5.11 C6 - VENT SENSOR FAULT(Design Iteration 1 & 2 Only)

	VENT SENSOR HAS FAILED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT VENT SENSOR IS CONNECTED TO THE WIRING HARNESS. INSPECT WIRES AT CONNECTOR AND VENT SENSOR.	5.4.2	RECONNECT VENT SENSOR TO WIRING HARNESS RESTART HEATER
2	DEFECTIVE VENT SENSOR	5.4.2	REPLACE VENT SENSOR RESTART HEATER
3	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER
4	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC CONTROLLER BOARD RESTART HEATER

6.5.12 C6 - VENT SENSOR FAULT (Design Iteration 3 Only)

	VENT SENSOR IS OUTSIDE NORMAL LIMITS; VENT RING SHORT, OPEN AND GROUNDED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT VENT SENSOR IS CONNECTED TO THE WIRING HARNESS.	5.4.2	RECONNECT VENT SENSOR TO WIRING HARNESS AND GROUND WIRE ATTACHED TO BURNER HOUSING RESTART HEATER
2	CHECK FOR DAMAGED WIRE FROM VENT SENSOR TO HARNESS PLUG		REPLACE VENT SENSOR RESTART HEATER
3	CHECK WIRES FROM PLUG P10 TO VENT FAN BOARD (PLUG P11) FOR DAMAGE		CHECK 2 WIRES FROM VENT SENSOR P10 TO VENT FAN BOARD P11 FOR CONTINUITY; P10-PIN A TO P11-PIN11 P10-PIN B TO P11-PIN3
4	CHECK J13 CONNECTOR SOLDER JOINTS ON THE VENT FAN BOARD FOR SHORT AND LOOSE JOINT		REPLACE VENT FAN BOARD RESTART HEATER
5	CHECK WIRE HARNESS FOR CONTINUITY AND SHORTS		CHECK 2 WIRES FROM THE VENT FAN BOARD TO THE LOGIC BOARD FOR CONTINUITY: P11-PIN12 TO P1-PIN3 P11-PIN4 TO P1-PIN12 CHECK FOR SHORT TO GROUND P1-PIN3 TO CHASSIS SHOULD BE OPEN LINE P1-PIN12 TO CHASSIS SHOULD BE OPEN LINE IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER
6	CHECK J8 CONNECTOR SOLDER JOINTS ON THE LOGIC BOARD FOR SHORT AND LOOSE JOINTS		REPLACE LOGIC BOARD RESTART HEATER
7	DEFECTIVE VENT SENSOR RING	5.4.2	REPLACE VENT SENSOR RING RESTART HEATER
8	DEFECTIVE VENT FAN BOARD		REPLACE VENT FAN BOARD RESTART HEATER
9	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.13 C7 - FUEL PRESSURE SENSOR FAULT (Design Iteration 1 & 2 Only)

	FUEL PRESSURE SENSOR HAS FAILED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ELECTRICAL CONNECTOR IS ATTACHED TO FUEL PRESSURE SENSOR	5.5.1	RECONNECT FUEL PRESSURE SENSOR TO WIRING HARNESS RESTART HEATER
2	DEFECTIVE FUEL PRESSURE SENSOR	5.5.1	REPLACE FUEL PRESSURE SENSOR RESTART HEATER
3	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE PROGRAMMED CONTROLLER RESTART HEATER
4	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

NOTE: IF A C7 FAULT OCCURS DURING RUN MODE (07 OR 14), THE HEATER WILL CONTINUE TO OPERATE AT REDUCED TEMPERATURE IF POSSIBLE, AND ALTERNATELY DISPLAY THE C7 CODE AND THE APPROPRIATE RUN MODE (07 OR 14)

6.5.14 C7 - FUEL PRESSURE SENSOR FAULT (Design Iteration 3 Only)

	FUEL PRESSURE SENSOR SIGNAL IS OUTSIDE NORMAL LIMITS; FUEL PRESSURE OVER 20 PSI, OR OPEN CIRCUIT		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK FUEL PRESSURE SUPPLY TO THE HEATER IS BETWEEN 3 TO 15 PSI		REDUCE FUEL SUPPLY PRESSURE RESTART HEATER
2	CHECK THAT ELECTRICAL CONNECTOR IS ATTACHED TO FUEL PRESSURE SENSOR	5.5.1	RECONNECT FUEL PRESSURE SENSOR TO WIRING HARNESS RESTART HEATER
3	CHECK WIRING HARNESS FOR CONTINUITY	5.5.6	CHECK 3 WIRES FROM TRANSDUCER PLUG P4 TO LOGIC BOARD PLUG P1; P4-PIN A TO P1-PIN17 P4-PIN B TO P1-PIN15 P4-PIN C TO P1-PIN16 IF ANY CHECK FAILS REPLACE WIRING HARNESS RESTART HEATER
4	DEFECTIVE FUEL PRESSURE SENSOR	5.5.1	REPLACE FUEL PRESSURE SENSOR RESTART HEATER
5	DEFECTIVE LOGIC BOARD	5.2.5	REPLACE LOGIC BOARD RESTART HEATER

NOTE: IF A C7 FAULT OCCURS DURING RUN MODE (07 OR 14), THE HEATER WILL CONTINUE TO OPERATE AT REDUCED TEMPERATURE IF POSSIBLE, AND ALTERNATELY DISPLAY THE C7 CODE AND THE APPROPRIATE RUN MODE (07 OR 14)

6.5.15 C8 - CONTROLLER FAULT(Design Iteration 1 & 2 Only)

	CONTROLLER HAS FAILED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER
2	CALIBRATION VALUES HAVE BEEN CORRUPTED		CONTACT MANUFACTURER

6.5.16 C8 – CONTROLLER FAULT (Design Iteration 3 Only)

	CONTROL PARAMETER SIGNALS ARE OUTSIDE NORMAL OPERATING LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	DEFECTIVE VENT BOARD		REPLACE VENT BOARD RESTART HEATER
2	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
3	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.17 C9 - FUEL PUMP FAULT (Design Iteration 1 & 2 Only)

	OPERATING PARAMETERS FOR THE FUEL PUMP ARE OUTSIDE NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ELECTRICAL CONNECTOR IS ATTACHED TO FUEL PUMP	5.5.3	RECONNECT FUEL PUMP TO WIRING HARNESS RESTART HEATER
2	DEFECTIVE FUEL PUMP	5.5.3	REPLACE FUEL PUMP RESTART HEATER
3	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER
4	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

NOTE: THE HEATER DOES NOT SHUT DOWN WHEN A C9 FAULT IS ENCOUNTERED, BUT WILL CONTINUE TO OPERATE AT REDUCED PERFORMANCE.

6.5.18 C9 - FUEL PUMP FAULT (Design Iteration 3 Only)

	OPERATING PARAMETERS FOR THE FUEL PUMP ARE OUTSIDE NORMAL LIMITS; FUEL PUMP OPEN		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ELECTRICAL CONNECTOR IS ATTACHED TO FUEL PUMP AND HARNESS TO POWER BOARD	5.5.3	RECONNECT FUEL PUMP TO WIRING HARNESS RECONNECT PLUG P8 INTO POWER BOARD RESTART HEATER
2	CHECK FUEL PUMP RESISTANCE		RESISTANCE SHOULD BE 7 TO 8 OHMS IF RESISTANCE IS HIGH OR AN OPEN LINE REPLACE FUEL PUMP RESTART HEATER
3	CHECK WIRING HARNESS FOR DAMAGE AND CONTINUITY		CHECK 2 WIRES FROM PLUG P7 TO POWER BOARD PLUG P8: P7-PIN A TO P8-PIN2 P7-PIN B TO P8-PIN1 IF ANY CHECK FAILS REPLACE WIRING HARNESS RESTART HEATER
4	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
5	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

NOTE: THE HEATER DOES NOT SHUT DOWN WHEN A C9 FAULT IS ENCOUNTERED, BUT WILL CONTINUE TO OPERATE AT REDUCED PERFORMANCE.

6.5.19 CA - FUEL INJECTOR FAULT (Design Iteration 1 & 2 Only)

	OPERATING PARAMETERS FOR THE FUEL INJECTOR ARE OUTSIDE NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ELECTRICAL CONNECTOR IS ATTACHED TO FUEL INJECTOR	5.5.5	RECONNECT FUEL INJECTOR TO WIRING HARNESS RESTART HEATER
2	CHECK THAT GROUND LUG (LOCATED UNDERNEATH TOP HOUSING) IS ATTACHED	5.4.1	FASTEN GROUND LUG TO TOP HOUSING CHASSIS RESTART HEATER
3	CHECK THE RESISTANCE OF FUEL INJECTOR.	5.5.5	IF RESISTANCE SHOWS GREATER THAN 100 OHMS OR OPEN CIRCUIT, THE FUEL INJECTOR HAS FAILED. REPLACE FUEL INJECTOR RESTART HEATER IF RESISTANCE IS APPROXIMATELY 15 OHMS, THEN GO TO STEP 4.
4	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER
5	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.20 CA - FUEL INJECTOR FAULT (Design Iteration 3 Only)

	OPERATING PARAMETERS FOR THE FUEL INJECTOR ARE OUTSIDE NORMAL LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ELECTRICAL CONNECTOR IS ATTACHED TO FUEL INJECTOR		RECONNECT FUEL INJECTOR TO WIRING HARNESS PLUG P5 AND RECONNECT THE HARNESS PLUG P8 TO THE POWER BOARD RESTART HEATER
2	CHECK THE RESISTANCE OF FUEL INJECTOR.	5.5.5	IF RESISTANCE SHOWS GREATER THAN 100 OHMS OR LESS THAN 5 OHMS, THE FUEL INJECTOR HAS FAILED. REPLACE FUEL INJECTOR RESTART HEATER IF RESISTANCE IS APPROXIMATELY 15 OHMS, THEN GO TO STEP 3.
3	CHECK WIRING HARNESS FOR DAMAGE AND CONTINUITY		CHECK 2 WIRES FROM PLUG P5 TO POWER BOARD PLUG P8: P5-PIN1 TO P8-PIN4 P5-PIN2 TO P8-PIN3 CHECK FOR SHORT; P5-PIN1 TO CHASIS SHOULD BE OPEN LINE P5-PIN2 TO CHASIS SHOULD BE OPEN LINE IF ANY CHECK FAILS REPLACE WIRING HARNESS RESTART HEATER
4	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
5	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.21 E1 - LOW VOLTAGE (Design Iteration 1 & 2 Only)

	VOLTAGE SUPPLIED TO THE HEATER IS BELOW NORMAL VOLTAGE LIMITS (19VDC - 28VDC NORMAL RANGE)		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THE SOURCE VOLTAGE OR BATTERY LEVELS.		IF VOLTAGE IS LESS THAN 19VDC THEN OPERATE HEATER WITH VEHICLE RUNNING
2	WITH HEATER OFF, CHECK FOR FREE ROTATION OF THE VENT IMPELLER BY MANUALLY SPINNING BY HAND	5.2.6 5.2.4	IF IMPELLER DOES NOT SPIN FREELY, REPLACE VENT FAN MOTOR AND VENT FAN IMPELLER RESTART HEATER
3	CHECK ELECTRICAL INPUT CONNECTIONS FOR LOOSE WIRES	2.5 5.5.6	RECONNECT ALL ELECTRICAL CONNECTIONS TO WIRING HARNESS RESTART HEATER
4	DEFECTIVE ELECTRONIC VENT FAN DRIVER BOARD	5.2.5	REPLACE ELECTRONIC VENT FAN DRIVER BOARD RESTART HEATER
5	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

6.5.22 E1 - LOW VOLTAGE (Design Iteration 3 Only)

	VOLTAGE SUPPLIED TO THE HEATER IS BELOW NORMAL VOLTAGE LIMITS (19VDC - 28VDC NORMAL RANGE); LOW VOLTAGE OR LOW VOLTAGE IN VENT ONLY		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THE SOURCE VOLTAGE OR BATTERY LEVELS.		IF VOLTAGE IS LESS THAN 19VDC THEN OPERATE HEATER WITH VEHICLE RUNNING
2	CHECK POWER INLET SIDE OF THE START/OFF/RUN SWITCH TO HAVE GREATER THAN 19 VDC		IF VOLTAGE IS LESS THAN 19VDC THEN OPERATE HEATER WITH VEHICLE RUNNING
3	CHECK THAT THE PROPER GAUGE OF WIRE IS USED FOR THE LENGTH OF CIRCUIT.		REQUIREMENT IS 12 AWG FOR < 12 FT; FOR LONGER CIRCUITS THE RESISTANCE MUST BE LESS THAN OR EQUAL TO 12 AWG @ 12FT. INSTALL PROPER GAUGE OF SUPPLY WIRE RESTART HEATER
4	CHECK ELECTRICAL INPUT CONNECTIONS FOR LOOSE WIRES		RECONNECT ALL ELECTRICAL CONNECTIONS TO HEATER RESTART HEATER
5	CHECK VOLTAGE ON OUTLET SIDE OF FILTER BOARD WITH POWER SUPPIED TO HEATER		VOLTAGE BETWEEN GROUND (J2-PIN1) AND HOT WIRE (J2-PIN3) SHOULD EQUAL THE VOLTAGE SUPPLIED IF THE VOLTAGE IS LOW REPLACE THE FILTER BOARD RESTART HEATER
6	CHECK VOLTAGE AT THE POWER BOARD INLET		VOLTAGE BETWEEN GROUND (J7) AND HOT WIRE (J2) SHOULD EQUAL THE VOLTAGE SUPPLIED IF THE VOLTAGE IS LOW REPLACE THE POWER BOARD RESTART HEATER

	VOLTAGE SUPPLIED TO THE HEATER IS BELOW NORMAL VOLTAGE LIMITS (19VDC - 28VDC NORMAL RANGE); LOW VOLTAGE OR LOW VOLTAGE IN VENT ONLY		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
7	CHECK VOLTAGE AT THE POWER BOARD TO LOGIC BOARD INTERFACE		VOLTAGE BETWEEN GROUND (J9-PIN1) AND HOT WIRE (J2-PIN6) SHOULD EQUAL THE VOLTAGE SUPPLIED IF THE VOLTAGE IS LOW REPLACE THE POWER BOARD RESTART HEATER
8	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.23 E2 - LOW FUEL PRESSURE (Design Iteration 1 & 2 Only)

	FUEL SUPPLY PRESSURE TO THE HEATER IS BELOW 3PSI		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT VEHICLE OR SOURCE FUEL PUMP IS OPERATING	2.6	RECONNECT SOURCE FUEL PUMP RESTART HEATER
2	CHECK IF VEHICLE FUEL FILTER IS PLUGGED		REPLACE FUEL FILTER RESTART HEATER
3	CHECK FOR AIR BUBBLES IN THE FUEL LINE.		BLEED AIR FROM FUEL LINES.
4	CHECK TO SEE IF FUEL LINE LEADING TO HEATER IS PINCHED OR OBSTRUCTED		STRAIGHTEN FUEL LINES AND REMOVE OBSTRUCTIONS RESTART HEATER
5	CHECK THAT THERE IS AMPLE FUEL SUPPLY	TABLE 2-1	FILL FUEL TANK WITH FUEL RESTART HEATER
6	ENSURE THAT FUEL PRESSURE SENSOR IS CONNECTED TO WIRING HARNESS	5.5.1	RECONNECT FUEL PRESSURE SENSOR TO WIRING HARNESS RESTART HEATER
7	DEFECTIVE FUEL PRESSURE SENSOR	5.5.1	REPLACE FUEL PRESSURE SENSOR RESTART HEATER
8	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

6.5.24 E2 – LOW FUEL PRESSURE (Design Iteration 3 Only)

NOTE: THIS IS A WARNING ONLY, THE UNIT WILL NOT FAULT.
TO ELIMINATE THE WARNING, BOOST SUPPLY FUEL PRESSURE.

	FUEL SUPPLY PRESSURE TO THE HEATER IS BELOW 3.6 PSI		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT VEHICLE OR SOURCE FUEL PUMP IS OPERATING	2.6	RECONNECT SOURCE FUEL PUMP RESTART HEATER
2	CHECK IF VEHICLE FUEL FILTER IS PLUGGED		REPLACE FUEL FILTER RESTART HEATER
3	CHECK FOR AIR BUBBLES IN THE FUEL LINE.		BLEED AIR FROM FUEL LINES.
4	CHECK TO SEE IF FUEL LINE LEADING TO HEATER IS PINCHED OR OBSTRUCTED		STRAIGHTEN FUEL LINES AND REMOVE OBSTRUCTIONS RESTART HEATER
5	CHECK THAT THERE IS AMPLE FUEL SUPPLY	TABLE 2-1	FILL FUEL TANK WITH FUEL RESTART HEATER
6	ENSURE THAT FUEL PRESSURE SENSOR IS CONNECTED TO WIRING HARNESS		RECONNECT FUEL PRESSURE SENSOR TO WIRING HARNESS PLUG P4 AND RECONNECT WIRE HARNESS PLUG P1 INTO THE LOGIC BOARD RESTART HEATER
7	CHECK WIRING HARNESS FOR DAMAGE AND CONTINUITY		CHECK 3 WIRES FROM PLUG P4 TO PLUG P1: P4-PIN A TO P1-PIN17 P4-PIN B TO P1-PIN15 P4-PIN C TO P1-PIN16 CHECK FOR SHORT : P4-PIN A TO CHASSIS SHOULD BE OPEN LINE P4-PIN B TO CHASSIS SHOULD BE OPEN LINE P4-PIN C IS THE GROUND IF ANY CHECK FAILS REPLACE WIRING HARNESS RESTART HEATER
8	DEFECTIVE FUEL PRESSURE SENSOR	5.5.1	REPLACE FUEL PRESSURE SENSOR RESTART HEATER

6.5.25 E3 - LOW BURNER AIR FLOW (Design Iteration 1 & 2 Only)

	COMBUSTION AIR FLOW OPERATING LIMITS ARE OUT OF ALLOWABLE RANGE		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK FOR OBSTRUCTIONS IN COMBUSTION INLET OR EXHAUST DUCTING		REMOVE OBSTRUCTIONS RESTART HEATER
2	CHECK FOR KINKING/BLOCKAGE OF DUCTING TO HEATER		REPLACE DEFECTIVE DUCTING AND REMOVE ALL UNNECESSARY BENDS RESTART HEATER
3	IF AMBIENT TEMPERATURE IS BELOW 32°F (0°C), CHECK FOR FROST OBSTRUCTING HEATER DUCTING		REMOVE FROST FROM AIR INLET RESTART HEATER
4	CHECK FOR CARBON ACCUMULATION INSIDE BURNER CHECK CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3.7 5.4.1 5.3.2 5.3.5	CLEAN BURNER HOUSING CLEAN HEAT EXCHANGER RESTART HEATER IF EITHER ONE IS DISTORTED, REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
5	DEFECTIVE BURNER FAN PLATE	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER
6	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER
7	AIR IN FUEL LINES.		PURGE HEATER AND BLEED FUEL LINES.
8	DEFECTIVE BURNER FAN MOTOR	5.6.5	REPLACE BURNER FAN MOTOR RESTART HEATER
9	DEFECTIVE BURNER FAN DRIVER BOARD	5.6.3	REPLACE BURNER FAN DRIVER BOARD RESTART HEATER
10	DEFECTIVE BURNER FAN IMPELLER	5.6.4	REPLACE BURNER FAN IMPELLER RESTART HEATER

NOTE: OBSTRUCTIONS TO LOOK FOR IN COMBUSTION OR EXHAUST DUCTING INCLUDE: ICE, FROST, DUST, MUD, WATER, FOREIGN OBJECTS, SOOT, RODENTS, SMALL BIRDS, ETC.

6.5.26 E3- LOW BURNER AIRFLOW (Design Iteration 3 Only)

	HEATER DID NOT REACH MODE 04 WITHIN 3MINUTES 30 SECONDS; LOW BURNER AIRFLOW – ON IGNITION TIME OUT OR – LOW BURNER AIR FLOW IN STAGE 04 OR – DURING RUN MODE NOTE: IF ANY BURNER COMPONENTS ARE NEW, START-UP MAY REQUIRE 3 ATTEMPTS.

	CHECK/POSSIBLE CAUSE	REF.	REPAIR
1	CHECK FOR OBSTRUCTIONS IN COMBUSTION INLET OR EXHAUST DUCTING CHECK THAT EXHAUST IS SET-UP TO MIL-PRF 62250D		REMOVE OBSTRUCTIONS RESTART HEATER
2	CHECK FOR KINKING/BLOCKAGE OF INLET DUCTING TO HEATER		REPLACE DEFECTIVE INLET DUCTING AND REMOVE ALL UNNECESSARY BENDS RESTART HEATER
3	IF AMBIENT TEMPERATURE IS BELOW 32 °F (0 °C), CHECK FOR FROST OBSTRUCTING HEATER DUCTING		REMOVE FROST FROM AIR INLET RESTART HEATER
4	AIR IN FUEL LINES.		PURGE HEATER AND BLEED FUEL LINES.
5	CHECK FOR CARBON ACCUMULATION INSIDE BURNER CHECK CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3.7 5.4.1 5.3.2 5.3.5	CLEAN BURNER HOUSING CLEAN HEAT EXCHANGER RESTART HEATER IF EITHER ONE IS DISTORTED, REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
6	CHECK FOR WARPED BURNER FAN PLATE; GAP BETWEEN GASKET AND CASTING	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER
7	DEFECTIVE BURNER FAN MOTOR	5.6.5	REPLACE BURNER FAN MOTOR RESTART HEATER
8	DEFECTIVE BURNER FAN IMPELLER	5.6.4	REPLACE BURNER FAN IMPELLER RESTART HEATER
9	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER

NOTE: OBSTRUCTIONS TO LOOK FOR IN COMBUSTION OR EXHAUST DUCTING INCLUDE: ICE, FROST, DUST, MUD, WATER, FOREIGN OBJECTS, SOOT, RODENTS, SMALL BIRDS, ETC.

6.5.27 E4 - REVERSE BURNER AIR FLOW (Design Iteration 1 & 2 Only)

	BURNER FAN IS MEASURING REVERSE AIR THROUGH THE HEATER, OR IS OPERATING OUT OF RANGE		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT DUCTING OF THE COMBUSTION AIR SYSTEM TO THE INLET AND THE EXHAUST DUCTING ARE CORRECTLY ATTACHED TO THE HEATER	2.2	RECONNECT COMBUSTION AIR DUCTING CORRECTLY RESTART HEATER
2	CHECK THAT COMBUSTION AIR AND EXHAUST DUCTING IS FREE FROM OBSTRUCTIONS		REMOVE OBSTRUCTIONS RESTART HEATER
3	CHECK FOR CARBON ACCUMULATION OR OBSTRUCTIONS IN COMBUSTION ASSEMBLY CHECK CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3 5.3.2 5.3.5	REMOVE CARBON AND CLEAN COMBUSTION ASSEMBLY RESTART HEATER IF DISTORTED, REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
4	DEFECTIVE BURNER FAN	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER
5	DEFECTIVE HEAT EXCHANGER	5.4.1	REPLACE HEAT EXCHANGER RESTART HEATER
6	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.28 E4 – REVERSE BURNER AIRFLOW (Design Iteration 3 Only)

	BURNER FAN IS MEASURING REVERSE AIR THROUGH THE HEATER, OR IS OPERATING OUT OF RANGE; REVERSE BURNER AIRFLOW – DURING RUN MODE W/ TEMP DELTAS OR – DURING STARTUP OR – DUE TO BURNER RPM'S OR – DUE TO BURNER DUTY		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT DUCTING OF THE COMBUSTION AIR SYSTEM TO THE INLET AND THE EXHAUST DUCTING ARE CORRECTLY ATTACHED TO THE HEATER NEGATIVE PRESSURE ON STARTUP WILL GIVE THIS FAULT	2.2	RECONNECT COMBUSTION AIR DUCTING CORRECTLY RESTART HEATER
2	CHECK THAT COMBUSTION AIR AND EXHAUST DUCTING IS FREE FROM OBSTRUCTIONS		REMOVE OBSTRUCTIONS RESTART HEATER
3	CHECK FOR CARBON ACCUMULATION OR OBSTRUCTIONS IN COMBUSTION ASSEMBLY CHECK CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3 5.3.2 5.3.5	REMOVE CARBON AND CLEAN COMBUSTION ASSEMBLY RESTART HEATER IF DISTORTED, REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
4	CHECK FOR WARPED BURNER FAN PLATE	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER
5	DEFECTIVE BURNER FAN MOTOR		REPLACE BURNER FAN MOTOR RESTART HEATER
6	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER
7	DEFECTIVE HEAT EXCHANGER		REPLACE HEAT EXCHANGER RESTART HEATER

6.5.29 E5 - INLET OVER PRESSURE (Design Iteration 1 & 2 Only)

	AIR IS BEING FORCED THROUGH THE HEATER BY THE NBC SYSTEM AT STARTUP, OR BURNER FAN OPERATING LIMITS ARE OUT OF RANGE		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	ENSURE ALL DUCTING TO HEATER IS PROPERLY CONNECTED	2.3 2.7	RECONNECT DUCTING RESTART HEATER
2	CHECK THAT NBC SYSTEM IS OFF REF. APPROPRIATE VEHICLE TM	VEHICLE TM	TURN NBC SYSTEM OFF IF POSSIBLE RESTART HEATER RESTART NBC SYSTEM 5 MINUTES AFTER HEATER ENTERS RUN MODE (07 OR 14)

6.5.30 E5 - INLET OVER PRESSURE (Design Iteration 3 Only)

	AIR IS BEING FORCED THROUGH THE HEATER BY THE NBC SYSTEM AT STARTUP, OR BURNER FAN OPERATING LIMITS ARE OUT OF RANGE AIR PRESSURE IS GREATER ON THE INLET SIDE OF THE BURNER FAN THAN ON THE EXHAUST SIDE

	CHECK/POSSIBLE CAUSE	REF.	REPAIR
1	ENSURE ALL DUCTING TO HEATER IS PROPERLY CONNECTED	2.3 2.7	RECONNECT DUCTING RESTART HEATER
2	CHECK THAT NBC SYSTEM IS OFF REF. APPROPRIATE VEHICLE TM	VEHICLE TM	TURN NBC SYSTEM OFF IF POSSIBLE RESTART HEATER RESTART NBC SYSTEM 5 MINUTES AFTER HEATER ENTERS RUN MODE (07 OR 14)

NOTE: THIS IS A WARNING, THE AIR PRESSURE DIFFERENCE IS GREATER THAN 6 IWC; THE HEATER WILL ATTEMPT TO OPERATE, BUT HAS THE POTENTIAL TO FLAME OUT.

6.5.31 E6 - HIGH VOLTAGE (Design Iteration 1 & 2 Only)

	VOLTAGE SUPPLIED TO THE HEATER IS ABOVE NORMAL VOLTAGE LIMITS (19VDC - 30VDC NORMAL RANGE)

	CHECK/POSSIBLE CAUSE	REF.	REPAIR
1	CHECK THE SOURCE VOLTAGE OR BATTERY LEVELS.	VEHICLE TM	IF VOLTAGE IS GREATER THAN 30VDC THEN CHECK VEHICLE ALTERNATOR - SEE APPROPRIATE VEHICLE TM TURN HEATER OFF UNTIL VOLTAGE SYSTEM REPAIRED
2	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.32 E6 - HIGH VOLTAGE (Design Iteration 3 Only)

	VOLTAGE SUPPLIED TO THE HEATER IS ABOVE NORMAL VOLTAGE LIMITS (19VDC - 30VDC NORMAL RANGE)		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THE SOURCE VOLTAGE OR BATTERY LEVELS.	VEHICLE TM	IF VOLTAGE IS GREATER THAN 30VDC THEN CHECK VEHICLE ALTERNATOR - SEE APPROPRIATE VEHICLE TM TURN HEATER OFF UNTIL VOLTAGE SYSTEM REPAIRED
2	CHECK VOLTAGE AT THE POWER BOARD TO LOGIC BOARD INTERFACE		VOLTAGE BETWEEN GROUND (J9-PIN1) AND HOT WIRE (J2-PIN6) SHOULD EQUAL THE VOLTAGE SUPPLIED IF THE VOLTAGE IS HIGH REPLACE THE POWER BOARD RESTART HEATER
3	DEFECTIVE LOGIC BOARD	5.2.5	REPLACE LOGIC BOARD RESTART HEATER

NOTE: IF VOLTAGE IS 29.5 – 31 VDC HEATER WILL FLASH AN E6 WARNING AND CONTINUE TO OPERATE. AT VOLTAGES GREATER THAN 31 VDC MEASURED AT THE HEATER, THE HEATER WILL SHUT DOWN WITH AN E6 HARD FAULT.

6.5.33 F1 - IGNITION OVERTIME (Design Iteration 1 & 2 Only)

	THE HEATER WAS UNABLE TO ESTABLISH IGNITION IN THE 3 ½ MINUTE TIME LIMIT		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT WIRE IS INSTALLED ONTO IGNITOR AND THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL WIRE ON IGNITOR POST INSTALL IGNITOR HATCH RESTART HEATER
2	CHECK THAT IGNITOR HOLDER IS CLEAN	4.1.1	CLEAN IGNITOR HOLDER RESTART HEATER
3	CHECK THAT IGNITOR IS WET WITH FUEL		IF IGNITOR IS DRY THEN PROCEED TO STEPS 3-9 IF IGNITOR IS WET THEN PROCEED TO STEPS 10-16
4	CHECK THAT VEHICLE OR SOURCE FUEL PUMP IS OPERATING	VEHICLE TM	RECONNECT SOURCE FUEL PUMP RESTART HEATER
5	CHECK IF VEHICLE FUEL FILTER IS PLUGGED	VEHICLE TM	REPLACE VEHICLE FUEL FILTER RESTART HEATER
6	REMOVE TOP COVER AND CHECK FOR AIR BUBBLES IN FUEL LINE. CHECK IF FUEL LINE TO HEATER IS PINCHED/OBSTRUCTED		BLEED AIR FROM FUEL LINES, STRAIGHTEN FUEL LINES AND REMOVE OBSTRUCTIONS RESTART HEATER
7	CHECK FOR AMPLE FUEL SUPPLY	TABLE 2-1	FILL FUEL TANK WITH FUEL & RESTART
8	DEFECTIVE FUEL INJECTOR	5.5.5	REPLACE FUEL INJECTOR RESTART HEATER
9	CHECK FOR FUEL FLOW FROM THE SOURCE PUMP TO THE FUEL INJECTOR	VEHICLE TM	TURN VEHICLE FUEL PUMPS ON AND REMOVE OBSTRUCTIONS AND BENDS IN FUEL LINES RESTART HEATER
10	HEATER IS FLOODED (AFTER 3 "NO START" CONDITIONS)	3.5	IF HEATER IS FLOODED, PURGE 3 TIMES WITHOUT STARTING (SEE 3.5) WAIT FOR 30 MIN. ATTEMPT THREE MORE STARTS.
11	CHECK FOR CARBON BUILD-UP ON BURNER FUEL SHAFT	5.3.7	CLEAN FUEL SHAFT
12	CHECK FOR OBSTRUCTIONS OF BURNER SYSTEM	5.3	CLEAN COMBUSTION ASSEMBLY
13	CHECK CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
14	WICK IS DEGRADED	5.3.6	REPLACE BURNER CARTRIDGE
15	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER

6.5.34 F1 - IGNITION OVERTIME (Design Iteration 3 Only)

	THE HEATER WAS UNABLE TO ESTABLISH IGNITION IN THE 3 ½ MINUTE TIME LIMIT		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT WIRE IS INSTALLED ONTO IGNITOR AND THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL WIRE ON IGNITOR POST INSTALL IGNITOR HATCH RESTART HEATER
2	CHECK THAT IGNITOR HOLDER IS CLEAN	4.1.1	CLEAN IGNITOR HOLDER RESTART HEATER
3	CHECK THAT IGNITOR IS WET WITH FUEL		IF IGNITOR IS DRY THEN PROCEED TO STEPS 3-9 IF IGNITOR IS WET THEN PROCEED TO STEPS 10-16
4	CHECK THAT VEHICLE OR SOURCE FUEL PUMP IS OPERATING	VEHICLE TM	RECONNECT SOURCE FUEL PUMP RESTART HEATER
5	CHECK IF VEHICLE FUEL FILTER IS PLUGGED	VEHICLE TM	REPLACE VEHICLE FUEL FILTER RESTART HEATER
6	REMOVE TOP COVER AND CHECK FOR AIR BUBBLES IN FUEL LINE. CHECK IF FUEL LINE TO HEATER IS PINCHED/OBSTRUCTED		BLEED AIR FROM FUEL LINES, STRAIGHTEN FUEL LINES AND REMOVE OBSTRUCTIONS RESTART HEATER
7	CHECK FOR AMPLE FUEL SUPPLY	TABLE 2-1	FILL FUEL TANK WITH FUEL & ENSURE A MINIMUM OF 3PSIG FUEL PRESSURE IS SUPPLIED TO THE HEATER INLET RESTART HEATER
8	DEFECTIVE FUEL INJECTOR	5.5.5	REPLACE FUEL INJECTOR RESTART HEATER
9	CHECK FOR FUEL FLOW FROM THE SOURCE PUMP TO THE FUEL INJECTOR	VEHICLE TM	TURN VEHICLE FUEL PUMPS ON AND REMOVE OBSTRUCTIONS AND BENDS IN FUEL LINES RESTART HEATER
10	HEATER IS FLOODED (AFTER 3 "NO START" CONDITIONS)	3.5	IF HEATER IS FLOODED, PURGE 3 TIMES WITHOUT STARTING (SEE 3.5) WAIT FOR 30 MIN. ATTEMPT THREE MORE STARTS.
11	CHECK FOR FREE ROTATION AND CARBON BUILD-UP ON BURNER FUEL SHAFT	5.3.7	CLEAN FUEL SHAFT, CHECK FOR SECURE PUSHNUT AND FREE ROTATION OF THE SHAFT. IF PUSHNUT IS LOOSE OR SHAFT DRAGS REPLACE THE BURNER RESTART HEATER
12	CHECK FOR OBSTRUCTIONS OF BURNER SYSTEM	5.3	CLEAN COMBUSTION ASSEMBLY

	THE HEATER WAS UNABLE TO ESTABLISH IGNITION IN THE 3 ½ MINUTE TIME LIMIT		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
13	CHECK CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
14	WICK IS DEGRADED	5.3.6	REPLACE BURNER CARTRIDGE
15	CHECK FOR LOOSE CONNECTIONS BETWEEN THE VENT FAN BOARD AND THE LOGIC BOARD		RECONNECT THE P11 PLUG INTO THE VENT FAN BOARD AND THE P1 PLUG INTO THE LOGIC BOARD RESTART HEATER
16	CHECK WIRE HARNESS FOR CONTINUITY AND SHORTS		CHECK 2 WIRES FROM THE VENT FAN BOARD TO THE LOGIC BOARD FOR CONTINUITY AND SHORT TO GROUND: P11-PIN12 TO P1-PIN3 P11-PIN4 TO P1-PIN12 CHECK FOR MV SIGNAL BETWEEN P11-PIN13 AND P11-PIN5 FOR BT SENSOR P11-PIN14 AND P11-PI N 6 FOR XT SENSOR CHECK FOR OPEN LINE BETWEEN P11-PIN13 TO CHASIS GROUND AND P11-PIN14 TO CHASIS GROUND IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER

6.5.35 F2 - BURNER FLAMEOUT (Design Iteration 1 & 2 Only)

	DURING RUN OPERATIONS THE BURNER TEMPERATURE DROPS BELOW NORMAL OPERATING LIMITS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK IF VEHICLE FUEL FILTER IS PLUGGED	VEHICLE TM	REPLACE FUEL FILTER RESTART HEATER
2	CHECK FOR AIR BUBBLES IN THE FUEL LINE.		BLEED AIR FROM FUEL LINES.
3	CHECK TO SEE IF FUEL LINE LEADING TO HEATER IS PINCHED OR OBSTRUCTED		STRAIGHTEN FUEL LINES AND REMOVE OBSTRUCTIONS RESTART HEATER
4	CHECK THAT THERE IS AMPLE FUEL SUPPLY	TABLE 2-1	FILL FUEL TANK WITH FUEL RESTART HEATER
5	CHECK FOR OBSTRUCTIONS IN ALL HEATER DUCTING		REMOVE OBSTRUCTIONS RESTART HEATER
6	CHECK FOR CARBON BUILD-UP ON BURNER FUEL SHAFT	5.3.7	CLEAN FUEL SHAFT
7	CHECK FOR CARBON ACCUMULATION OR OBSTRUCTIONS IN BURNER	5.3	REMOVE CARBON AND CLEAN COMBUSTION ASSEMBLY
8	DEFECTIVE FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	REPLACE FLAME TUBE REPLACE BURNER CHAMBER
9	DEFECTIVE BURNER HOUSING	5.3.7	REPLACE BURNER HOUSING RESTART HEATER
10	DEFECTIVE FUEL INJECTOR	5.5.5	REPLACE FUEL INJECTOR RESTART HEATER
11	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER
12	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.36 F2 - BURNER FLAMEOUT (Design Iteration 3 Only)

	DURING RUN OPERATIONS THE BURNER TEMPERATURE DROPS BELOW NORMAL OPERATING LIMITS; - FLAME OUT DURNIG HIGH TO LOW OR - XT BELOW FLAMEOUT THRESHOLD OR - BT BELOW FLAMEOUT THRESHOLD OR - XT DROPPED MORE THAN 40C IN 8 SECONDS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK IF VEHICLE FUEL FILTER IS PLUGGED	VEHICLE TM	REPLACE FUEL FILTER RESTART HEATER
2	CHECK FOR AIR BUBBLES IN THE FUEL LINE.		BLEED AIR FROM FUEL LINES.
3	CHECK TO SEE IF FUEL LINE LEADING TO HEATER IS PINCHED OR OBSTRUCTED		STRAIGHTEN FUEL LINES AND REMOVE OBSTRUCTIONS RESTART HEATER
4	CHECK THAT THERE IS AMPLE FUEL SUPPLY	TABLE 2-1	FILL FUEL TANK WITH FUEL ENSURE A MINIMUM OF 3PSIG FUEL PRESSURE IS SUPPLIED TO THE HEATER INLET RESTART HEATER
5	CHECK FOR OBSTRUCTIONS IN ALL HEATER DUCTING		REMOVE OBSTRUCTIONS RESTART HEATER
6	DEFECTIVE FUEL INJECTOR	5.5.5	REPLACE FUEL INJECTOR RESTART HEATER
7	CHECK FOR CARBON BUILD-UP ON BURNER FUEL SHAFT	5.3.7	CLEAN FUEL SHAFT
8	CHECK FOR CARBON ACCUMULATION OR OBSTRUCTIONS IN BURNER	5.3	REMOVE CARBON AND CLEAN COMBUSTION ASSEMBLY
9	DEFECTIVE FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	REPLACE FLAME TUBE REPLACE BURNER CHAMBER
10	DEFECTIVE BURNER HOUSING	5.3.7	REPLACE BURNER HOUSING RESTART HEATER
11	CHECK FOR LOOSE CONNECTIONS BETWEEN THE VENT FAN BOARD AND THE LOGIC BOARD		RECONNECT THE P11 PLUG INTO THE VENT FAN BOARD AND THE P1 PLUG INTO THE LOGIC BOARD RESTART HEATER

	DURING RUN OPERATIONS THE BURNER TEMPERATURE DROPS BELOW NORMAL OPERATING LIMITS; - FLAME OUT DURNIG HIGH TO LOW OR - XT BELOW FLAMEOUT THRESHOLD OR - BT BELOW FLAMEOUT THRESHOLD OR - XT DROPPED MORE THAN 40C IN 8 SECONDS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
12	CHECK WIRE HARNESS FOR CONTINUITY AND SHORTS		CHECK 2 WIRES FROM THE VENT FAN BOARD TO THE LOGIC BOARD FOR CONTINUITY AND SHORT TO GROUND: P11-PIN12 TO P1-PIN3 P11-PIN4 TO P1-PIN12 CHECK FOR MV SIGNAL BETWEEN P11-PIN13 AND P11-PIN5 FOR BT SENSOR P11-PIN14 AND P11-PI N 6 FOR XT SENSOR CHECK FOR OPEN LINE BETWEEN P11-PIN13 TO CHASIS GROUND AND P11-PIN14 TO CHASIS GROUND IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER
13	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.37 F3 - HEAT LIMIT (Design Iteration 1 & 2 Only)

	VENT AIR OUTLET TEMPERATURE HAS EXCEEDED THE UPPER TEMPERATURE LIMITS OF 340°F (171°C) AND HEAT OUTPUT WILL BE REDUCED		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ALL DAMPERS IN VEHICLE ARE OPEN		OPEN ALL DAMPERS FULLY SWITCH HEATER TO LOW MODE
2	CHECK FOR OBSTRUCTIONS IN FRONT OF HEATER VENTILATION OUTLET		REMOVE OBSTRUCTIONS SWITCH HEATER TO LOW MODE
3	CHECK ALL DUCTING CONNECTIONS	VEHICLE TM 2.2 2.3 2.7	INSTALL DUCTING CORRECTLY SWITCH HEATER TO LOW MODE
4	DEFECTIVE HEAT EXCHANGER	5.4.1	REPLACE HEAT EXCHANGER RESTART HEATER

6.5.38 F3 - HEAT LIMIT (Design Iteration 3 Only)

	VENT AIR OUTLET TEMPERATURE HAS EXCEEDED THE TARGET TEMPERATURE AND HEAT OUTPUT WILL BE REDUCED.		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK THAT ALL DAMPERS IN VEHICLE ARE OPEN		OPEN ALL DAMPERS FULLY SWITCH HEATER TO LOW MODE
2	CHECK FOR OBSTRUCTIONS IN FRONT OF HEATER VENTILATION OUTLET		REMOVE OBSTRUCTIONS SWITCH HEATER TO LOW MODE
3	CHECK ALL DUCTING CONNECTIONS	VEHICLE TM 2.2 2.3 2.7	INSTALL DUCTING CORRECTLY SWITCH HEATER TO LOW MODE

NOTE: THIS IS A WARNING ONLY, IT PRECEDES A F4 FAULT.

6.5.39 F4 - VENT AIR OVERHEAT (Design Iteration 1 & 2 Only)

	THE VENT AIR OUTLET TEMPERATURE HAS EXCEEDED A SAFE OPERATING TEMPERATURE OF 345°F (174°C)		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK TO SEE IF FAULT OCCURS AT START UP		IF FAULT OCCURS AT START UP GO TO STEP 7
2	CHECK THAT ALL DAMPERS IN VEHICLE ARE OPEN		OPEN ALL DAMPERS FULLY SWITCH HEATER TO LOW MODE
3	CHECK FOR OBSTRUCTIONS IN FRONT OF HEATER VENTILATION OUTLET		REMOVE OBSTRUCTIONS SWITCH HEATER TO LOW MODE
4	CHECK ALL DUCTING CONNECTIONS	VEHICLE TM 2.2 2.3 2.7	INSTALL PROPER DUCTING CORRECTLY SWITCH HEATER TO LOW MODE
5	DEFECTIVE HEAT EXCHANGER	5.4.1	REPLACE HEAT EXCHANGER RESTART HEATER
6	HEATER DID NOT PROPERLY PURGE	2.5 3.5	CHECK ALL ELECTRICAL CONNECTIONS AND PURGE HEATER 3 TIMES. RESTART HEATER
7	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.40 F4 - VENT AIR OVERHEAT (Design Iteration 3 Only)

	THE VENT AIR OUTLET TEMPERATURE HAS EXCEEDED A SAFE OPERATING TEMPERATURE OF 345°F (174°C)		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK TO SEE IF FAULT OCCURS AT START UP		IF FAULT OCCURS AT START UP GO TO STEP 7
2	CHECK THAT ALL DAMPERS IN VEHICLE ARE OPEN		OPEN ALL DAMPERS FULLY SWITCH HEATER TO LOW MODE
3	CHECK FOR OBSTRUCTIONS IN FRONT OF HEATER VENTILATION OUTLET		REMOVE OBSTRUCTIONS SWITCH HEATER TO LOW MODE
4	CHECK ALL DUCTING CONNECTIONS	VEHICLE TM 2.2 2.3 2.7	INSTALL PROPER DUCTING CORRECTLY SWITCH HEATER TO LOW MODE
5	HEATER DID NOT PROPERLY PURGE	2.5 3.5	CHECK ALL ELECTRICAL CONNECTIONS AND PURGE HEATER 3 TIMES. RESTART HEATER
6	DEFECTIVE VENT SENSOR		REPLACE VENT SENSOR RING RESTART HEATER
7	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER
8	DEFECTIVE HEAT EXCHANGER	5.4.1	REPLACE HEAT EXCHANGER RESTART HEATER

6.5.41 F5 - OVER CURRENT (Design Iteration 1 & 2 Only)

	THE HEATER HAS DETECTED THAT THE CURRENT DRAWN FROM THE VEHICLE HAS EXCEEDED THE NORMAL OPERATING LIMIT OF 20 AMPS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	WITH HEATER OFF, CHECK FOR FREE ROTATION OF THE VENT IMPELLER BY SPINNING BY HAND	5.2.4 5.2.6	IF IMPELLER DOES NOT ROTATE FREELY, REPLACE VENT FAN IMPELLER AND MOTOR RESTART HEATER
2	DEFECTIVE POWER AND WIRING HARNESSES	5.5.6	REPLACE BOTH LOGIC AND WIRING HARNESSES RESTART HEATER
3	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.42 F5 - OVER CURRENT (Design Iteration 3 Only)

	THE HEATER HAS DETECTED THAT THE CURRENT DRAWN FROM THE VEHICLE HAS EXCEEDED THE NORMAL OPERATING LIMIT OF 20 AMPS		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	WITH HEATER OFF, CHECK FOR FREE ROTATION OF THE VENT IMPELLER BY SPINNING BY HAND NOTE: IF ON TEST STAND, BE SURE THAT POWER SUPPLY/ TEST APPARATUS IS NOT CURRENT LIMITING	5.2.4 5.2.6	IF IMPELLER DOES NOT ROTATE FREELY, REPLACE VENT FAN IMPELLER AND MOTOR RESTART HEATER
2	CHECK IGNITER RESISTANCE		MEASURE THE RESISTANCE OF THE IGNITER IF LESS TRHAN 1.6 TO 1.8 OHMS REPLACE IGNITER RESTART HEATER
3	DEFECTIVE WIRING HARNESSES		REPLACE WIRING HARNESSES RESTART HEATER
4	DEFECTIVE VENT FAN BOARD		REPLACE VENT FAN BOARD RESTART HEATER
5	DEFECTIVE POWER BOARD		REPLACE POWER BOARD RESTART HEATER
6	DEFECTIVE LOGIC BOARD		REPLACE LOGIC BOARD RESTART HEATER

6.5.43 F6 - INLET OVERHEAT (All Design Iterations)

	A WARNING FAULT CODE WILL FLASH WHEN AMBIENT TEMPERATURE EXCEEDS 104°F (40°C) AND THE HEATER WILL OPERATE ONLY ON LOW HEAT MODE. IF THE AMBIENT TEMPERATURE EXCEEDS A SAFE OPERATING TEMPERATURE OF 115°F (46°C) THEN THE HEATER WILL DISPLAY THIS FAULT AND SHUTDOWN.		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	IS HEATER PRODUCING HEAT AND OPERATING FAULT CODE FLASHING?		NONE. THIS IS NORMAL OPERATION. HEATER HAS SWITCHED TO LOW MODE TO ALLOW AMBIENT TEMPERATURE TO DROP BELOW 104°F (40°C). OPERATE HEATER IN LOW MODE
2	CHECK TO ENSURE THAT HEATER DUCTING IS PROPERLY INSTALLED	VEHICLE TM 2.2 2.3 2.7	INSTALL DUCTING CORRECTLY TO HEATER. ENSURE VENTILATION AIR BLOWS AWAY FROM HEATER TO ENSURE PROPER AIR MIXING.
3	IS HEATER IN PURGE MODE AND ERROR CODE DISPLAYED?	3.5	NONE. AMBIENT TEMPERATURE IS ABOVE 131°F (55°C) AND HAS TURNED ITSELF OFF. PURGE HEATER AT LEAST 3 TIMES. RESTART HEATER WHEN INSIDE VEHICLE AMBIENT TEMPERATURE HAS COOLED DOWN.
4	REVERSE AIR FLOW CONDITIONS	VEHICLE TM 2.2 2.3 2.7	INSTALL DUCTING CORRECTLY. RESTART HEATER

6.5.44 F7 - EXHAUST OVERHEAT(Design Iteration 1 & 2 Only)

	EXHAUST TEMPERATURE HAS EXCEEDED A SAFE OPERATING TEMPERATURE		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK TO ENSURE HEATER DUCTING IS PROPERLY INSTALLED	VEHICLE TM 2.2 2.3 2.7	INSTALL DUCTING CORRECTLY TO HEATER. ENSURE VENTILATION AIR BLOWS AWAY FROM HEATER TO ENSURE PROPER AIR MIXING.
2	CHECK FOR OBSTRUCTIONS IN AIR INLET OR EXHAUST DUCTING		REMOVE OBSTRUCTIONS RESTART HEATER
3	CHECK FOR BENDING OR CRIMPING OF EXHAUST DUCTING	2.3	REPLACE DEFECTIVE DUCTING AND REMOVE ALL UNNECESSARY BENDS RESTART HEATER
4	CHECK FOR CARBON ACCUMULATION INSIDE BURNER HOUSING	5.3.7 5.4.1	CLEAN BURNER HOUSING CLEAN HEAT EXCHANGER
5	CHECK FOR CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	IF DISTORTED, REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
6	DEFECTIVE BURNER FAN PLATE	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER
7	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.45 F7 - EXHAUST OVERHEAT (Design Iteration 3 Only)

	EXHAUST TEMPERATURE HAS EXCEEDED A SAFE OPERATING TEMPERATURE		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK TO ENSURE HEATER DUCTING IS PROPERLY INSTALLED	VEHICLE TM 2.2 2.3 2.7	INSTALL DUCTING CORRECTLY TO HEATER. ENSURE VENTILATION AIR BLOWS AWAY FROM HEATER TO ENSURE PROPER AIR MIXING.
2	CHECK FOR OBSTRUCTIONS IN AIR INLET OR EXHAUST DUCTING		REMOVE OBSTRUCTIONS RESTART HEATER
3	CHECK FOR BENDING OR CRIMPING OF EXHAUST DUCTING	2.3	REPLACE DEFECTIVE DUCTING AND REMOVE ALL UNNECESSARY BENDS RESTART HEATER
4	CHECK FOR CARBON ACCUMULATION INSIDE BURNER HOUSING	5.3.7 5.4.1	CLEAN BURNER HOUSING CLEAN HEAT EXCHANGER
5	CHECK FOR CONDITION OF FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	IF DISTORTED, REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
6	CHECK FOR WARPED BURNER FAN PLATE	5.5.4	REPLACE BURNER FAN PLATE RESTART HEATER

	EXHAUST TEMPERATURE HAS EXCEEDED A SAFE OPERATING TEMPERATURE		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
7	CHECK FOR LOOSE CONNECTIONS BETWEEN THE VENT FAN BOARD AND THE LOGIC BOARD		RECONNECT THE P11 PLUG INTO THE VENT FAN BOARD AND THE P1 PLUG INTO THE LOGIC BOARD RESTART HEATER
8	CHECK WIRE HARNESS FOR CONTINUITY AND SHORTS		CHECK 2 WIRES FROM THE VENT FAN BOARD TO THE LOGIC BOARD FOR CONTINUITY AND SHORT TO GROUND: P11-PIN12 TO P1-PIN3 P11-PIN4 TO P1-PIN12 CHECK FOR MV SIGNAL BETWEEN P11-PIN13 AND P11-PIN5 FOR BT SENSOR P11-PIN14 AND P11-PI N 6 FOR XT SENSOR CHECK FOR OPEN LINE BETWEEN P11-PIN13 TO CHASIS GROUND AND P11-PIN14 TO CHASIS GROUND IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER
9	DEFECTIVE VENT FAN BOARD		REPLACE VENT FAN BOARD RESTART HEATER
10	DEFECTIVE LOGIC BOARD FOR		REPLACE LOGIC BOARD RESTART HEATER

6.5.46 F8 - IGNITION FLAME OUT(Design Iteration 1 & 2 Only)

	DURING START UP, THE BURNER TEMPERATURE HAS DROPPED BELOW NORMAL OPERATING LIMITS AND THE HEATER IS UNABLE TO RE-ESTABLISH IGNITION		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	CHECK FOR CARBON BUILD-UP IN IGNITOR HOLDER	4.4.1	CLEAN CARBON FROM IGNITOR HOLDER RESTART HEATER
2	CHECK THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL IGNITOR HATCH RESTART HEATER
3	CHECK THAT WIRE IS CONNECTED TO IGNITOR	4.1.1	CHECK SPRING WASHER ON IGNITOR POST. PLACE WIRE ON POST REPLACE HATCH COVER RESTART HEATER
4	DEFECTIVE IGNITOR	4.1.1	REPLACE IGNITOR RESTART HEATER
5	CHECK FUEL SYSTEM AND FUEL SUPPLY	2.6 TABLE 2-1	RECONNECT FUEL SYSTEM, REMOVE ALL UNNECESSARY BENDS AND FILL FUEL TANK WITH FUEL RESTART HEATER
6	CHECK FOR OBSTRUCTIONS IN ALL DUCTING TO THE HEATER		REMOVE OBSTRUCTIONS RESTART HEATER
7	CHECK FOR CARBON BUILD-UP ON BURNER FUEL SHAFT	5.3.7	CLEAN BURNER FUEL SHAFT
8	CHECK FOR CARBON ACCUMULATION OR OBSTRUCTIONS IN BURNER CARTRIDGE	5.3.7	REMOVE CARBON AND CLEAN BURNER CARTRIDGE
9	DEFECTIVE FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
10	DEFECTIVE BURNER CARTRIDGE	5.3.7	REPLACE BURNER CARTRIDGE RESTART HEATER
11	DEFECTIVE FUEL INJECTOR	5.5.5 5.6.2	REPLACE FUEL INJECTOR RESTART HEATER
12	DEFECTIVE WIRING HARNESS	5.5.6	REPLACE WIRING HARNESS RESTART HEATER
13	DEFECTIVE ELECTRONIC PROGRAMMED CONTROLLER BOARD	5.2.5	REPLACE ELECTRONIC PROGRAMMED CONTROLLER RESTART HEATER

6.5.47 F8 - IGNITION FLAME OUT (Design Iteration 3 Only)

	DURING START UP, THE BURNER TEMPERATURE HAS DROPPED BELOW NORMAL OPERATING LIMITS AND THE HEATER IS UNABLE TO RE-ESTABLISH IGNITION; -IGNITION TIMEOUT IN STAGE 04

	CHECK/POSSIBLE CAUSE	REF.	REPAIR
1	CHECK FOR CARBON BUILD-UP IN IGNITOR HOLDER	4.4.1	CLEAN CARBON FROM IGNITOR HOLDER RESTART HEATER
2	CHECK THAT IGNITOR HATCH IS INSTALLED CORRECTLY	4.1.1	INSTALL IGNITOR HATCH RESTART HEATER
3	CHECK THAT WIRE IS CONNECTED TO IGNITOR	4.1.1	CHECK SPRING WASHER ON IGNITOR POST. PLACE WIRE ON POST REPLACE HATCH COVER RESTART HEATER
4	DEFECTIVE IGNITOR	4.1.1	REPLACE IGNITOR RESTART HEATER
5	CHECK FUEL SYSTEM AND FUEL SUPPLY EXTERNAL TO HEATER	2.6 TABLE 2-1	RECONNECT FUEL SYSTEM, REMOVE ALL UNNECESSARY BENDS AND FILL FUEL TANK WITH FUEL RESTART HEATER
6	CHECK FOR OBSTRUCTIONS IN ALL DUCTING(INLET AND EXHAUST) TO THE HEATER		REMOVE OBSTRUCTIONS RESTART HEATER
7	DEFECTIVE FUEL INJECTOR	5.5.5 5.6.2	REPLACE FUEL INJECTOR RESTART HEATER
8	CHECK FOR CARBON BUILD-UP ON BURNER FUEL SHAFT	5.3.7	CLEAN BURNER FUEL SHAFT
9	CHECK FOR CARBON ACCUMULATION OR OBSTRUCTIONS IN BURNER CARTRIDGE	5.3.7	REMOVE CARBON AND CLEAN BURNER CARTRIDGE
10	DEFECTIVE FLAME TUBE AND BURNER CHAMBER	5.3.2 5.3.5	REPLACE FLAME TUBE AND BURNER CHAMBER RESTART HEATER
11	DEFECTIVE BURNER CARTRIDGE	5.3.7	REPLACE BURNER CARTRIDGE RESTART HEATER
12	CHECK FOR LOOSE CONNECTIONS BETWEEN THE VENT FAN BOARD AND THE LOGIC BOARD		RECONNECT THE P11 PLUG INTO THE VENT FAN BOARD AND THE P1 PLUG INTO THE LOGIC BOARD RESTART HEATER

	DURING START UP, THE BURNER TEMPERATURE HAS DROPPED BELOW NORMAL OPERATING LIMITS AND THE HEATER IS UNABLE TO RE-ESTABLISH IGNITION; -IGNITION TIMEOUT IN STAGE 04		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
13	CHECK WIRE HARNESS FOR CONTINUITY AND SHORTS		CHECK 2 WIRES FROM THE VENT FAN BOARD TO THE LOGIC BOARD FOR CONTINUITY AND SHORT TO GROUND: P11-PIN12 TO P1-PIN3 P11-PIN4 TO P1-PIN12 CHECK FOR MV SIGNAL BETWEEN P11-PIN13 AND P11-PIN5 FOR BT SENSOR P11-PIN14 AND P11-PI N 6 FOR XT SENSOR CHECK FOR OPEN LINE BETWEEN P11-PIN13 TO CHASIS GROUND AND P11-PIN14 TO CHASIS GROUND IF ANY CHECK FAILS REPLACE WIRE HARNESS RESTART HEATER
14	DEFECTIVE VENT FAN BOARD		REPLACE VENT FAN BOARD RESTART HEATER
15	DEFECTIVE LOGIC BOARD FOR		REPLACE LOGIC BOARD RESTART HEATER

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APPENDIX A

List of References

A-1. PUBLICATION INDEX.

Index should be consulted frequently for latest changes, revisions, or references given in this appendix and for new publications relating to material covered in this publication.

Consolidated Index of Army Publications and Blank Forms DA PAM 310-1

A-2 FORMS.

Refer to DA PAM 738-750, The Army Maintenance Management System (TAMMS), for instructions on the use of maintenance forms pertaining to the material.

A-3. OTHER PUBLICATIONS.

The following publications contain information pertinent to the major item material and associated equipment.

TM 9-2350-217-	Howitzer, Medium, Self-propelled, 155
TM 9-2350-232-	Reconnaissance Airborne Assault Vehicle 152mm Gun/Launcher, M60
TM 9-2350-230-	Tank, Combat full Tracked, 120mm.
TM 9-2350-252-	Bradley Infantry Fighting Vehicle
TM 9-2350-253-	Tank Combat Full tracked, 105mm M60A3
TM 9-2350-255-	Tank, Combat, Full Tracked, 105mm
TM 9-2350-257	Tank Combat, full Tracked, M105mm.
TM 9-2350-259-	Combat Vehicle Anti-tank, ImprovedTow Vehicle
TM 9-2350-261-	Carrier, Armored Personnel

REFERENCES - Continued

TM 9-2350-264-	Tank, Combat Full Tracked, 120mm
TM 9-2350-266-	Carrier, Fire Support Vehicle
TM 9-2350-267-	Carrier, Ammunition, Full Tracked
TM 9-2350-277-	Carrier, Armored Vehicles
TM 9-2350-284-	Bradley Infantry Fighting Vehicle
TM 9-2350-288-	Tank, Combat Full Tracked 120mm
TM 9-2350-292-	Recovery Vehicle
TM 9-2350-294-	Infantry fighting Vehicle, Cavalry
TM 9-2350-297-	Bradley fire Support Vehicle
TM 9-2350-311-	Howitzer, Medium, Self-propelled
TM 9-2350-314-	Howitzer, Medium, Self-propelled
TM 9-4910-558-35	Calibration Procedures
TM 9-4910-755-13&P	Heater Test Stand
TM 5-5420-202	Launcher, M60A1, Tank Chassis, Transporting for Bridge, Armored, Vehicle

APPENDIX B

Maintenance Allocation Chart

Section I. INTRODUCTION

B-1. GENERAL

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special and common tool sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. MAINTENANCE FUNCTIONS

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or touch).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), preserve, drain, paint, or replenish fuel.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position or by setting the operating characteristics to specified parameters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified

standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of replacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of a piece of equipment or system.

h. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. Replace is authorized by the MAC and shown as the 3rd position code of the SMR code.

I. Repair. The application of maintenance services[1], Including fault location/troubleshooting[2], remove/installation, and disassembly/assembly procedures[3], and maintenance actions[4] to identify trouble and restore serviceability to an end item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service or action) prescribed to restore an item to completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

l. Services. Inspect, test, service, adjust, aline, calibrate, and/or replace.

m. Fault locate/troubleshooting. The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).

n. Disassemble/assemble. Encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least componency identified as maintenance significant (i.e., assigned an SMR code) for category of maintenance under consideration.

o. Actions. Welding, grinding, riveting, straightening, facing, re-machining, and/or resurfacing.

B-3. EXPLANATION OF COLUMNS IN THE MAC (see SECTION II)

Column 1, Group Number. Column 1 lists functions group code numbers, the purpose of which is to identify maintenance of significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00".

Column 2. Components/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized and its "useable on" code. Uncoded items are applicable to all models. Identification of the "useable on" codes used in this publication are:

None at this time.

Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (See paragraph B-2 for a detailed explanation of these functions.)

Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate sub-column (s), the category of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. Appropriate work time figures will be shown for each category. The working figure represents the average time required to restore an item (assembly, subassembly, components, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the MAC. The symbol designations for the various maintenance categories are as follows:

C - Operator or Crew
O - Organization
F - Direct Support
H - General Support
D - Deport

Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetical order, that shall be keyed to the remarks contained in Section IV.

B-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.

Column 1, Reference code. The tools and test equipment reference code correlates with a code used in the MAC, Section II, column 5.

Column 2, Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

Column 3, Nomenclature. Name or identification of the tool or test equipment.

Column 4, National Stock Number. The national stock number of the tool or test equipment.

Column 5, Tool Number. The manufacturer's part number.

B-5 EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.

Column 1, Reference Code. The code recorded in column 6, Section II.

Column 2, Remarks. This lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1)	(2)	(3)	(4) MAINTENANCE LEVEL					(5)	(6)
			FIELD			SUSTAINMENT		TOOLS	
GROUP	COMPONENTS/ASSEMBLY	MAINTENANCE	UNIT		DS	GS	DEPOT	AND	
NUMBER		FUNCTION	C	O	F	H	D	EQUIP	REMARKS
22	Body, Chasis, and Hull Accessory Items								
2202	Burner, Housing Assy.	Inspect			0.2	0.2	0.2		
		Service			0.3	0.3	0.3		
		Remove/ Replace			1.0	1.0	1.0		
	Cartridge, Burner	Inspect			0.2	0.2	0.2		
		Replace			1.0	1.0	1.0		
	Controller, (PCB)	Remove/ Replace			0.8	0.8	0.8		
	Cover, Top	Inspect		0.1	0.1	0.1	0.1		
		Remove/ Replace		0.2	0.2	0.2	0.2		
	Display, Diagnostic	Remove/ Replace			0.2	0.2	0.2		
	Driver, Magnet	Remove/ Replace			0.4	0.4	0.4		
	Duct, Air Combustion	Inspect			0.1	0.1	0.1		
		Remove/ Replace			0.2	0.2	0.2		

Section II. MAINTENANCE ALLOCATION CHART - Continued

(1)	(2)	(3)	(4)					(5)	(6)
			MAINTENANCE LEVEL						
			FIELD			SUSTAINMENT		TOOLS	
GROUP	COMPONENTS/ASSEMBLY	MAINTENANCE	UNIT		DS	GS	DEPOT	AND	
NUMBER		FUNCTION	C	O	F	H	D	EQUIP	REMARKS
22	Body, Chasis, and Hull Accessory Items								
2202									
	Exchanger, Heat	Inspect			0.2	0.2	0.2		
		Remove/ Replace			1.5	1.5	1.5		
	Fuel System, i.e. Injector and pump, Fuel	Remove/ Replace			0.3	0.3	0.3		
	Harness, Wiring	Inspect			0.3	0.3	0.3		
		Remove/ Replace			0.5	0.5	0.5		
	Ignitor	Inspect		0.1	0.1	0.1	0.1		
		Remove/ Replace		0.2	0.1	0.1	0.1		
	Holder, Ignitor	Remove/ Replace		0.2	0.2	0.2	0.2		
	Impeller, Fan	Remove/ Replace			0.3	0.3	0.3		
	Motor, Vent Fan	Inspect			0.2	0.2	0.2		
		Adjust			0.3	0.3	0.3		
		Remove/ Replace			0.8	0.8	0.8		
	Sensor, Fuel Pressure	Remove/ Replace			0.3	0.3	0.3		

Section II. MAINTENANCE ALLOCATION CHART - Continued

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Field			Sustainment			
Group	Components/Assembly	Maintenance	Unit		DS	GS	Depot	Tools and	
Number		Function	C	O	F	H	D	Equip	Remarks
22	Body, Chasis, and Hull Accessory Items								
2202									
	Shell, Bottom	Inspect			0.1	0.1	0.1		
		Remove/ Replace			0.4	0.4	0.4		
	Shell, Top	Inspect			0.1	0.1	0.1		
		Remove/ Replace			0.4	0.4	0.4		
	Shroud, Vent Fan	Remove/ Replace			0.5	0.5	0.5		
	Thermal Pickup	Remove/ Replace			0.5	0.5	0.5		
	Wiring Harness	Inspect			0.4	0.4	0.4		
		Remove/ Replace			1.5	1.5	1.5		
	Vent Sensor/ Motor Magnet	Remove/ Replace			0.4	0.4	0.4		

Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) TOOL NUMBER
		COMMON TOOLS	5180-00-177-7033	
1	O,F	Tool Kit, Mechanic Gen		
2	O,F	Shop Equipment, Common Set No. 1	4910-00-754-0654	
3	O,F	Shop Equipment, Supplement Set No. 1	4910-00-754-0653	
		SPECIAL TOOLS:		
		NONE		

APPENDIX C

Expendable Supplies and Materials List

Section I. INTRODUCTION

SCOPE

This appendix lists expendable supplies and materials you will need to operator and maintain the personnel heater. These items are authorized to you by CTA 50-970, Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

EXPLANATION OF COLUMNS

Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., Use cleaning compound, item 5, Appendix. D.).

Column(2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support

Column (3) - National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Maintenance (CAGE) in parentheses followed by the number.

Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea., in., pr.). If the unit of measurement differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirement.

SECTION II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION (CAGE)	(5) U/M
1	O	7920-00-514-2417	Brush, Acid Swabbing HB-643, (81348) Bx 144	ea
2	O	7920-00-205-171	Rags, Wiping A-A-531 (58536) 50 lb.	lb
3	F		Silicone, RTV 26B,	tu
4	F		Loctite 243, 24240	tu
5	F		Loctite PST 592, 59234	btl
6	F		Loctite 609, 60921	btl
7	F		Loctite 401, 40140	btl
8	F		Loctite 770, 18396	btl
9	F		Loctite Anti-seize, nickel 77164,	tu
10	F	9150-01-197-7688 9150-01-197-7689	Grease (GAA)	tu cn
11	O	9320-01-053-8266	Tape, Teflon	ro
12	F	5975-01-067-3359	Tie Wraps	ea
13	F		Dow Corning 55 O-Ring lub., 1864947	tu

APPENDIX D

OPERATOR, FIELD, AND SUSTAINMENT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LISTS

NOTE! FOR DESIGN ITERATION 1 & 2 ONLY. FOR DESIGN ITERATION 3, REFER TO APPENDIX E

SCOPE

This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement and diagnostic equipment (TMDE); and other special support equipment required for performance of Operator, Field, and Sustainment maintenance of the Personnel Heater, Model A20. It authorizes the requisitioning, issue, and disposition of spares, repair parts, and special tools as indicated by the source, maintenance, and recoverability (SMR) codes.

GENERAL

In addition to the Introduction work package, this RPSTL is divided into the following work packages:

1. **Repair Parts List Work Packages**. Work packages containing lists of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. These work packages also include parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Sending units, brackets, filters, and bolts are listed with the component they mount on. Bulk materials are listed by item name in FIG. BULK at the end of the work packages. Repair parts kits are listed separately in their own functional group and work package. Repair parts for reparable special tools are also listed in a separate work package. Items listed are shown on the associated illustrations.

2. **Special Tools List Work Packages**. Work packages containing lists of special tools, special TMDE, and other special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in DESCRIPTION AND USABLE ON CODE (UOC) column). Tools that are components of common tool sets and/or Class VII are not listed.

3. **Cross-Reference Indexes Work Packages**. There are two cross-reference index work packages in this RPSTL: The National Stock Number Index and the Part Number Index. The National Stock Number Index refers you to the figure and item number. The Part Number Index refers you to the figure and item number

EXPLANATION OF COLUMNS IN THE REPAIR PARTS LIST AND SPECIAL TOOLS LIST WORK PACKAGES

1. Item No. (Column 1). Indicates the number used to identify items called out in the illustration.

2. SMR Code (Column 2). The SMR code containing supply/requisitioning information, maintenance level authorization criteria, and disposition instruction, as shown in the following:

Source Code	**Maintenance Code**		**Recoverability Code**
XX	XX		X
1st two positions: How to get an item.	3rd position: Who can install, replace, or use the item	4th position: Who can do complete repair[1] on the item.	5th position: Who determines disposition action on unserviceable items.

1. Complete repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

Source Code	**Application/Explanation**
PA PB PC PD PE PF PG	Stock items; use the applicable NSN to request/requisition items with these source codes. They are authorized to the level indicated by the code entered in the 3rd position of the SMR code. **NOTE** Items coded PC are subject to deterioration.
KD KF KB	Items with these codes are not to be requested/requisitioned individually. They are part of a kit which is authorized to the maintenance level indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.
MO-Made at unit/AVUM level MF-Made at DS/AVIM level MH-Made at GS level ML-Made at SRA MD-Made at depot	Items with these codes are not to be requested/requisitioned individually. They must be made from bulk material which is identified by the P/N in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the bulk material group work package of the RPSTL. If the item is authorized to you by the 3d position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance.

Source Code	Application/Exploration
AO-Assembled by unit/ AVUM level AF-Assembled by DS/ AVIM level AH-Assembled by GS level AL-Assembled by SRA AD-Assembled by depot	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3d position of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.
XA	Do not requisition an "XA" coded item. Order the next higher assembly. (Refer to NOTE below.)
XB	If an item is not available from salvage, order it using the CAGEC and P/N.
XC	Installation drawings, diagrams, instruction sheets, field service drawings; identified by manufacturer's P/N
XD	Item is not stocked. Order an XD-coded item through normal supply channels using the CAGEC and P/N given, if no NSN is available.

NOTE

Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those items source coded "XA" or those aircraft support items restricted by requirements of AR 750-1.

Source Code. The source code tells you how to obtain an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follow:

Maintenance Code. Maintenance codes tell you the level(s) of maintenance authorized to use and repair support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

Third Position. The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to the following levels of maintenance:

Maintenance Code	Application/Explanation
C	Crew or operator maintenance done within unit/AVUM maintenance.
O	Unit level/AVUM maintenance can remove, replace, and use the item.
F	Direct support/AVIM maintenance can remove, replace, and use the item.
H	General support maintenance can remove, replace, and use the item.
L	Specialized repair activity can remove, replace, and use the item.
D	Depot can remove, replace, and use the item.

Fourth Position. The maintenance code entered in the fourth position tells you whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (perform all authorized repair functions).

NOTE: Some limited repair may be done on the item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes.

Maintenance Code	Application/Explanation
O	Unit /AVUM is the lowest level that can do complete repair of the item.
F	Direct support/AVIM is the lowest level that can do complete repair of the item.
H	General support is the lowest level that can do complete repair of the item.
L	Specialized repair activity is the lowest level that can do complete repair of the item.
D	Depot is the lowest level that can do complete repair of the item.
Z	Non-reparable. No repair is authorized.
B	No repair is authorized. No parts or special tools are authorized for maintenance of "B" coded item. However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR code as follows:

Recoverability Code	Application/Explanation
Z	Non-reparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in the third position of the SMR code.
O	Reparable item. When uneconomically reparable, condemn and dispose of the item at the unit level.
F	Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support level.
H	Reparable item. When uneconomically reparable, condemn and dispose of the item at the general support level.
D	Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item are not authorized below depot level.
L	Reparable item. Condemnation and disposal not authorized below Specialized Repair Activity (SRA).

Recoverability Code	Application/Explanation
A	Item requires special handling or condemnation procedures because of specific reasons (such as precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

3. NSN (Column 3). The NSN for the item is listed in this column.

4. CAGEC (Column 4). The Commercial and Government Entity Code (CAGEC) is a five-digit code which is used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

5. PART NUMBER (Column 5). Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

NOTE

When you use a NSN to requisition an item, the item you receive may have a different P/N from the number listed.

6. Description of “Usable On Code” (UOC) (Column 6). This column includes the following information:

   - The federal item name, and when required, a minimum description to identify the item.

   - P/Ns of bulk materials are referenced in this column in the line entry to be manufactured or fabricated.

   - Hardness Critical Item (HCI). A support item that provides the equipment with special protection from electromagnetic pulse (EMP) damage during a nuclear attack.

   - The statement END OF FIGURE appears just below the last item description in column (6) for a given figure in both the repair parts list and special tools list work packages.

7. QTY (Column 7). The QTY (quantity per figure) column indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, sub-functional group, or an assembly. A "V" appearing in this column instead of a quantity indicates that the quantity is variable and the quantity may change from application to application.

EXPLANATION OF CROSS-REFERENCE INDEXES WORK PACKAGES FORMAT & COLUMNS

1. National Stock Number (NSN) Index Work Package.

STOCK NUMBER Column. This column lists the NSN in National item identification number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN.

NSN (e.g., 2540-01-396-2826) NIIN	When using this column to locate an item, ignore the first four digits of the NSN. However, the complete NSN should be used when ordering items by stock number.

FIG. Column. This column lists the number of the figure where the item is identified/located. The figures are in numerical order in the repair parts list & special tools list work packages.

ITEM Column. The item number identifies the item associated with the figure listed in the adjacent FIG. column. This item is also identified by the NSN listed on the same line.

2. Part Number (P/N) Index Work Package. P/Ns in this index are listed in ascending alphanumeric sequence (vertical arrangement of letter and number combinations which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9 and each following letter or digit in like order).

PART NUMBER Column. Indicates the P/N assigned to the item.

FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list and special tools list work packages.

ITEM Column. The item number is the number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

3. Reference Designator Index Work Package. Reference designators in this index are listed in ascending alphanumeric sequence (vertical arrangement of letter and number combination which places the first letter or digit of each group in order “A” through “Z”, followed by the numbers “0” through “9” and each following letter or digit in like order).

REFERENCE DESIGNATOR Column. Indicates the reference designator assigned to the item.

FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list or special tools list work package.

ITEM Column. The item number is the number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

SPECIAL INFORMATION

UOC. The UOC appears in the lower left corner of the Description Column heading. Usable on

codes are shown as "UOC:…" in the Description Column (justified left) on the first line under the applicable item/nomenclature. Un-coded items are applicable to all models. Identification of the UOCs used in the RPSTL are:

Code	Used On
TBA	TBA

Fabrication Instructions. Bulk materials required to manufacture items are listed in the bulk material functional group of this RPSTL. Part numbers for bulk material are also referenced in the Description Column of the line item entry for the item to be manufactured/fabricated. Detailed fabrication instructions for items source coded to be manufactured or fabricated are found in TM N/A.

Index Numbers. Items which have the word BULK in the figure column will have an index number shown in the item number column. This index number is a cross-reference between the NSN / P/N index work packages and the bulk material list in the repair parts list work package.

Associated Publications. The publication(s) listed below pertains to the N/A.

Publication	Short Title
N/A	N/A

Illustrations List. The illustrations in this RPSTL contain unit authorized items. Illustrations published in TM 9-2540-207-13&P that contain unit authorized items also appear in this RPSTL. The tabular list in the repair parts list work package contains only those parts coded “O” in the third position of the SMR code, therefore, there may be a break in the item number sequence.

HOW TO LOCATE REPAIR PARTS

1. When NSNs or P/Ns Are Not Known.

- Using the table of contents, determine the assembly group to which the item belongs. This is necessary since figures are prepared for assembly groups and subassembly groups, and lists are divided into the same groups.
- Find the figure covering the functional group or the sub-functional group to which the item belongs.
- Identify the item on the figure and note the number(s).
- Look in the repair parts list work packages for the figure and item numbers. The NSNs and part numbers are on the same line as the associated item numbers.

2. When NSN Is Known.

- If you have the NSN, look in the STOCK NUMBER column of the NSN index work package. The NSN is arranged in NIIN sequence. Note the figure and item number next to the NSN.

- Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

3. When P/N Is Known.

- If you have the P/N and not the NSN, look in the PART NUMBER column of the P/N index work package. Identify the figure and item number.

- Look up the item on the figure in the applicable repair parts list work package.

4. When Reference Designator Is Known.

- If you know the reference designator, look in the REFERENCE DESIGNATOR column of the reference designator index work package. Note the figure and item number.

- Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

ABBREVIATIONS

Abbreviation	Explanation
N/A	

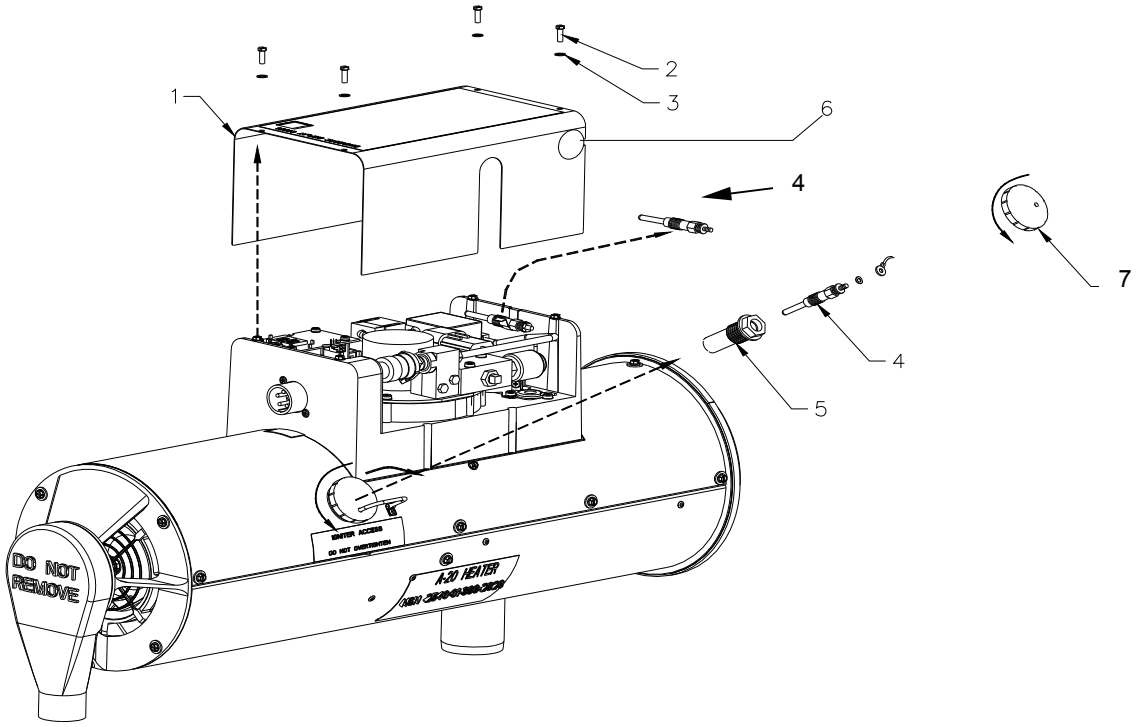


Figure D- 1. Ignitor and Cover Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-1, IGNITOR AND COVER ASSEMBLY	
1	PAOZZA	2540014978997	92878	5000-30018	COVER, TOP ASSEMBLY	1
2	PAOZZA	5305002118193	96906	2508-30113	SCREW, #8-32 X .5, HEX HEAD SLOT	4
3	PAOZZA	5310005590070	96906	2808-10318	WASHER, LOCK INTERNAL, #8	4
4	PAOZZA	4520014983001	92878	5000-30014	IGNITOR, SPARK, FUEL	2
5	PAOZZA	4520014983868	92878	5000-30013	HOLDER, IGNITOR	1
6				2900-30372	REMOTE DISPLAY ACCESS CAP	1
7	PAOZZA	4520015017034	92878	500030143	IGNITOR HATCH ASSEMBLY	1
					END OF FIGURE	

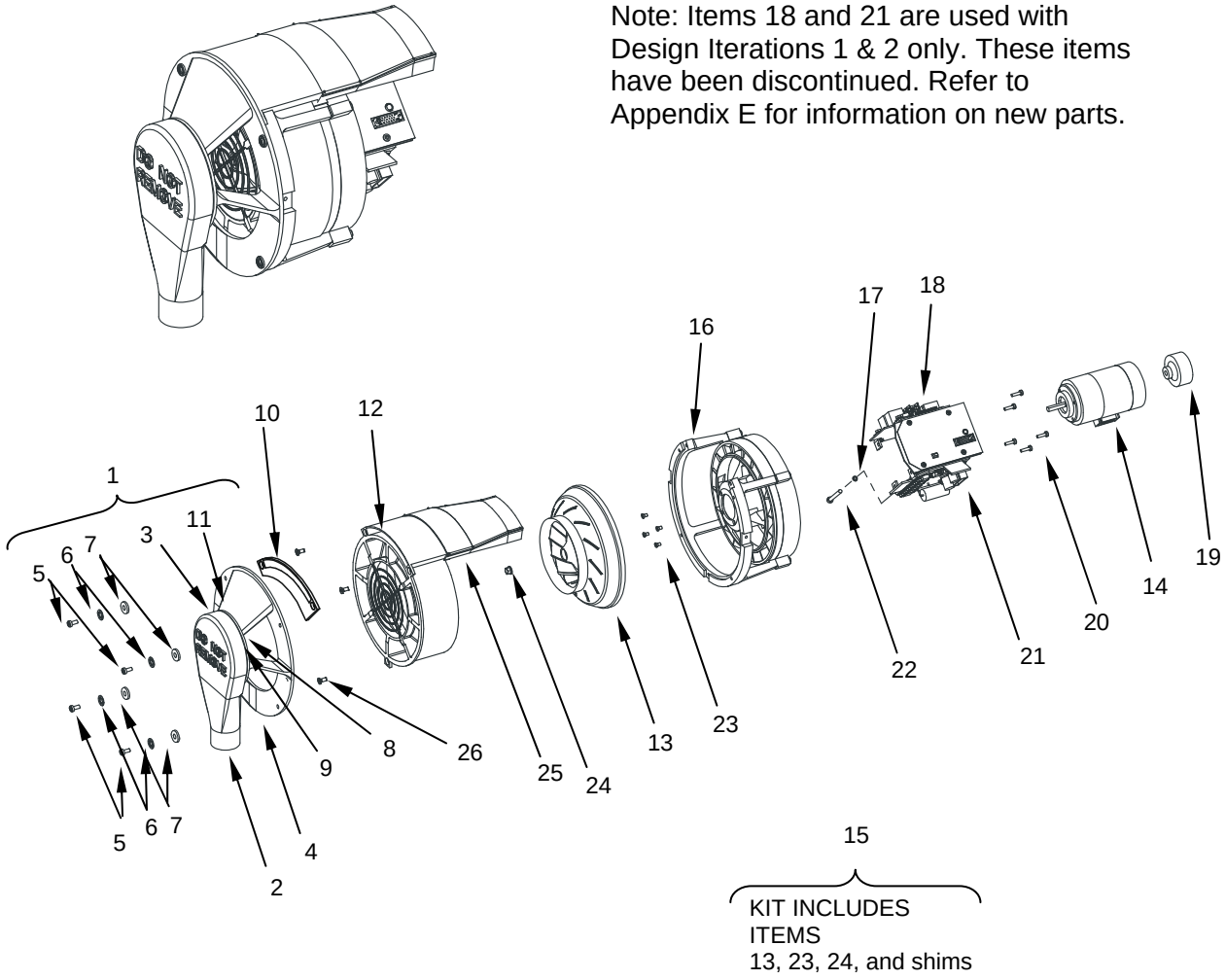


Figure D- 2. Vent Housing Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-2, VENT HOUSING ASSEMBLY	
1	PA0ZZA	1270014995304	92878	5000-30026	ADAPTER, DUAL AIR	1
2					AIR ADAPTER	1
3					DUAL AIR O-RINGS	1
4					DUAL AIR STANDOFF	1
5	PAFZZA	5305002118193		2508-30113	SCREW, #8-32 X 1/2 HEX, SLOT HEAD	4
6	PAFZZA	5310005590070		2808-10318	LOCK WASHER, #8 STAR	4
7	PAFZZA	5310007653197		2808-10317	FLAT WASHER, #8 STAR	4
8					SHOULDER BOLT	1
9					STEEL FLAT WASHER	1
10	PAOZZA	5330015025508	92878	5000-30121	DUAL AIR ADAPTER GASKET	1
11					FLAT WASHER, NYLON	1
12	PAFZZA	2540014978997	92878	5000-30018	SHROUD, VENT FAN	1
13	PAFZZA	6105014983867	92878	5000-30000	MOTOR/IMPELLER, VENT FAN	1
14	PAFZZA	6105015032368	92878	5000-30031	MOTOR, VENT, FAN	1
15	PAFZZA	4140015032369	92878	5000-30032	KIT,VENT FAN IMPELLER SPARE PARTS	1
16	XAFZZA		92878	5000-10247	HOUSING, VENT FAN	1
17				2810-10320	WASHER, #10 LOCK	1
18	PAFZZA	7050014979004	92878	5000-30003	PCB, PROGRAMMED CONTROLLER BOARD	1
19	PAFZZA	5340014978999	92878	5000-30002	MAGNET, DRIVER	1
20			96906	2506-10340	SCREW, #6-32 X 1/2 FLAT HEAD PHILLIPS	5
21	PAFDDA	4140014532512	92878	5000-30001	VENT DRIVE BOARD	1
22				2510-30109	SCREW, #10-32 X 7/16 HEX SLOT HEAD	1
23	PAFZZA	5305015025507	96906	2506-30227	SCREW, #6-32 X 1/4 FLAT HEAD, HEX SOCKET	4
24				2714-30163	NUT, LOCK 1/4-28	1
25	PAFZZA	2540014979006	92878	5000-30007	COMBUSTION AIR DUCT	1
26			92878	2508-30114	SCREW, #8-32 X 3/8 FLAT HEAD, PHILLPS	3
					END OF FIGURE	

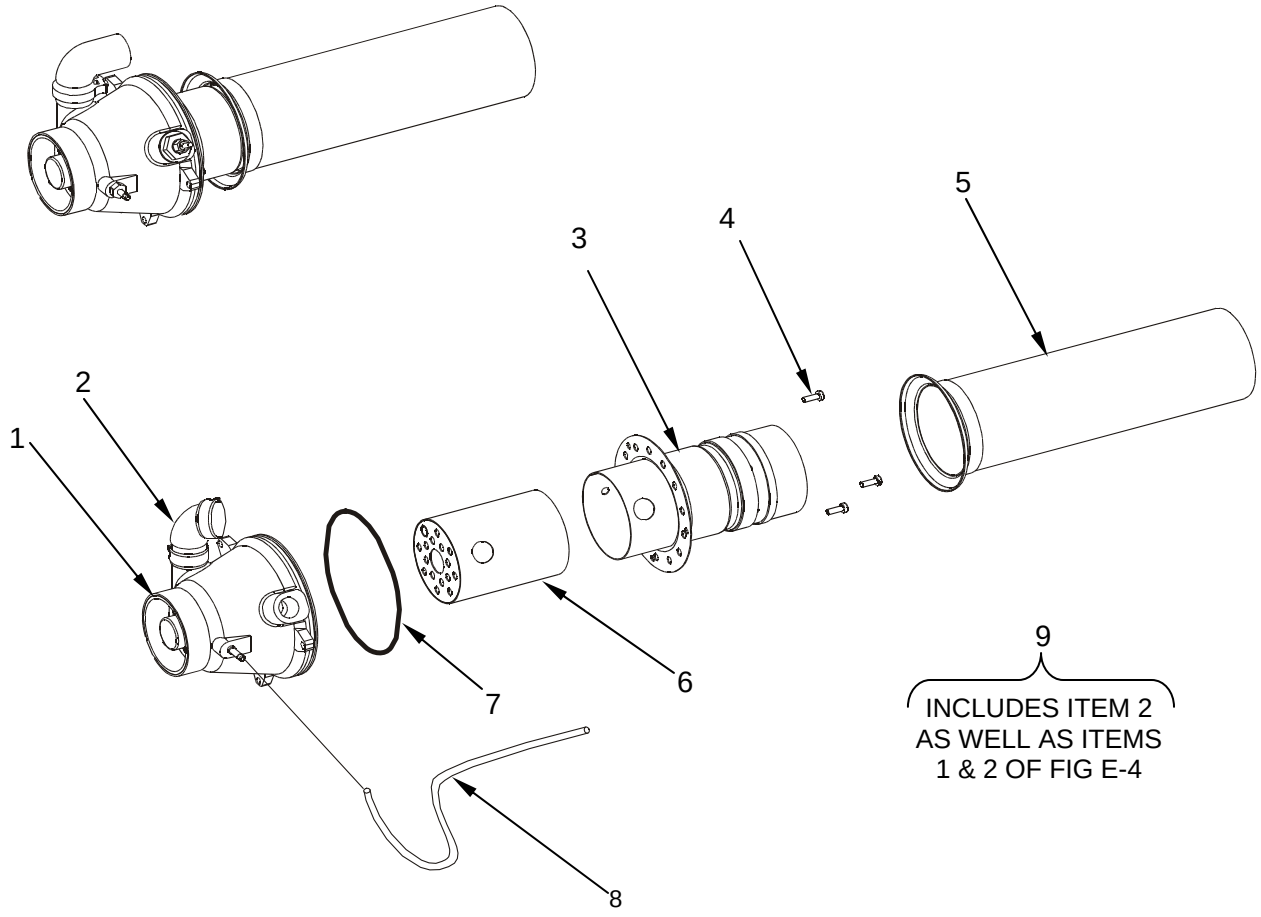


Figure D- 3. Burner Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-3, BURNER ASSEMBLY	
1	PAFZZA	4530014979012	92878	5000-30011	HOUSING ASSEMBLY, BURNER	1
2	KFFZZA		92878	5000-30323	DUCT ASSEMBLY, PRIMARY AIR (PART OF KIT 5000-30007)	1
3	PAFZZA	4520014979013	92878	5000-30022	CHAMBER, BURNER	1
4	PAFZZA	5305002118193	96906	2508-10305	SCREW, #8-32 X 1/2 PAN HEAD PHILLIPS	3
5	PAFZZA	4710014979011	92878	5000-30021	TUBE ASSEMBLY, FLAME	1
6	PAFZZA	4520014927585	92878	5000-30012	CARTRIDGE, BURNER	1
7	PAFZZA	5330014979009	92878	5000-30023	O-RING, BURNER	1
8	PAFZZA	2540015352763	92878	5000-30038	KIT, FLURAN FUEL LINE W/BRAIDED SLEEVE	1
9	PAFZZA	2540014979006	92878	5000-30007	KIT, COMBUSTION AIR DUCT SPARE PARTS (INCLUDES ITEM 2 AS WELL AS ITEMS 1 & 2 OF FIG D-4)	1
					END OF FIGURE	

NOTE: ITEM #1 INCLUDES ITEM #9

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING.

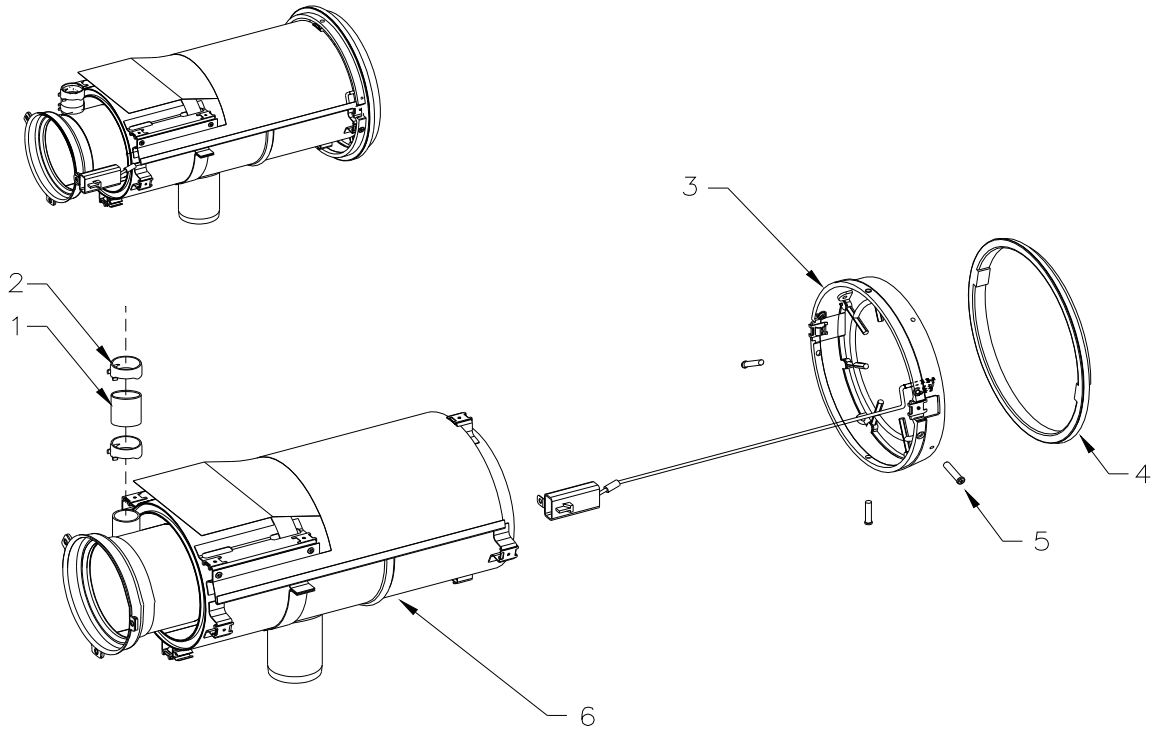


Figure D- 4. Heat Exchanger Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-4, HEAT EXCHANGER ASSEMBLY	
1	KFFZZA		92878	5000-10150	DUCT, SECONDARY, (Part of Kit 30007)	1
2	PAFZZA			2900-10326	CLAMP, HOSE 1" STEEL	2
3	PADZZA	6110014983870	92878	5000-30005	VENT SENSOR ASSEMBLY	1
4	PAOZZA	5330014981090	92878	5000-30025	VENT OUTLET SEAL ASSEMBLY	1
5	PAFZZA			2508-10350	SCREW, #8B X 5/8 PAN HEAD, PHILLIPS	3
6	PADZZA	2540014997587	92878	5000-30006	EXCHANGER, HEAT	1
7	PAFZZA	2540014979006	92878	5000-30007	KIT, COMBUSTION AIR DUCT SPARE PARTS INCLUDES ITEM 3 OF FIGURE D-3 AS WELL AS ITEMS 1 & 2 OF FIG D-4	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING. ITEM # 2 IS SPRING STEEL WITH OIL FINISH.

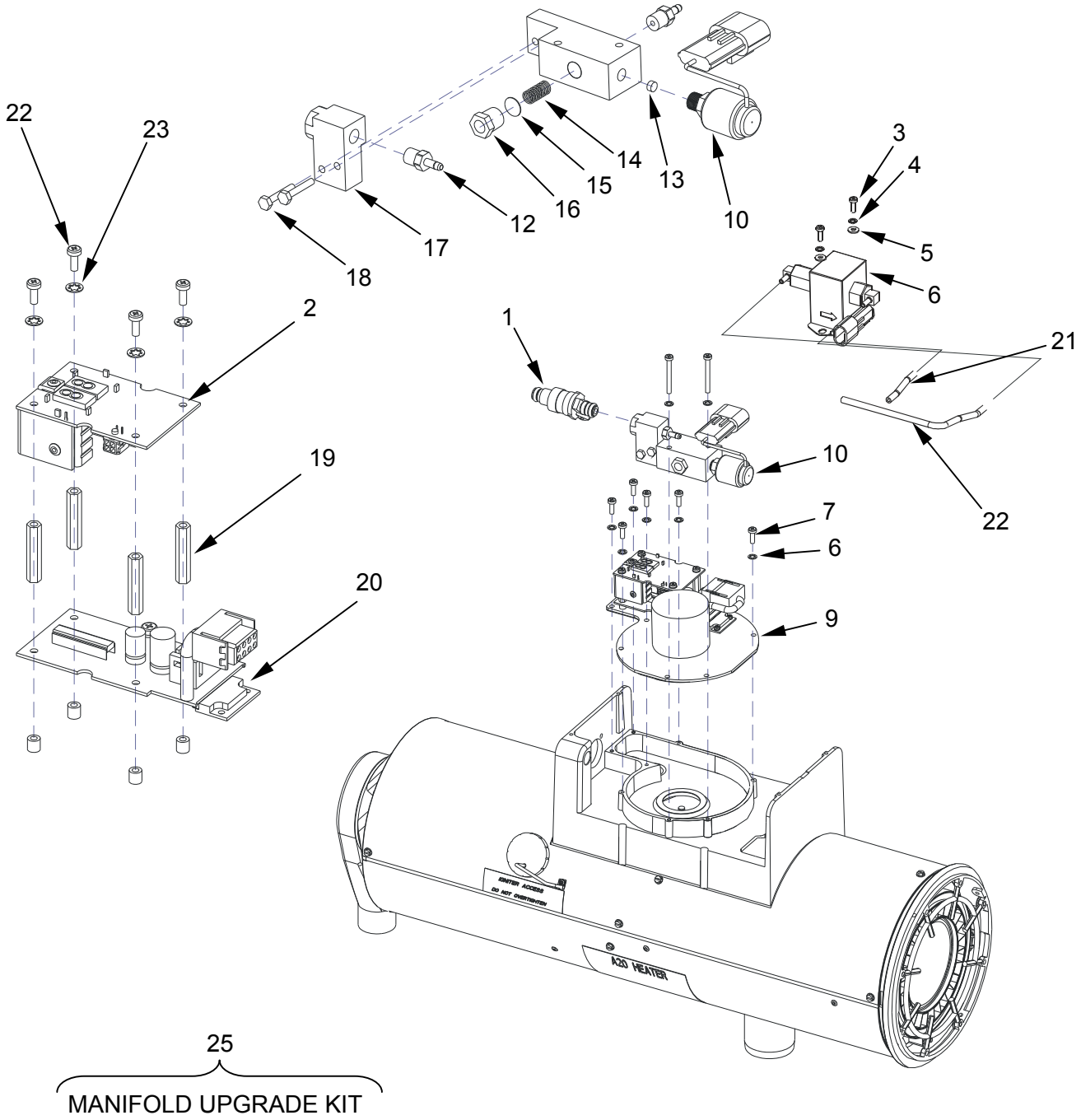


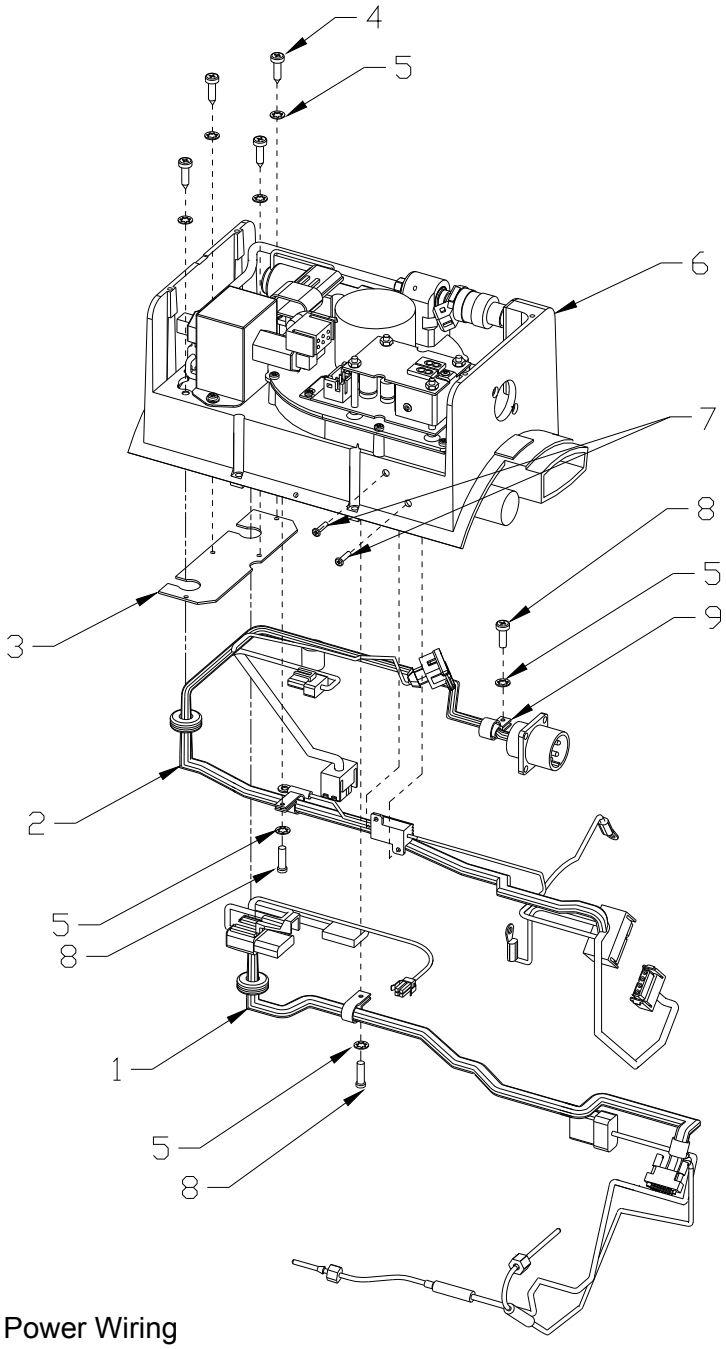
Figure D- 5. Top Housing Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-5, TOP HOUSING ASSEMBLY	
1	PAFZZA	2910014983869	92878	5000-30027	INJECTOR, FUEL	1
2	PAFZZA	5998014983003	92878	5000-30010	PCB DISPLAY, DIAGNOSTIC	1
3	PAFZZA			2508-10305	SCREW, #8-32 X ½" PAN HEAD PHILLLIPS"	2
4	PAFZZA			2808-10318	WASHER, #8 STAR	2
5	PAFZZA	5310005590070		2508-10315	WASHER, #8 FLAT X 7/16	2
6	PAFZZA	2540014979008	92878	5000-30008	PUMP, FUEL	1
7	PAFZZA			2508-10305	SCREW, #8-32 X ½" HEX PAN HEAD PHILLIPS	7
8	PAFZZA	5310007653197	96906	2808-10317	WASHER, #8 STAR X 7/16	7
9	PEFZZA		92878	5000-30406	PLATE ASSEMBLY, BURNER FAN	1
10	PAFZZA	5830014979010	92878	5000-30017	SENSOR, FUEL PRESSURE	1
11	PAFZZA		92878	5000-30408	FUEL MANIFOLD	2
12				3024-30292	CONNECTOR 0.17" TB X 1/8 NPT, BRASS	2
13			92878	5000-10467	PRESSURE SNUBBER	1
14	PAFZZA	5360015435496	92878	2900-30403	SPRING, FUEL BLOCK	1
15	PAOZZA	4330015008628	92878	5000-30149	FILTER SCREEN	1
16				2900-30397	REDUCING BUSHING	1
17				2508-30407	INJECTOR MANIFOLD	1
18				2508-30396	MACHINE SCREW 6-32 HEX HEAD	2
19	PAFZZA		92878	2900-30394	STANDOFF, FEMALE ¼"	4
20				5000-30029	DRIVER, BURNER FAN	1
21	PAFZZA		92878	0800-10423-2.5	FUEL LINE, TYGOTHANE 2.5-INCH	1
22	PAFZZA		92878	0800-10423-7.5	FUEL LINE, TYGOTHANE 7.5-INCH	1
23			96906	2506-30112	SCREW, MACHINE 6-32 X 3/8-INCH	4
24			96906	2806-10333	WASHER, STAR #6	4
25	PAFZZA	2540014925540	96906	5000-30028	KIT, MANIFOLD UPGRADE KIT	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING.

NOTE: BURNER FAN PLATE ASSEMBLY REDESIGN SHOWN. PREVIOUS ASSEMBLY PARTS MAY BE OBSOLETE, BUT CAN BE UPGRADED TO REDESIGNED CONFIGURATION. ITEMS THAT HAVE BEEN REDESIGN ARE 9 AND 11 THRU TO 16.

NOTE: ITEM 20 INCLUDES ALL REQUIRED FASTENERS.



Note: The Logic and Power Wiring Harness is used with Design Iterations 1 & 2 only. These harnesses have been discontinued. Refer to Appendix E for information on new Wiring Harness.

Figure D- 6. Logic and Power Wiring Harnesses

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-6, LOGIC AND POWER WIRE HARNESS	
1	XDFZZB	6150014979007	92878	5000-30004	LOGIC, WIRING HARNESS - DISCONTINUED	1
2	XDFZZB	6150014979006	92878	5000-30009	POWER, WIRING HARNESS - DISCONTINUED	1
3			92878	5000-30285	WIRING PLATE (Not Included In The Kit)	1
4				2508-10350	SCREW, #8B X 5/8 PAN HEAD PHILLIPS	4
5	PAFZZA	5310005590070	96906	2808-10318	WASHER, #8 STAR	7
6			92878	5000-10276	TOP HOUSING (Not Included In The Kit)	1
7				2806-10341	SCREW, #6-32 X 1/2 PAN HEAD PHILLIPS	2
8	PAFFZZA	5305002118193	96906	2508-10305	SCREW, #8-32 X 1/2 PAN HEAD PHILLIPS	2
9				2900-30297	CLIP, TUBING	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING.

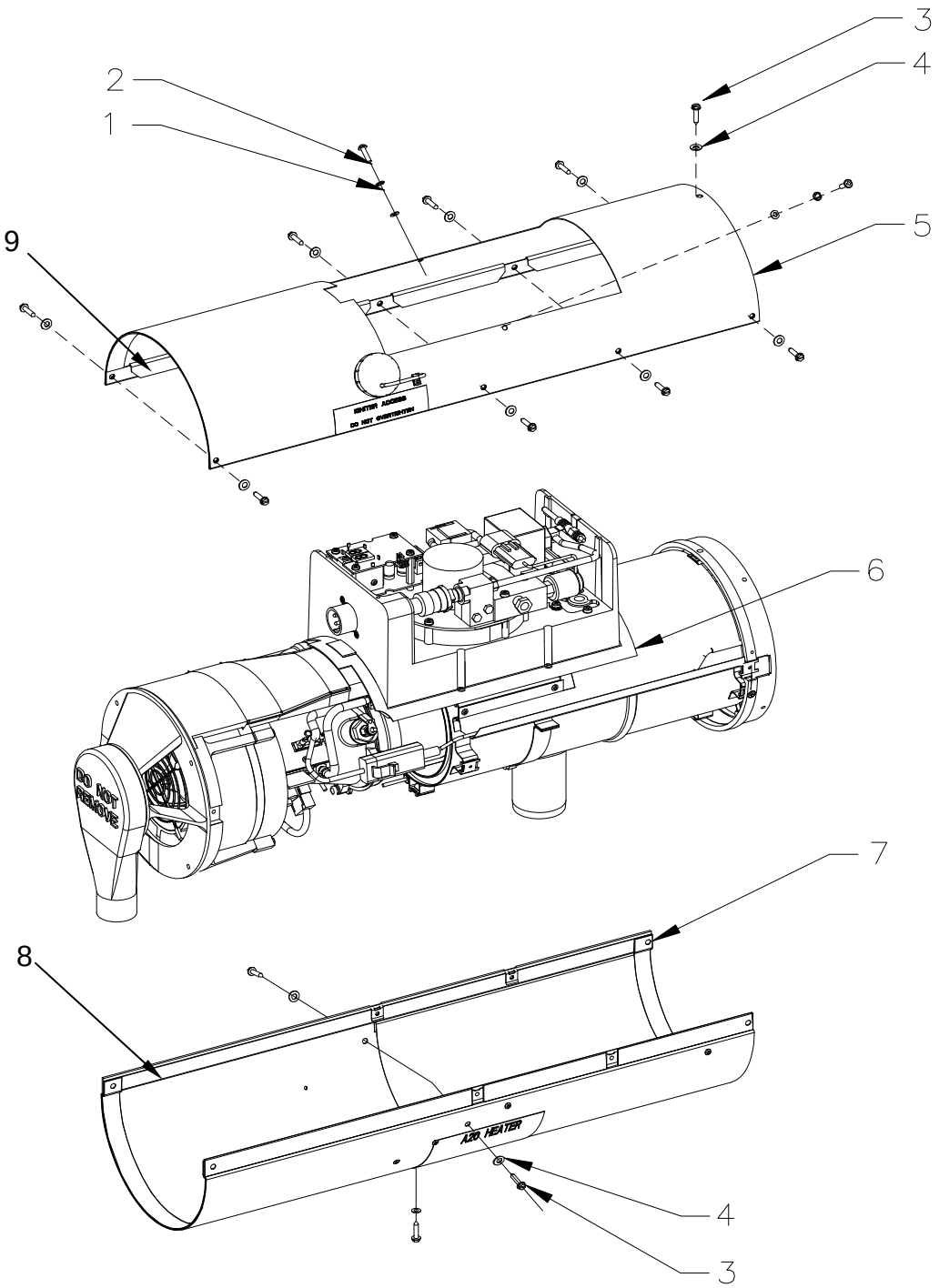


Figure D- 7. Shell Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-7, SHELL ASSEMBLY	
1	PA0ZZA	5310005590070	96906	2808-10318	WASHER, LOCK INTERNAL, #8	2
2	PAFZZA			2508-10305	SCREW, #8-32 X 1/2, HEX HEAD	2
3	PAFZZA			2508-30117	SCREW, #8AB X 3/4 HEX WASHER HEAD	12
4	PAFZZA	5310007653197		2808-10317	WASHER, #8BB FLAT X 1/2	12
5	PAFZZA	2540014979002	92878	5000-30019	SHELL ASSEMBLY, DOG HOUSE	1
6	PAFZZA	5330014976957	92878	5000-30024	GASKET, TOP SHELL	1
7	PAFZZA	2540014979003	92878	5000-30020	SHELL ASSEMBLY, BOTTOM	1
8	PAFZZA	5330045063654	92878	5000-30034	BOTTOM SHELL GASKET SET	1
9	PAFZZA	5330015063656	92878	5000-30036	TOP SHELL GASKET SET	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING

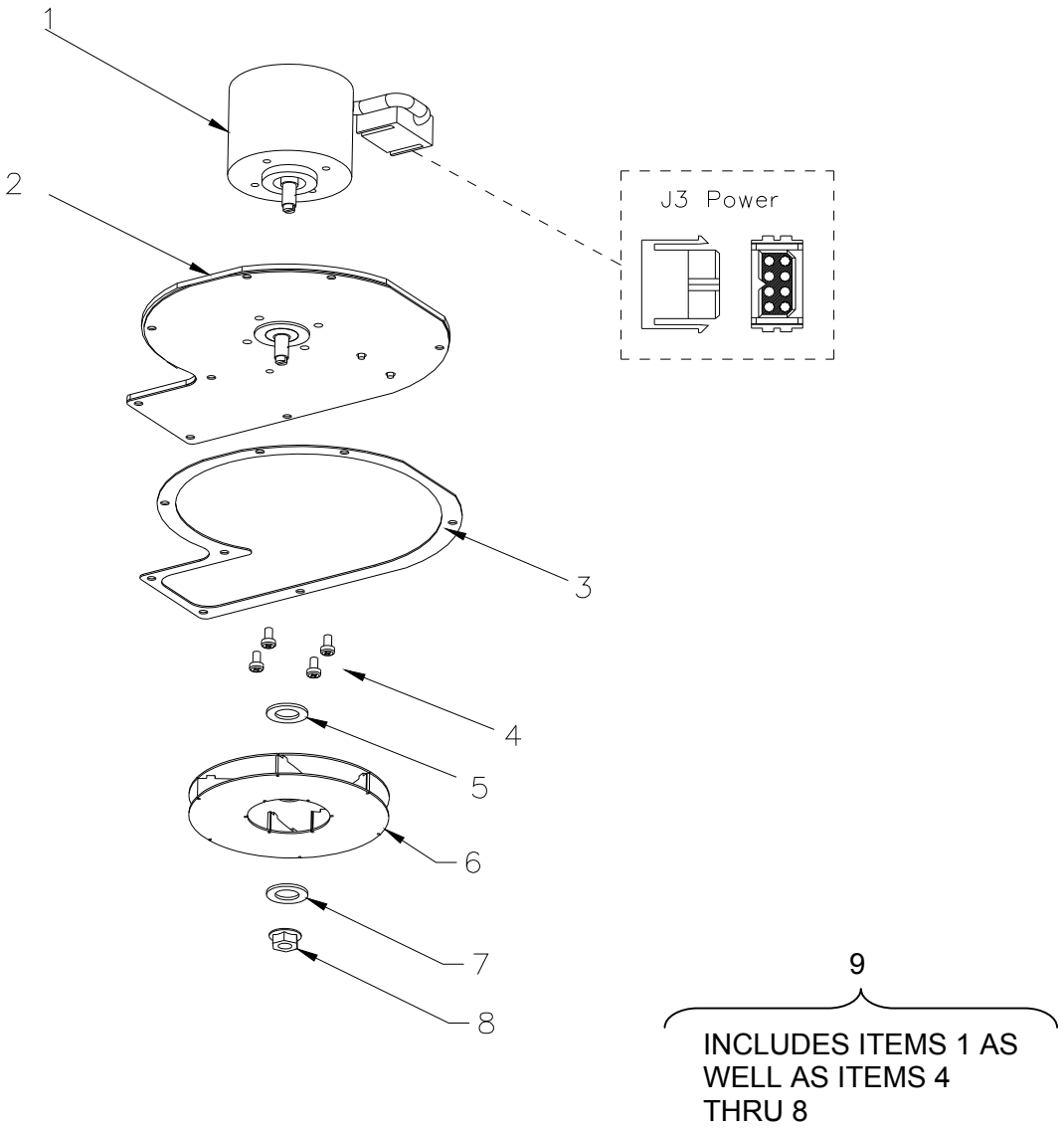


Figure D- 8. Burner Fan Motor

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-8, BURNER FAN MOTOR	
1	PAFZZA			2400-10460	MOTOR, BURNER FAN	1
2	PAFZZA		92878	5000-30406	PLATE, BURNER FAN	1
3	PAFZZA	5330015017156	92878	5000-30401	GASKET, BURNER FAN	1
4	PAFZZA			2506-10301	SCREW, #8-32 HEX, CROSS HEAD	4
5	PAFZZA	5310007653197	96906	5000-10461	SPACER, BURNER, IMPELLOR	1
6	PAFZZA	4520014540194	96906	5000-10011	IMPELLER, BURNER FAN	1
7	PAFZZA			2838-10462	WASHER, 3/8” FLAT	1
8	PAFZZA			2714-10463	NUT, MAC-LOC ¼-28 UNF	1
9	PAFZZA	4520015393080	92878	5000-30047	A20 COMBUSTION BLOWER KIT (MOTOR/IMPELLOR) (INCLUDES ITEMS 1 AS WELL AS 4 THROUGH 8)	1
					END OF FIGURE	

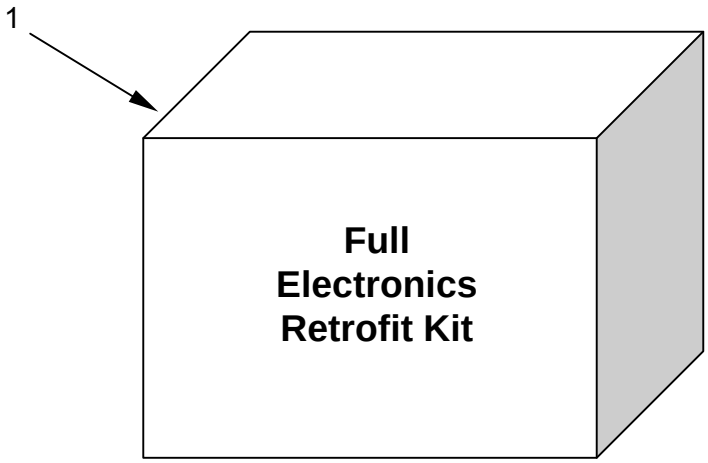


Figure D- 9. Full Electronics Retrofit Kit

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					ELECTRONICS UPGRADE KIT, REPAIR KITS	
1		2540015290585	92878	5000-30040	ELECTRONICS UPGRADE KIT	1
2			92878	53521	VENT FAN BOARD ASSEMBLY	1
3			92878	53522	FILTER BOARD ASSEMBLY	1
4			92878	53523	LOGIC BOARD ASSEMBLY	1
5			92878	53524	POWER BOARD ASSEMBLY	1
6			92878	53525	HARNESS	1
7			92878	53526	MOUNTING PLATE (POWER BOARD)	1
8			92878	53560	ASSEMBLY, BURNER CABLE	1
9			92878	2504-30110	SCREW MACH #4-40 X 1/4 PAN HD	2
10			92878	2506-10340	SCREW 6-32 X 1/2	2
11			92878	2506-30112	SCREW MACHINE BHP 6-32 X 3/8	12
12			92878	2508-10305	SCREW MACHINE 8-32 X ½ PHP	2
13			92878	2510-30109	SCREW MACHINE #10-32 X 7/16	1
14			92878	2806-10333	WASHER LOCK INT #6	6
15			92878	2808-10318	WASHER LOCK INTERNAL #8	1
17			92878	2810-10320	WASHER LOCK	1
18			92878	2900-30394	STANDOFF 1/4 HEX	4
19			92878	2900-30395	SPACER NYLON #6 X 1/4 OD X ¼ LONG	4
20			92878	3400-10215	FERRULE (SWAGELOCK)	1
21			92878	3400-30133	NUT (SWAGELOCK)	1
22			92878	3400-30202	FERRULE 3/16 FAIRVIEW BRASS 60-3	1
23			92878	3400-30203	NUT FAIRVIEW 1/8 NPT BRASS 61-3	1
24			92878	5000-30285	PLATE WIRE HARNESS (ALODINE)	1
25			92878	MS35206-229	SCREW PHM 6-32 X 7/16	2
26			92878	MS51861-37	SCREW, PHTF, TYPE AB, #8-18 X .75	4
					END OF FIGURE	

CROSS-REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX

NATIONAL STOCK NUMBER	FIGURE	ITEM	CAGEC	PART NUMBER
	D-5	20	92878	2400-10278
	D-8	1	92878	2400-10460
	D-8	4	92878	2506-10301
	D-2	8	92878	2506-10340
	D-2	11	92878	2506-30227
5305002118193	D-3	6	92878	2508-10305
5305002118193	D-5	3	92878	2508-10305
5305002118193	D-5	8	92878	2508-10305
5305002118193	D-6	8	92878	2508-10305
5305002118193	D-7	2	92878	2508-10305
5310005590070	D-5	5	92878	2508-10316
	D-4	5	92878	2508-10350
	D-6	4	92878	2508-10350
5305002118193	D-1	2	92878	2508-30113
5305002118193	D-2	16	92878	2508-30113
	D-2	13	92878	2508-30114
5305000546670	D-7	3	92878	2508-30117
	D-5	17	92878	2508-30386
	D-2	10	92878	2510-30109
	D-8	8	92878	2714-10463
	D-2	12	92878	2714-30163
	D-6	7	92878	2806-10341
5310007653197	D-2	14	92878	2808-10317
5310007653197	D-7	4	92878	2808-10317
5310005590070	D-1	3	92878	2808-10318
5310005590070	D-2	15	92878	2808-10318
5310005590070	D-5	4	92878	2808-10318
5310005590070	D-6	5	92878	2808-10318
5310005590070	D-7	1	92878	2808-10318
	D-2	5	92878	2810-10320
	D-8	7	92878	2838-10462
	D-3	2	OBSOLETE	2900-10326
	D-4	2	92878	2900-10326
	D-3	4	OBSOLETE	2900-30206
	D-6	9	92878	2900-30297
	D-1	6	92878	2900-30372
4730015411458	D-5	16	92878	2900-30397

NATIONAL STOCK NUMBER	FIGURE	ITEM	CAGEC	PART NUMBER
	D-5	12	92878	3024-30292
	D-8	6	92878	5000-10011
	D-3	3	OBSOLETE	5000-10149
	D-4	1	92878	5000-10150
	D-2	4	92878	5000-10247
	D-6	6	92878	5000-10276
	D-8	5	92878	5000-10461
	D-5	13	92878	5000-10467
6105014983567	D-2	3	92878	5000-30000
4140014532512	D-2	9	92878	5000-30001
5340014978989	D-2	7	92878	5000-30002
7030014974004	D-2	6	92878	5000-30003
6150014979007	D-6	2	92878	5000-30004
6110014983870	D-4	3	92878	5000-30005
2540014997587	D-4	6	92878	5000-30006
2540014974006	KIT	1	92878	5000-30007
6150014974008	D-5	6	92878	5000-30008
6150014974005	D-6	1	92878	5000-30009
5998014983003	D-5	2	92878	5000-30010
4530014974012	D-3	1	92878	5000-30011
4520014927585	D-3	8	92878	5000-30012
4520014983868	D-1	5	92878	5000-30013
4520014983001	D-1	4	92878	5000-30014
4520014983002	D-5	9	OBSOLETE	5000-30015
2540014978998	D-2	2	92878	5000-30016
5930014979010	D-5	10	92878	5000-30017
2540014978997	D-1	1	92878	5000-30018
2540014978002	D-7	5	92878	5000-30019
2540014979003	D-7	7	92878	5000-30020
4710014979011	D-3	7	92878	5000-30021
4520014979013	D-3	5	92878	5000-30022
5330014979009	D-3	9	92878	5000-30023
5330014976957	D-7	6	92878	5000-30024
5330014981040	D-4	4	92878	5000-30025
1270014995304	D-2	1	92878	5000-30026
2910014983869	D-5	1	92878	5000-30027
4330015008628	D-5	15	92878	5000-30149
	D-6	3	92878	5000-30285
	D-5	19	92878	5000-30394
	D-5	18	92878	5000-30396

NATIONAL STOCK NUMBER	FIGURE	ITEM	CAGEC	PART NUMBER
5330015097156	D-8	3	92878	5000-30401
	D-5	14	92878	5000-30403
	D-8	2	92878	5000-30406
	D-5	11	92878	5000-30408
6105015032368			92878	5000-30031
4140015032309			92878	5000-30032
5330015063654			92878	5000-30034
5330015063656			92878	5000-30036
5330015025508			96906	5000-30121
4520015017034			98278	5000-30143
2540015081060			92878	5000-30323
2540015290585			92878	5000-30040
4140015287945			92878	5000-30041
5998015287946			92878	5000-30042
5998015287947			92878	5000-30043
5998015287948			92878	5000-30044
7050015288737			92878	5000-30045
6150019287949			92878	5000-30046
2540019352763			92878	5000-30038
4520015393080			92878	5000-30047
5340015403351			92878	2900-10430
5360015435496			92878	2900-30403
2540015411459			92878	2900-30136
5330015411460			92878	2900-10459
5330015411461			92878	2900-10191
2540015315938			92878	0800-10423-25
2540015315940			92878	0800-10423-75

APPENDIX E

OPERATOR, FIELD, AND SUSTAINMENT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LISTS

NOTE! FOR DESIGN ITERATION 3 ONLY. FOR DESIGN ITERATION 1 & 2, REFER TO APPENDIX D

SCOPE

This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement and diagnostic equipment (TMDE); and other special support equipment required for performance of Operator, Field, and Sustainment maintenance of the Personnel Heater, Model A20. It authorizes the requisitioning, issue, and disposition of spares, repair parts, and special tools as indicated by the source, maintenance, and recoverability (SMR) codes.

GENERAL

In addition to the Introduction work package, this RPSTL is divided into the following work packages:

1. **Repair Parts List Work Packages**. Work packages containing lists of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. These work packages also include parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Sending units, brackets, filters, and bolts are listed with the component they mount on. Bulk materials are listed by item name in FIG. BULK at the end of the work packages. Repair parts kits are listed separately in their own functional group and work package. Repair parts for reparable special tools are also listed in a separate work package. Items listed are shown on the associated illustrations.

2. **Special Tools List Work Packages**. Work packages containing lists of special tools, special TMDE, and other special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in DESCRIPTION AND USABLE ON CODE (UOC) column). Tools that are components of common tool sets and/or Class VII are not listed.

3. **Cross-Reference Indexes Work Packages**. There are two cross-reference index work packages in this RPSTL: The National Stock Number Index and the Part Number Index. The National Stock Number Index refers you to the figure and item number. The Part Number Index refers you to the figure and item number.

EXPLANATION OF COLUMNS IN THE REPAIR PARTS LIST AND SPECIAL TOOLS LIST WORK PACKAGES

1. Item No. (Column 1). Indicates the number used to identify items called out in the illustration.

2. SMR Code (Column 2). The SMR code containing supply/requisitioning information, maintenance level authorization criteria, and disposition instruction, as shown in the following:

Source Code	**Maintenance Code**		**Recoverability Code**
XX	XX		X
1st two positions: How to get an item.	3rd position: Who can install, replace, or use the item	4th position: Who can do complete repair[1] on the item.	5th position: Who determines disposition action on unserviceable items.

1. Complete repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

Source Code	**Application/Explanation**
PA PB PC PD PE PF PG	Stock items; use the applicable NSN to request/requisition items with these source codes. They are authorized to the level indicated by the code entered in the 3rd position of the SMR code. **NOTE** Items coded PC are subject to deterioration.
KD KF KB	Items with these codes are not to be requested/requisitioned individually. They are part of a kit which is authorized to the maintenance level indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.
MO-Made at unit/AVUM level MF-Made at DS/AVIM level MH-Made at GS level ML-Made at SRA MD-Made at depot	Items with these codes are not to be requested/requisitioned individually. They must be made from bulk material which is identified by the P/N in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the bulk material group work package of the RPSTL. If the item is authorized to you by the 3d position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance.

Source Code	Application/Exploration
AO-Assembled by unit/ AVUM level AF-Assembled by DS/ AVIM level AH-Assembled by GS level AL-Assembled by SRA AD-Assembled by depot	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3d position of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.
XA	Do not requisition an "XA" coded item. Order the next higher assembly. (Refer to NOTE below.)
XB	If an item is not available from salvage, order it using the CAGEC and P/N.
XC	Installation drawings, diagrams, instruction sheets, field service drawings; identified by manufacturer's P/N
XD	Item is not stocked. Order an XD-coded item through normal supply channels using the CAGEC and P/N given, if no NSN is available.

NOTE

Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those items source coded "XA" or those aircraft support items restricted by requirements of AR 750-1.

Source Code. The source code tells you how to obtain an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follow:

Maintenance Code. Maintenance codes tell you the level(s) of maintenance authorized to use and repair support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

Third Position. The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to the following levels of maintenance:

Maintenance Code	Application/Explanation
C	Crew or operator maintenance done within unit/AVUM maintenance.
O	Unit level/AVUM maintenance can remove, replace, and use the item.
F	Direct support/AVIM maintenance can remove, replace, and use the item.
H	General support maintenance can remove, replace, and use the item.
L	Specialized repair activity can remove, replace, and use the item.
D	Depot can remove, replace, and use the item.

Fourth Position. The maintenance code entered in the fourth position tells you whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (perform all authorized repair functions).

NOTE: SOME LIMITED REPAIR MAY BE DONE ON THE ITEM AT A LOWER LEVEL OF MAINTENANCE, IF AUTHORIZED BY THE MAINTENANCE ALLOCATION CHART (MAC) AND SMR CODES.

Maintenance Code	Application/Explanation
O	Unit /AVUM is the lowest level that can do complete repair of the item.
F	Direct support/AVIM is the lowest level that can do complete repair of the item.
H	General support is the lowest level that can do complete repair of the item.
L	Specialized repair activity is the lowest level that can do complete repair of the item.
D	Depot is the lowest level that can do complete repair of the item.
Z	Non-reparable. No repair is authorized.
B	No repair is authorized. No parts or special tools are authorized for maintenance of B coded item. However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR code as follows:

Recoverability Code	Application/Explanation
Z	Non-reparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in the third position of the SMR code.
O	Reparable item. When uneconomically reparable, condemn and dispose of the item at the unit level.
F	Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support level.
H	Reparable item. When uneconomically reparable, condemn and dispose of the item at the general support level.
D	Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item are not authorized below depot level.
L	Reparable item. Condemnation and disposal not authorized below Specialized Repair Activity (SRA).

Recoverability Code	Application/Explanation
	reasons (such as precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

3. NSN (Column 3). The NSN for the item is listed in this column.

4. CAGEC (Column 4). The Commercial and Government Entity Code (CAGEC) is a five-digit code which is used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

5. PART NUMBER (Column 5). Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

NOTE

When you use a NSN to requisition an item, the item you receive may have a different P/N from the number listed.

6. Description of “Usable On Code” (UOC) (Column 6). This column includes the following information:

   - The federal item name, and when required, a minimum description to identify the item.

   - P/Ns of bulk materials are referenced in this column in the line entry to be manufactured or fabricated.

   - Hardness Critical Item (HCI). A support item that provides the equipment with special protection from electromagnetic pulse (EMP) damage during a nuclear attack.

   - The statement END OF FIGURE appears just below the last item description in column (6) for a given figure in both the repair parts list and special tools list work packages.

7. QTY (Column 7). The QTY (quantity per figure) column indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, sub-functional group, or an assembly. A "V" appearing in this column instead of a quantity indicates that the quantity is variable and the quantity may change from application to application.

EXPLANATION OF CROSS-REFERENCE INDEXES WORK PACKAGES FORMAT & COLUMNS

1. National Stock Number (NSN) Index Work Package.

STOCK NUMBER Column. This column lists the NSN in National item identification number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN.

NSN (e.g., 2540-01-396-2826) NIIN	When using this column to locate an item, ignore the first four digits of the NSN. However, the complete NSN should be used when ordering items by stock number.

FIG. Column. This column lists the number of the figure where the item is identified/located. The figures are in numerical order in the repair parts list & special tools list work packages.

ITEM Column. The item number identifies the item associated with the figure listed in the adjacent FIG. column. This item is also identified by the NSN listed on the same line.

2. Part Number (P/N) Index Work Package. P/Ns in this index are listed in ascending alphanumeric sequence (vertical arrangement of letter and number combinations which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9 and each following letter or digit in like order).

PART NUMBER Column. Indicates the P/N assigned to the item.

FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list and special tools list work packages.

ITEM Column. The item number is the number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

3. Reference Designator Index Work Package. Reference designators in this index are listed in ascending alphanumeric sequence (vertical arrangement of letter and number combination which places the first letter or digit of each group in order “A” through “Z”, followed by the numbers “0” through “9” and each following letter or digit in like order).

REFERENCE DESIGNATOR Column. Indicates the reference designator assigned to the item.

FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list or special tools list work package.

ITEM Column. The item number is the number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

SPECIAL INFORMATION

UOC. The UOC appears in the lower left corner of the Description Column heading. Usable on codes are shown as "UOC:…" in the Description Column (justified left) on the first line under the

applicable item/nomenclature. Un-coded items are applicable to all models. Identification of the UOCs used in the RPSTL are:

Code	Used On
N/A	N/A

Fabrication Instructions. Bulk materials required to manufacture items are listed in the bulk material functional group of this RPSTL. Part numbers for bulk material are also referenced in the Description Column of the line item entry for the item to be manufactured/fabricated. Detailed fabrication instructions for items source coded to be manufactured or fabricated are found in TM N/A.

Index Numbers. Items which have the word BULK in the figure column will have an index number shown in the item number column. This index number is a cross-reference between the NSN / P/N index work packages and the bulk material list in the repair parts list work package.

Associated Publications. The publication(s) listed below pertains to the N/A.

Publication	Short Title
N/A	N/A

Illustrations List. The illustrations in this RPSTL contain unit authorized items. Illustrations published in TM 9-2540-207-13&P that contain unit authorized items also appear in this RPSTL. The tabular list in the repair parts list work package contains only those parts coded “O” in the third position of the SMR code, therefore, there may be a break in the item number sequence.

HOW TO LOCATE REPAIR PARTS

1. When NSNs or P/Ns Are Not Known.

- Using the table of contents, determine the assembly group to which the item belongs. This is necessary since figures are prepared for assembly groups and subassembly groups, and lists are divided into the same groups.

- Find the figure covering the functional group or the sub-functional group to which the item belongs.

- Identify the item on the figure and note the number(s).

- Look in the repair parts list work packages for the figure and item numbers. The NSNs and part numbers are on the same line as the associated item numbers.

2. When NSN Is Known.

- If you have the NSN, look in the STOCK NUMBER column of the NSN index work package. The NSN is arranged in NIIN sequence. Note the figure and item number next to the NSN.

- Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

3. When P/N Is Known.

- If you have the P/N and not the NSN, look in the PART NUMBER column of the P/N index work package. Identify the figure and item number.

- Look up the item on the figure in the applicable repair parts list work package.

4. When Reference Designator Is Known.

- If you know the reference designator, look in the REFERENCE DESIGNATOR column of the reference designator index work package. Note the figure and item number.

- Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

ABBREVIATIONS

Abbreviation	Explanation
N/A	N/A

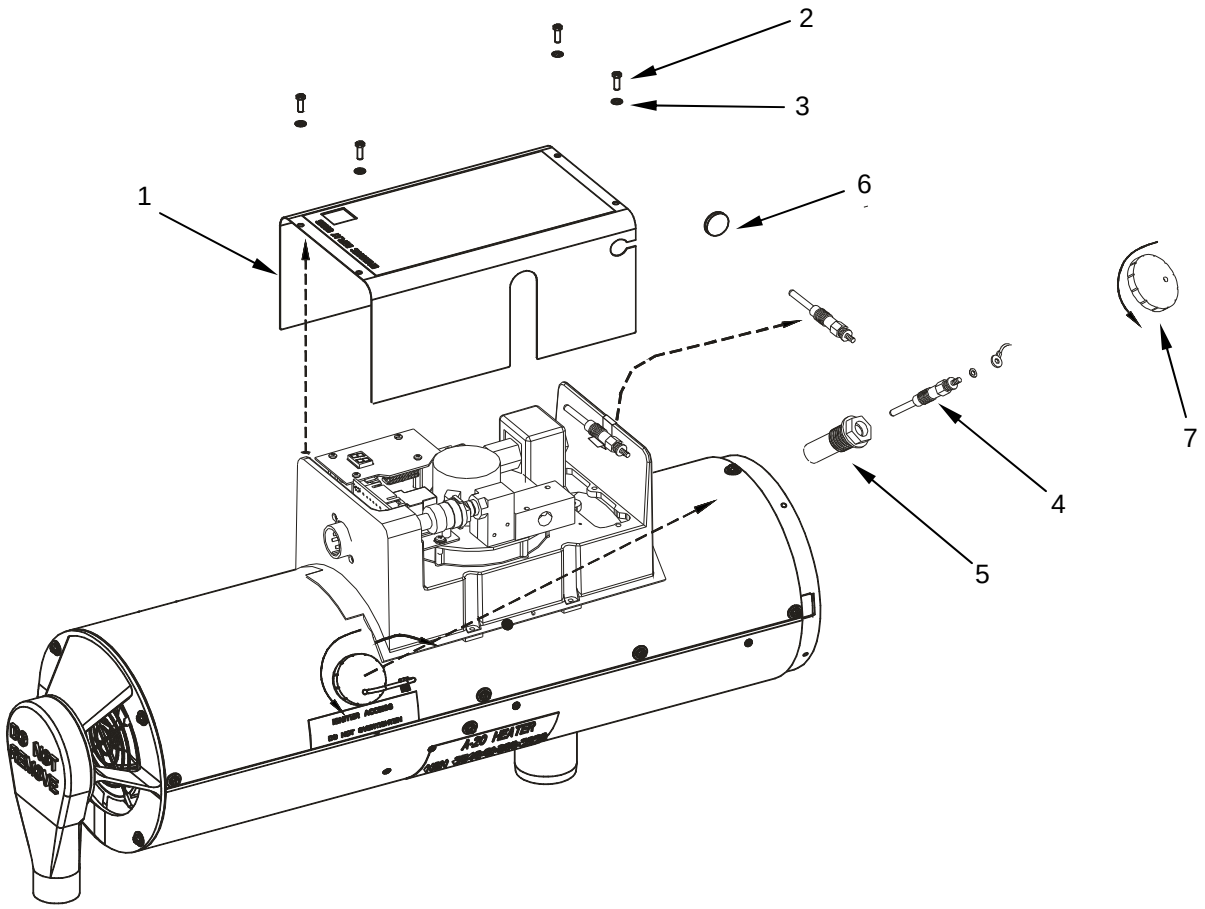


Figure E- 1. Ignitor and Cover Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-1, IGNITOR AND COVER ASSEMBLY	
1	PAOZZA	2540014978997	92878	5000-30018	COVER, TOP ASSEMBLY	1
2	PAOZZA	5305002118193	96906	2508-30113	SCREW, #8-32 X .5, HEX HEAD SLOT	4
3	PAOZZA	5310005590070	96906	2808-10318	WASHER, LOCK INTERNAL, #8	4
4	PAOZZA	4520014983001	92878	5000-30014	IGNITOR, FUEL	2
5	PAOZZA	4520014983868	92878	5000-30013	HOLDER, IGNITOR	1
6	PAOZZA		92878	2900-30372	REMOTE DISPLAY ACCESS CAP	1
7	PAOZZA	4520015017034	92878	5000-30143	IGNITOR HATCH ASSEMBLY	1
					END OF FIGURE	

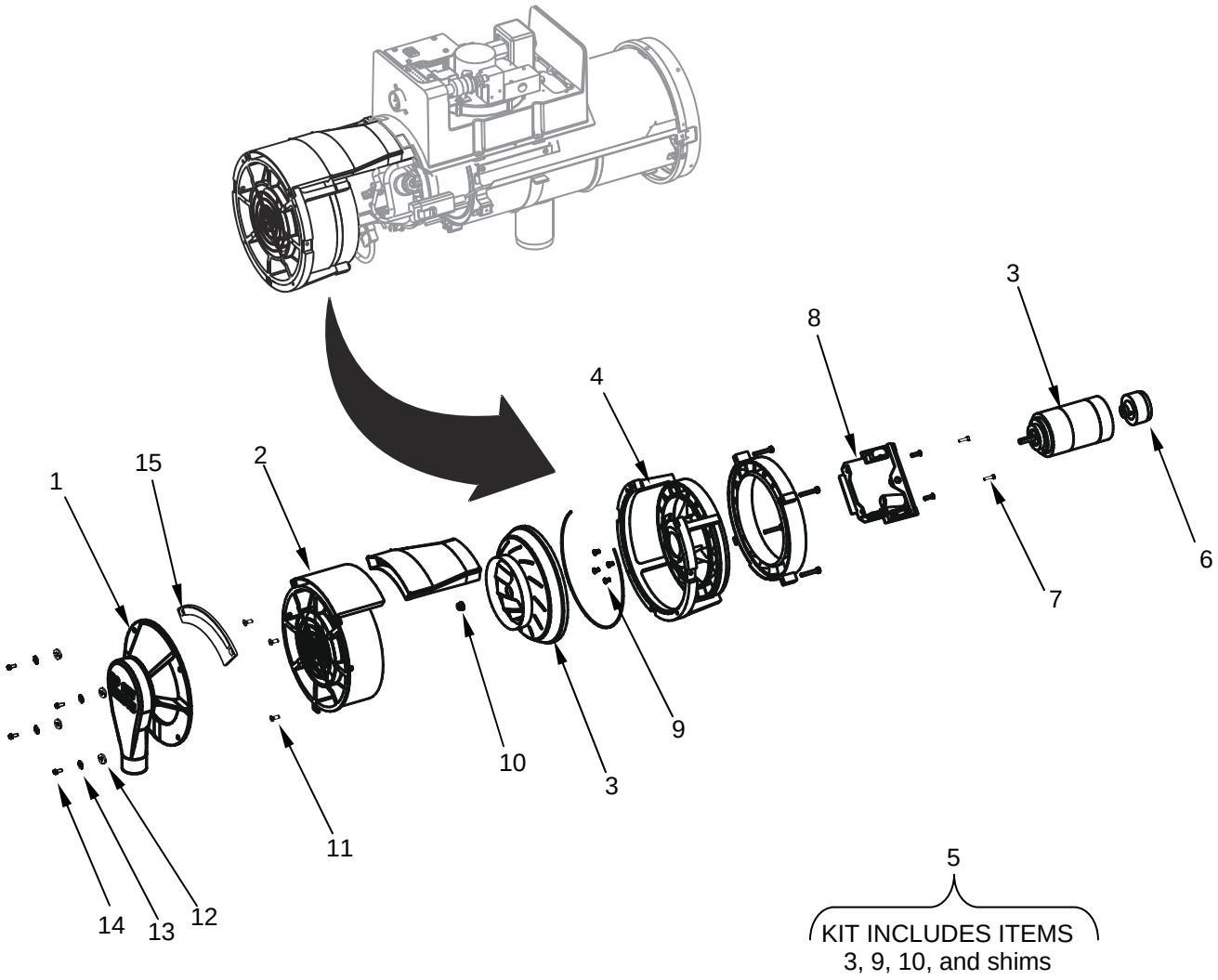


Figure E- 2. Vent Housing Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-2, VENT HOUSING ASSEMBLY	
1	PA0ZZA	1270014995304	92878	5000-30026	ADAPTER, DUAL AIR	1
2	PAFZZA	2540014978998	92878	5000-30016	SHROUD, VENT FAN	1
3	PAFZZA	4140015032369	92878	5000-30000	MOTOR, VENT FAN	1
4	XAFZZA		92878	5000-10247	HOUSING, VENT FAN	1
5	PAFDDA	6105015032368	92878	5000-30032	KIT, VENT FAN IMPELLER SPARE PARTS	1
6	PAFZZA	5340014978999	92878	5000-30002	MAGNET, DRIVER	1
7	PAFDDA		96906	2506-10340	SCREW, #6-32 X 1/2	2
8	PAFDDA	4140015287945	92878	5000-30041	DRIVER, VENT FAN	1
9	PAFDDA	5305016026507	96906	2506-30227	SCREW, CAP, HEX SOCKET	4
10	PAFDDA		96906	MS21042-4	NUT, HEX SL. 2500-28	1
11	PAFDDA		96906	2508-30114	SCREW, MACHINE FHP	3
12	PAFDDA	5310007653197	96906	2808-10317	WASHER, FLAT #8	4
13	PAFDDA	5310005590070	96906	2808-10318	WASHER, LOCK INTERNAL #8	4
14	PAFDDA	5305002118193	96906	2508-30113	SCREW, #8-32 X .50 HEX, HEAD SLOT	4
15	PAOZZA	5330015025508	92878	5000-30121	DUAL AIR ADAPTER GASKET	1
					END OF FIGURE	

NOTE: ALL FASTENERS EXCEPT ITEM #12 ARE STEEL WITH ZINC PLATING. ITEM #12 IS TO BE ZINC-DICHROMATE PLATED.

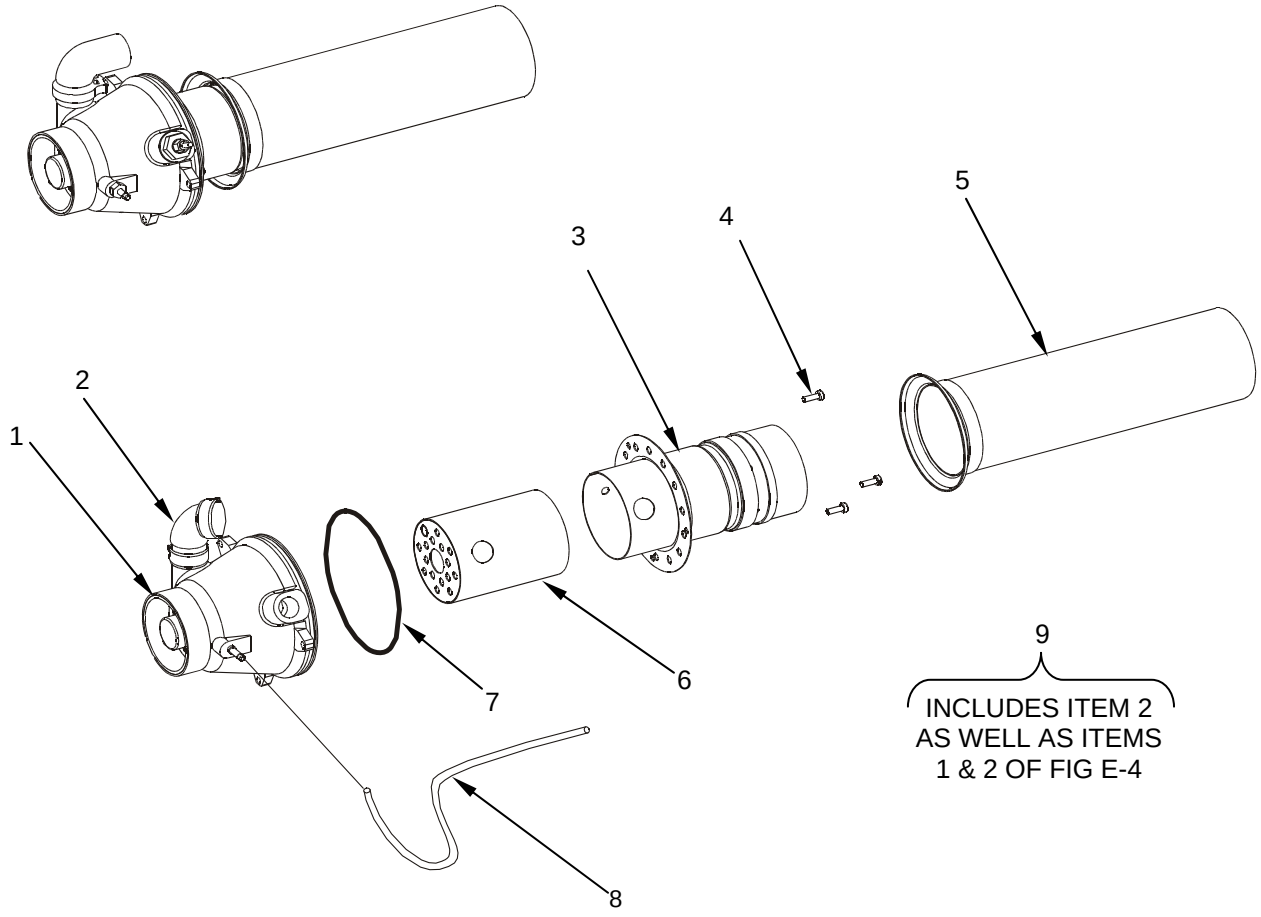


Figure E- 3. Burner Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-3, BURNER ASSEMBLY	
1	PAFZZA	4530014979012	92878	5000-30011	HOUSING ASSEMBLY, BURNER	1
2	KFFZZA		92878	5000-30323	DUCT ASSEMBLY, PRIMARY AIR (PART OF KIT 5000-30007)	1
3	PAFZZA	4520014979013	92878	5000-30022	CHAMBER, BURNER	1
4	PAFZZA	5305002118193	96906	2508-10305	SCREW, #8-32 X 1/2 PAN HEAD PHILLIPS	3
5	PAFZZA	4710014979011	92878	5000-30021	TUBE ASSEMBLY, FLAME	1
6	PAFZZA	4520014927585	92878	5000-30012	CARTRIDGE, BURNER	1
7	PAFZZA	5330014979009	92878	5000-30023	O-RING, BURNER	1
8	PAFZZA	2540015352763	92878	5000-30038	KIT, FLURAN FUEL LINE W/BRAIDED SLEEVE	1
9	PAFZZA	2540014979006	92878	5000-30007	KIT, COMBUSTION AIR DUCT SPARE PARTS (INCLUDES ITEM 2 AS WELL AS ITEMS 1 & 2 OF FIG E-4)	1
					END OF FIGURE	

NOTE: ITEM #1 INCLUDES ITEM #9

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING. ITEM #2 IS SPRING STEEL WITH OIL FINISH.

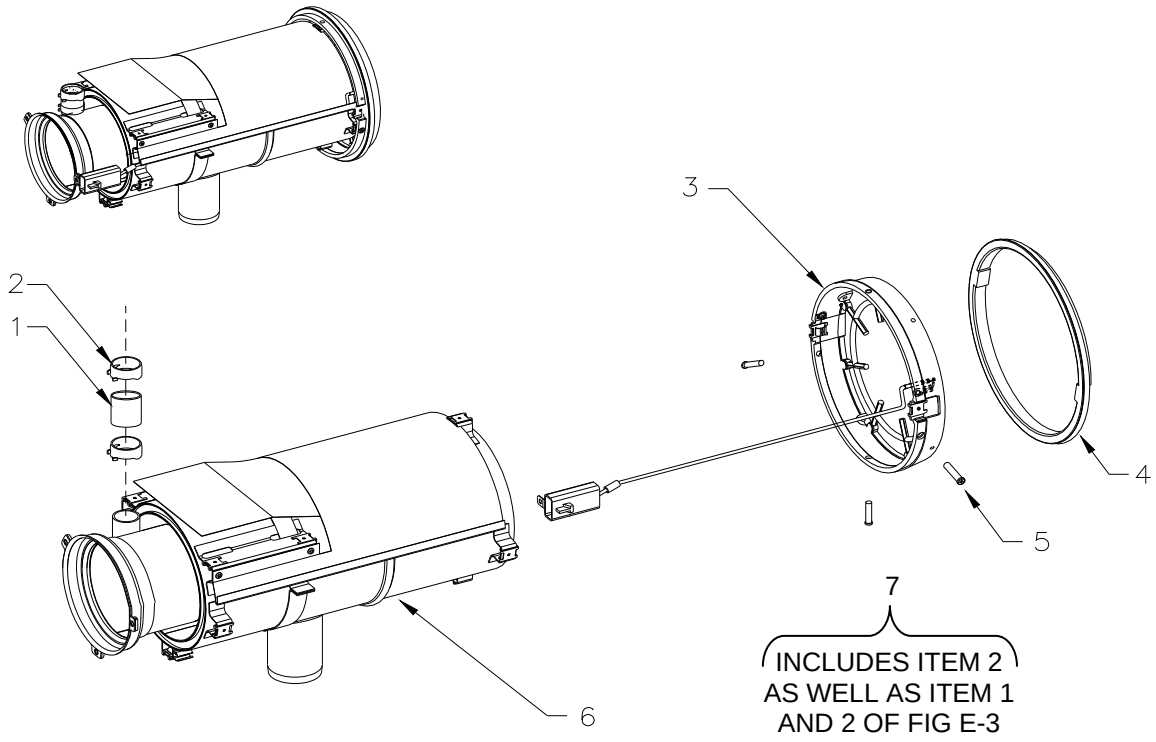


Figure E- 4. Heat Exchanger Assembly

SECTION II

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-4, HEAT EXCHANGER ASSEMBLY	
1	KFFZZA		92878	5000-10150	DUCT, SECONDARY, (Part of Kit 30007)	1
2	PAFZZA		92878	2900-10326	CLAMP, HOSE 1"	2
3	PAFZZA	6110014983870	92878	5000-30005	VENT SENSOR ASSEMBLY	1
4	PAFZZA	5330014981090	92878	5000-30025	VENT OUTLET SEAL ASSEMBLY	1
5	PAFZZA		96906	2508-10350	SCREW, #8B X .62 PAN HEAD PHILLIPS	3
6	PAFZZA	2540014997587	92878	5000-30006	EXCHANGER, HEAT	1
7	PAFZZA	2540014979006	92878	5000-30007	KIT, COMBUSTION AIR DUCT SPARE PARTS INCLUDES ITEM 2 AS WELL AS ITEM 1 AND 2 OF FIG E-3)	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING. ITEM # 2 IS SPRING STEEL WITH OIL FINISH.

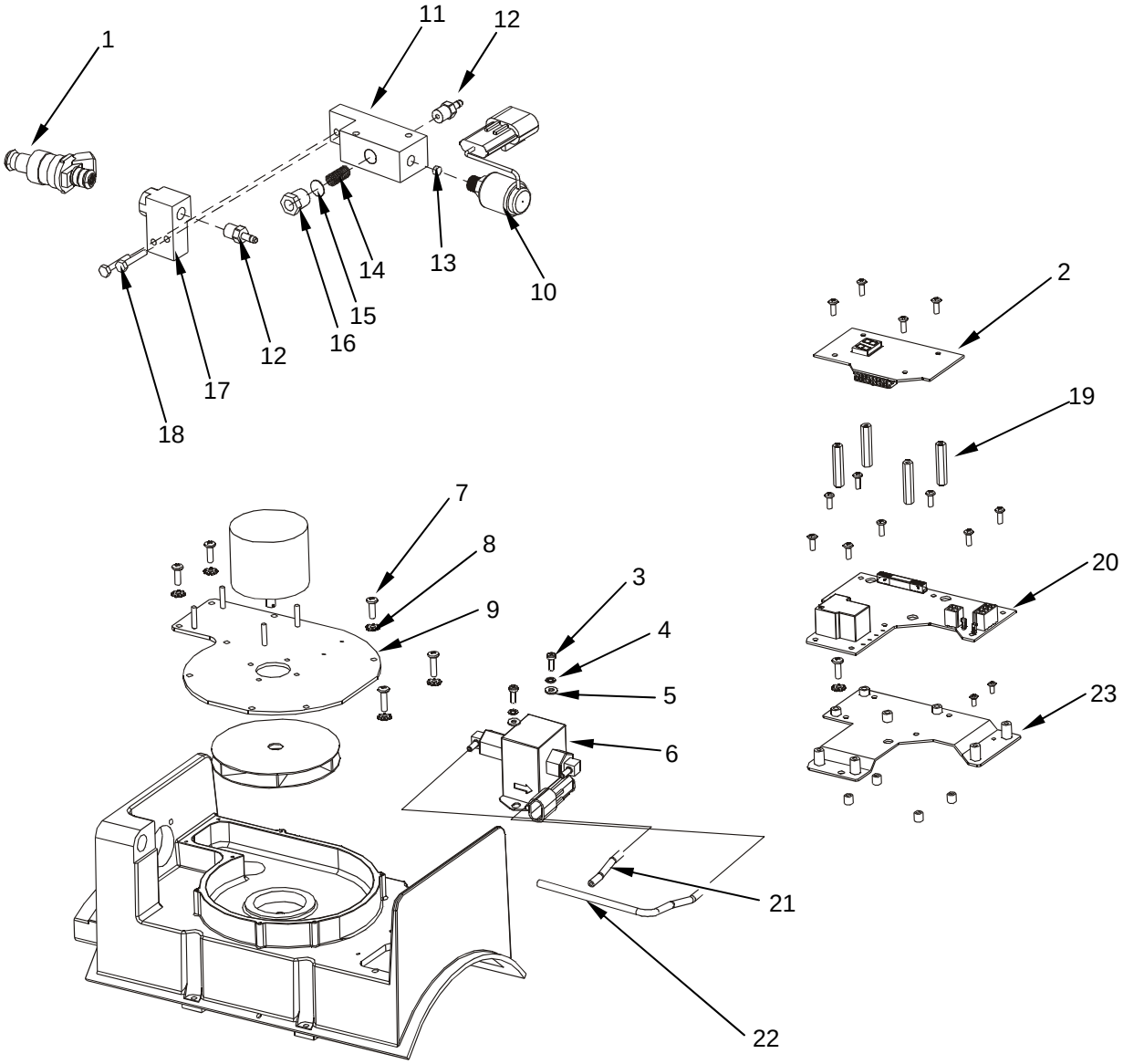


Figure E- 5. Top Housing Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-5, TOP HOUSING ASSEMBLY	
1	PAFZZA	2910014983869	92878	5000-30027	INJECTOR, FUEL	1
2	PAFDDA	5998015287947	92878	5000-30043	CIRCUIT BOARD, LOGIC (HARDWARE INCLUDED)	1
3	PAFZZA		96906	2508-10305	SCREW, 10-32 X1" PAN HEAD PHILLLIPS"	2
4			96906	2806-10333	WASHER, LOCK INT #6 (PART OF KIT 30015)	4
5	PAFZZA	5310005590070	96906	2508-10315	WASHER, #8 FLAT X 7/16	2
6	PAFZZA	2540014979008	92878	5000-30008	PUMP, FUEL	1
7	PAFZZA	5305002118193	96906	2508-30399	SCREW, MACH 8-32	10
8	PAFZZA	5310007653197	96906	2808-10317	WASHER, FLAT #8	2
9	PAFZZA	4520014983002	92878	5000-30406	PLATE ASSEMBLY, BURNER FAN	1
10	PAFZZA	5930014979010	92878	5000-30017	SENSOR, FUEL PRESSURE	1
11	PAFZZA		92878	5000-30385	FUEL MANIFOLD	2
12	PAFZZA		92878	3024-30292	CONNECTOR (0.17" ID)	2
13	PAFZZA		92878	5000-10467	PRESSURE SNUBBER	1
14	PAFZZA		92878	2900-30403	SPRING, FUEL BLOCK	1
15	PAFZZA	4330015008628	92878	5000-30149	FILTER SCREEN	1
16	PAFZZA		92878	5000-30397	REDUCING BUSHING	1
17	PAFZZA		92878	2508-30386	MANIFOLD, FUEL INJECTOR	1
18	PAFZZA		92878	5000-30395	MACHINE SCREW 6-32 HEX HEAD	2
19	PAFZZA		92878	2900-30394	STANDOFF, FEMALE ¼"	4
20	PAFZZA	7050015288737	92878	5000--30045	CIRCUIT BOARD ASSEMBLY, POWER BOARD (HARDWARE INCLUDED)	1
21	PAFZZA		92878	0800-40123-2.5	FUEL LINE, TYGOTHANE 2.5-INCH	1
22	PAFZZA		92878	0800-10423-7.5	FUEL LINE, TYGOTHANE 7.5-INCH	1
23	PAFZZA	5998015287948	92878	5000-30044	MOUNTING PLATE (POWER BOARD) (HARDWARE INCLUDED)	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING.

NOTE: BURNER FAN PLATE ASSEMBLY REDESIGN SHOWN. PREVIOUS ASSEMBLY PARTS MAY BE OBSOLETE, BUT CAN BE UPGRADED TO REDESIGNED CONFIGURATION. ITEMS THAT HAVE BEEN REDESIGN ARE 9 AND 11 THRU TO 16

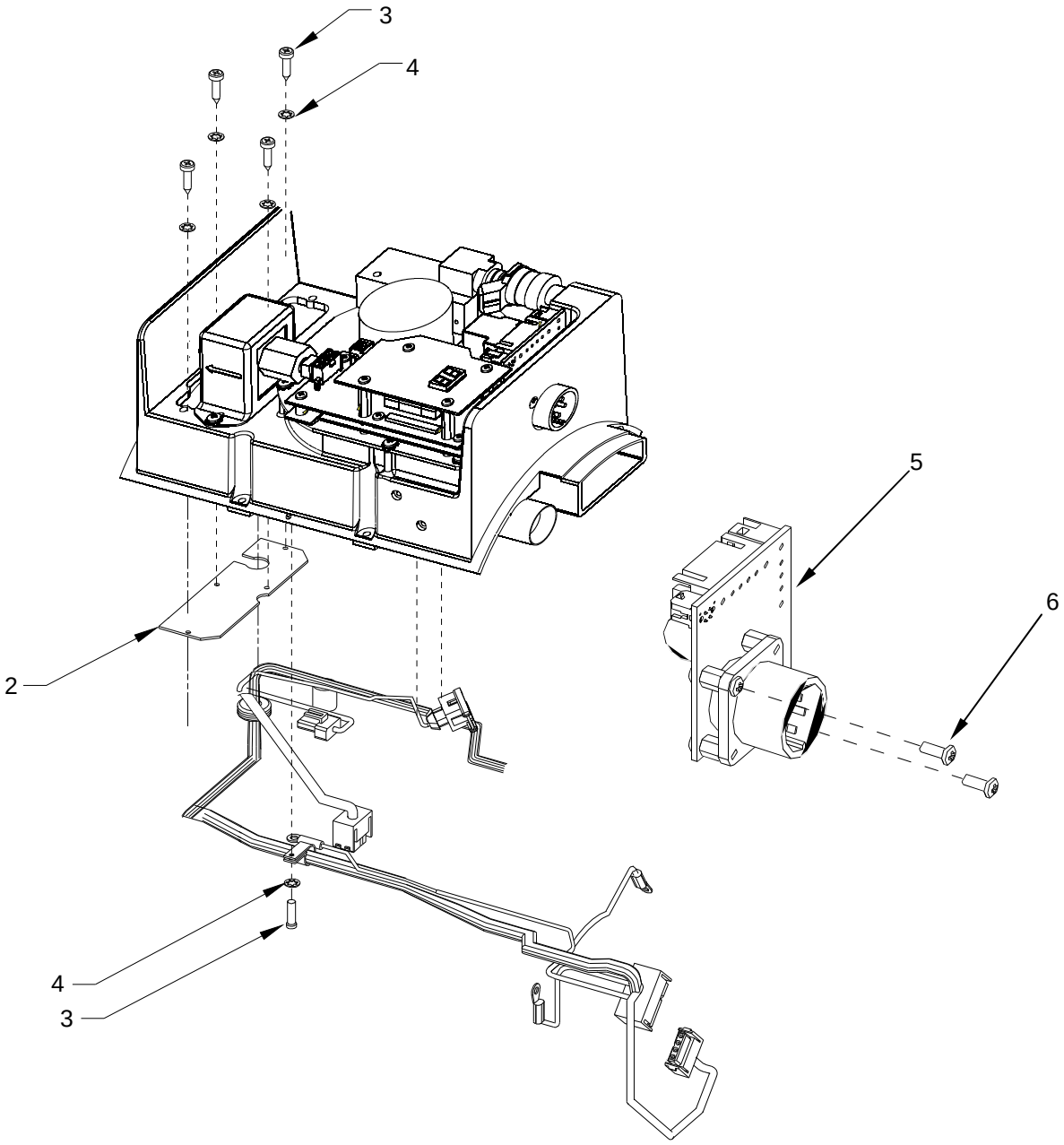


Figure E- 6. Wiring Harness

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-6, WIRE HARNESS	
1	PAFDDA	6150015287949	92878	5000-30046	KIT, HARNESS SPARE PARTS	1
2	PAFDDA		92878	5000-30285	PLATE, WIRE HARNESS (ALODINE) (NOT INCLUDED IN THE KIT)	1
3	PAFDDA		92878	2508-10350	SCREW, TAP, #8B X .62 PAN HEAD PHILLIPS	3
4	PAFDDA	5310005590070	96906	2808-10318	WASHER,LOCK INTERNAL, #8	5
5	PAFDDA	5998015287946	92878	5000-30042	FILTER BOARD	1
6	PAFDDA	5305002118193	96906	2508-10305	SCREW, #8-32 X 1/2 PAN HEAD PHILLIPS	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING.

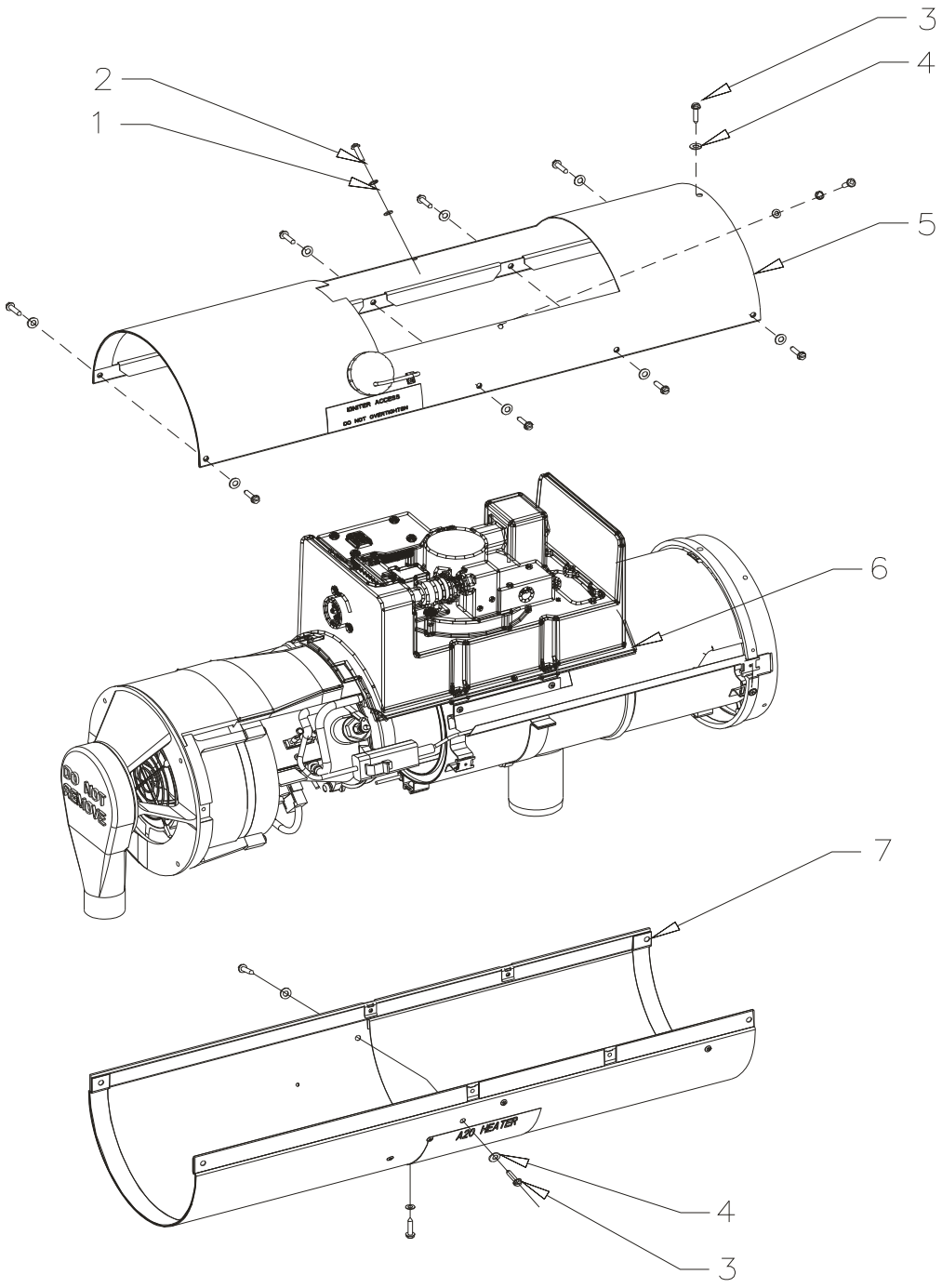


Figure E- 7. Shell Assembly

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-7, SHELL ASSEMBLY	
1	PA0ZZA	5310005590070	96906	2808-10318	WASHER, LOCK INTERNAL, #8	2
2	PAFZZA		96906	2508-10305	SCREW, #8-32 X 1/2, PAN HEAD PHILLIPS	2
3	PAFZZA		92878	2508-30117	SCREW, #8AB X 3/4 HEX WASHER HEAD	12
4	PAFZZA	5310007653197	96906	2808-10317	WASHER, FLAT, #8	12
5	PAFZZA	2540014979002	92878	5000-30019	SHELL ASSEMBLY, TOP	1
6	PAFZZA	5330014976957	92878	5000-30024	GASKET, TOP SHELL	1
7	PAFZZA	2540014979003	92878	5000-30020	SHELL ASSEMBLY, BOTTOM	1
					END OF FIGURE	

NOTE: ALL FASTENERS ARE STEEL WITH ZINC PLATING

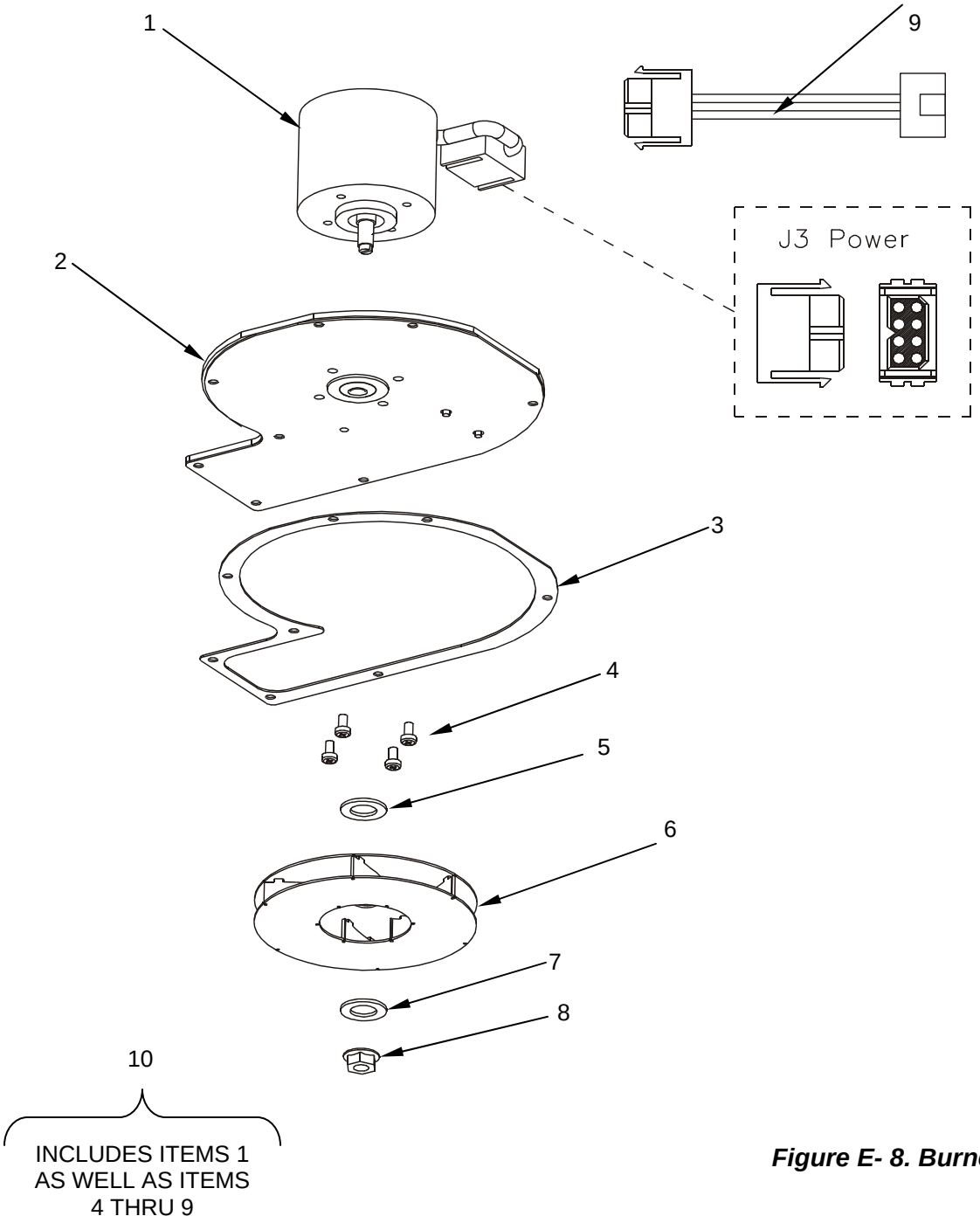


Figure E- 8. Burner Fan Motor

(1) ITEM NO.	(2) SMR CODE	(3) NSN	(4) CAGE CODE	(5) PART NUMBER	(6) DESCRIPTION AND USEABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE E-8, BURNER FAN MOTOR	
1	PA0ZZA		92878	2400-10460	MOTOR, BURNER FAN	1
2	PAFZZA		92878	5000-30406	PLATE, STUDDED BURNER FAN	1
3	PAFZZA	5330015017156	92878	5000-30401	GASKET, BURNER FAN	1
4	PAFZZA		96906	2506-10301	SCREW, MACHINE #6-32 X .25, PAN HEAD PHILLIPS	4
5	PAFZZA	5310007653197	96906	5000-10461	SPACER, BURNER, IMPELLER	1
6	PAFZZA	4520014540194	96906	5000-10011	IMPELLER, BURNER	1
7	PAFZZA		92878	2838-10462	WASHER, FLAT, .38	1
8	PAFZZA		92878	2714-10463	NUT, FLANGE MAT-LOC	1
9	PAFZZA		92878	53560	BURNER CABLE ASSEMBLY	1
10	PAFZZA	4520015393080	92878	5000-30047	A20 COMBUSTION BLOWER KIT (MOTOR/IMPELLER) (INCLUDES ITEMS 1 AS WELL AS 4 THRU 9)	1
					END OF FIGURE	

CROSS-REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX

NATIONAL STOCK NUMBER	FIGURE	ITEM	CAGEC	PART NUMBER
	E-5	2	96906	2400-10044
	E-5	20	96906	2400-10278
	E-8	3	96906	2400-10301
	E-8	1	96906	2400-10460
	E-2	8	96906	2506-10340
	E-2	11	96906	2506-30227
5305002118193	E-3	6	96906	2508-10305
5305002118193	E-5	5	96906	2508-10305
5305002118193	E-6	8	96906	2508-10305
5305002118193	E-7	2	96906	2508-10305
	E-4	5	96906	2508-10350
5305000546670	E-7	3	96906	2508-30117
5305002118193	E-1	2	96906	2508-30113
5305002118193	E-2	16	96906	2508-30113
	E-2	13	96906	2508-30114
	E-2	10	96906	2510-30109
	E-5	14	96906	2708-10349
	E-8	7	96906	2714-10463
	E-2	12	96906	2714-30163
	E-6	7	96906	2806-10341
5310007653197	E-2	14	96906	2808-10317
5310007653197	E-5	8	96906	2808-10318
5310007653197	E-7	4	96906	2808-10317
5310005590070	E-6	5	96906	2808-10318
5310005590070	E-1	3	96906	2808-10318
5310005590070	E-7	1	96906	2808-10318
	E-2	5	96906	2810-10320

NATIONAL STOCK NUMBER	FIGURE	ITEM	CAGEC	PART NUMBER
	E-6	4		2508-10350
	E-5	4		2806-10333
	E-5	16		2900-30397
	E-3	2		2900-10326
	E-4	2		2900-10326
	E-3	4		2900-30206
	E-5	13		2900-30214
	E-6	9		2900-30297
	E-5	12		3024-30292
	E-8	5		5000-10011
	E-3	3		5000-10149
	E-4	1		5000-10150
	E-8	4		5000-10461
	E-5	13		5000-10467
	E-2	4		5000-10247
6105219201063	E-2	3		5000-30000
4140014532512	E-2	9		5000-30001
5930219206763	E-2	7		5000-30002
7050219201157	E-2	6		5000-30003
6150219201548	E-6	2		5000-30004
6110219201072	E-4	3		5000-30005
2540219201461	E-4	6		5000-30006
2540219201462	KIT	1		5000-30007
2540219208126	E-5	6		5000-30008
6150219203242	E-6	1		5000-30009
	E-5	2		5000-30010
4530014527356	E-3	1		5000-30011
453001K654901	E-3	8		5000-30012
4720014599077	E-1	5		5000-30013

NATIONAL STOCK NUMBER	FIGURE	ITEM	CAGEC	PART NUMBER
4520014527358	E-1	4		5000-30014
4520014540194	E-5	9		5000-30015
2540219201459	E-2	2		5000-30016
5930219206704	E-5	10		5000-30017
2540219201458	E-1	1		5000-30018
2540219201457	E-7	5		5000-30019
2540219201455	E-7	7		5000-30020
4710219202920	E-3	7		5000-30021
4520019202929	E-3	5		5000-30022
5330219206771	E-3	9		5000-30023
5330219206765	E-7	6		5000-30024
5330219203240	E-4	4		5000-30025
1270219201381	E-2	1		5000-30026
291001K670969	E-5	1		5000-30027
	E-5	11		5000-30385
	E-5	18		5000-30395
	E-5	19		5000-30394
	E-5	14		5000-30403
	E-5	17		2508-30386
	E-5	15		5000-30149
	E-6	3		5000-30285
	E-6	6		5000-10276
	E-8	2		5000-30406

APPENDIX F

Heater Labels

Model A-20 HUNTER HEATER
Serial Number
NSN/NATO Stock Number: 2540-01-396-2826
Contract Number: DAAE07-96-C-T250
Cage Code: 38334
Mfg: Hunter Thermoelectric Inc.
Heater Assembly
Combustion Vehicle Compartment
Fuel Fired, 17.6 kW (60,000 Btu/hr)

Figure F- 1. Heater Name Plate Label

IGNITOR ACCESS
HATCH MUST BE SECURE DURING OPERATION
DO NOT OVERTIGHTEN

Figure F- 2. Ignitor Hatch Label

"CAUTION"
DO NOT OVER-TIGHTEN
FUEL FITTING

Figure F- 3. Fuel Inlet Label

Model A-20 Hunter Heater
Hunter Thermoelectric Inc.

OPERATING MODES

00	SHUTDOWN PURGE MODE
01	SELF CHECK
02	IGNITOR ON
03	DELIVER FUEL
04	IGNITOR OFF
05	FULL HEAT RAMP
06	ENTER RUN MODE
07	LOW HEAT MODE
14	HIGH HEAT MODE
99	VENT ONLY

Diagnostic Code

COMPONENT FAILURE

C1	IGNITOR FAILURE
C2	IGNITOR SHORT
C3	VENT FAN FAULT
C4	BURNER FAN FAULT
C5	BURNER SENSOR FAULT
C6	VENT SENSOR FAULT
C7	FUEL PRESSURE SENSOR FAULT
C8	CONTROLLER FAULT
C9	FUEL PUMP FAULT
CA	FUEL INJECTOR FAULT

ERRORS

E1	LOW VOLTAGE
E2	LOW FUEL PRESSURE
E3	LOW BURNER AIR FLOW
E4	REVERSE BURNER AIR FLOW
E5	INLET OVER PRESSURE
E6	OVER VOLTAGE

FAULTS

F1	IGNITION OVERTIME
F2	BURNER FLAMEOUT
F3	HEAT LIMIT
F4	VENT AIR OVERHEAT
F5	OVER CURRENT
F6	INLET OVERHEAT
F7	EXHAUST OVERHEAT
F8	IGNITION FLAME OUT

DATA CODES

D1	OPERATION HOURS
D2	NUMBER OF STARTS
D3	VERSION LEVEL

⚠ CAUTION ⚠

KEEP FLAMMABLE MATERIALS AWAY
HEARING PROTECTION REQUIRED

Figure F- 4. Diagnostic Codes Label

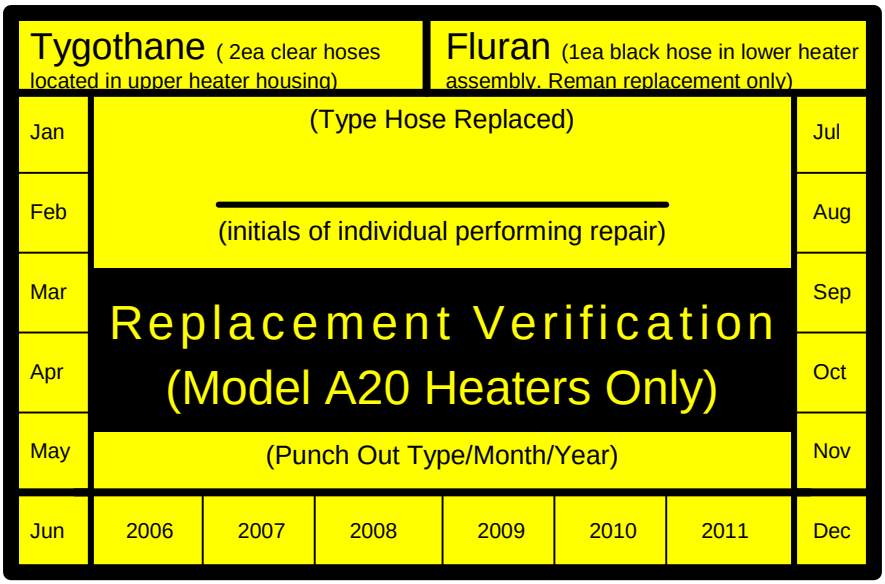


Figure F- 5. Post Service Verification Label

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By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0000000

Distribution:

To be distributed in accordance with the initial distribution number (IDN) XXXXXX, requirements for TM XXXXXXXXXXXXXXXXXXX.

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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse)* for Repair Parts and Special Tools Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	Date
TO: (*Forward to proponent of publication or form) (Include ZIP Code)*	FROM: *(Activity and location) (include ZIP code)*	

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE: Operator, Field, and Sustainment Maintenance Manual (Including RPSTL) for Heater, Vehicullar Compartment A20
TM 9-2540-207-14&P	July 31, 2007	

ITEM	PAGE	PARA	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON
	5-35					Incorrect reference on page under Step 5.

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO: *(Forward direct to addressee listed in publication)*	FROM: *(Activity and location) (Include Zip Code)*	DATE

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

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TM 9-2540-207-14&P	July 31, 2007	

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*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

DA FORM 2028 , FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V1.00

TO: *(Forward direct to addressee listed in publication)*	FROM: *(Activity and location) (Include Zip Code)*	DATE

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

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ITEM	PAGE	PARA	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce–inches	newton–meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound–feet	newton–meters	1.356	metric tons	short tons	1.102
pound–inches	newton–meters	.11296			

Temperature (Exact)

_F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	_C