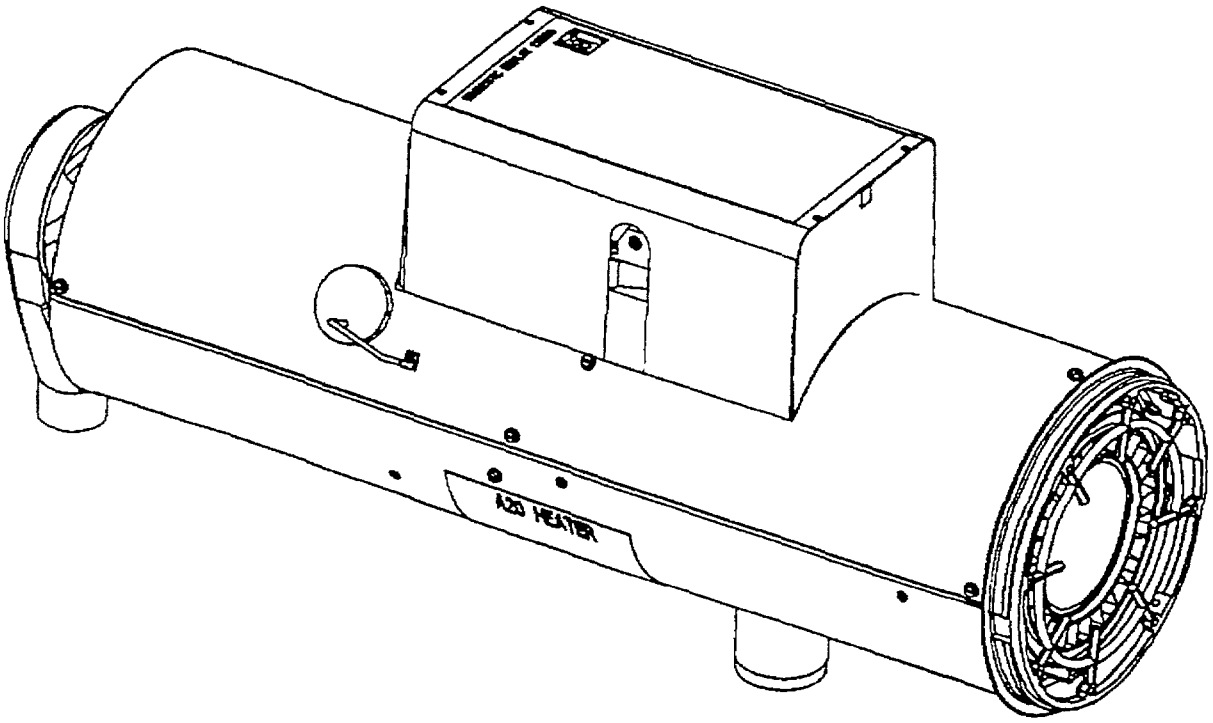
TECHNICAL MANUAL
UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) FOR HEATER, VEHICULAR COMPARTMENT

NSN 2540-01-396-2826
MODEL A-20



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1 APRIL 2001

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NOTE TO MAINTAINERS:

This heater is SMR coded PAOFD. This means that the heater may be removed replaced at Unit maintenance level. Any further repair work should be forwarded to Direct Support Maintenance Level Direct Support is authorized to send it to Depot if repairs are beyond their capability. Unit maintenance should NOT send this heater to Depot.

WARNINGS

Failure to follow these safety precautions could result in serious injury or death to personnel and/or property damage. Refer to FM 21-11 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 24 VDC. 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 bums 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 30 psi (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 21-11.

WARNING

Fuel is slippery and can cause falls. To avoid injury, clean up spilled fuel immediately. For first aid information refer to FM 21-11.

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GLOSSARY OF TERMS

Ambient Temperature - This is the natural temperature of the environment surrounding the Heater.

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 part of the vehicle equipped components.

PC Board - An electronic circuit board. The Heater has 5 PC boards: Power & Logic Controller (2), Vent Fan, Burner Fan, and Diagnostic Display.

PSI - An acronym for Pounds per Square Inch, which is a measure of pressure.

SCFM - An acronym for Standard Cubic Feet per Minute, which is a measure of air flow. 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 measure of liquid (fuel) flow.

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

SECTION 1
INTRODUCTION

1.1 THE A-20 GLOBAL HEATER

The model A-20 Global 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 A-20 Global 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 A-20 Global 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) ".

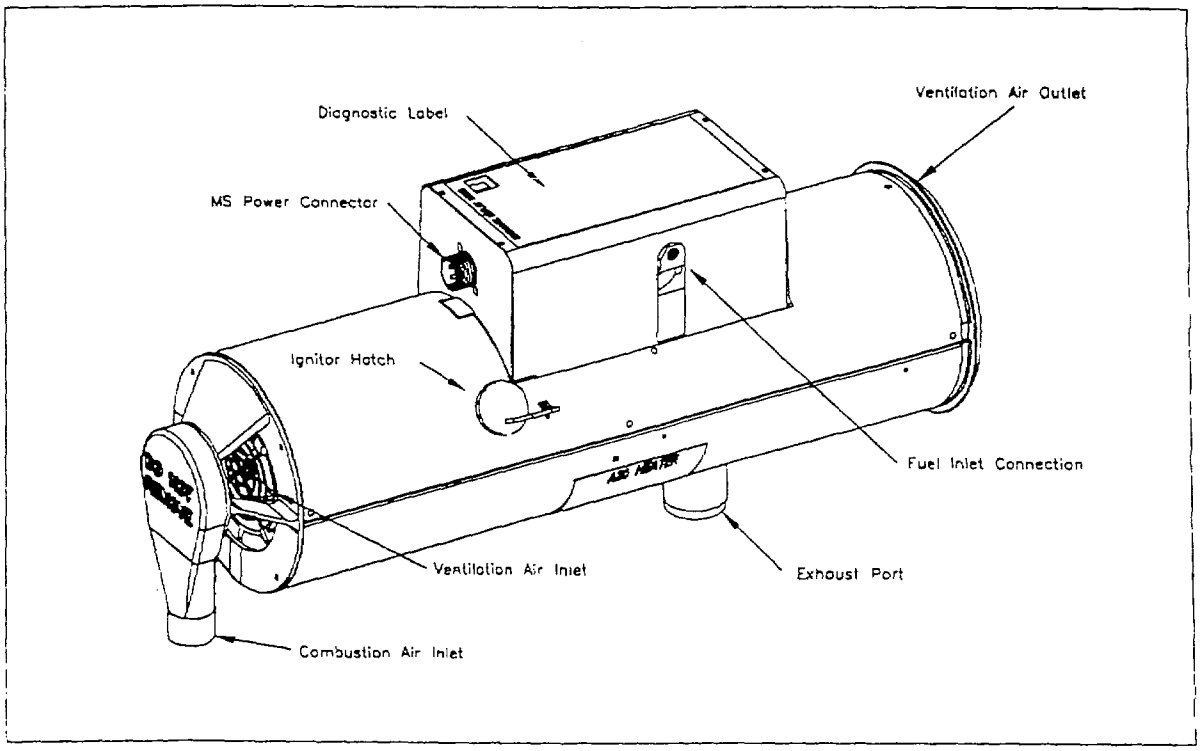

Figure 1-1. A-20 Global Heater

1.2 PRINCIPLES OF OPERATION

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.

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.

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.

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.

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.

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.

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.

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 1-1 for A-20 Global Heater specifications.

Nominal Heat Output	60,000 BTU/Hr High Heat 30,000 BTU/Hr Low Heat
Size	Ref. Figure 1-2
Weight	38 Pounds (17 Kg.)
Power Consumption	480 Watt at 24 VDC
Air 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 1-1. Heater Specifications

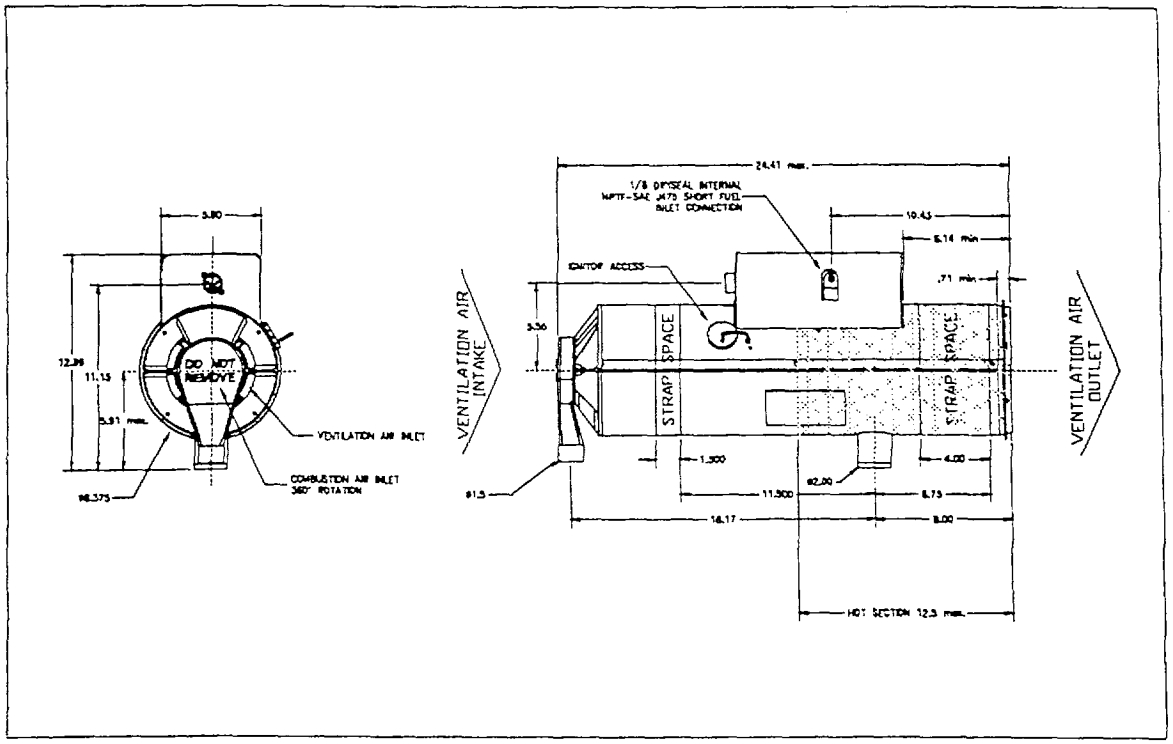

Figure 1-2. Heater, General Dimensions

1.4 SHIPPING CONTAINER

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

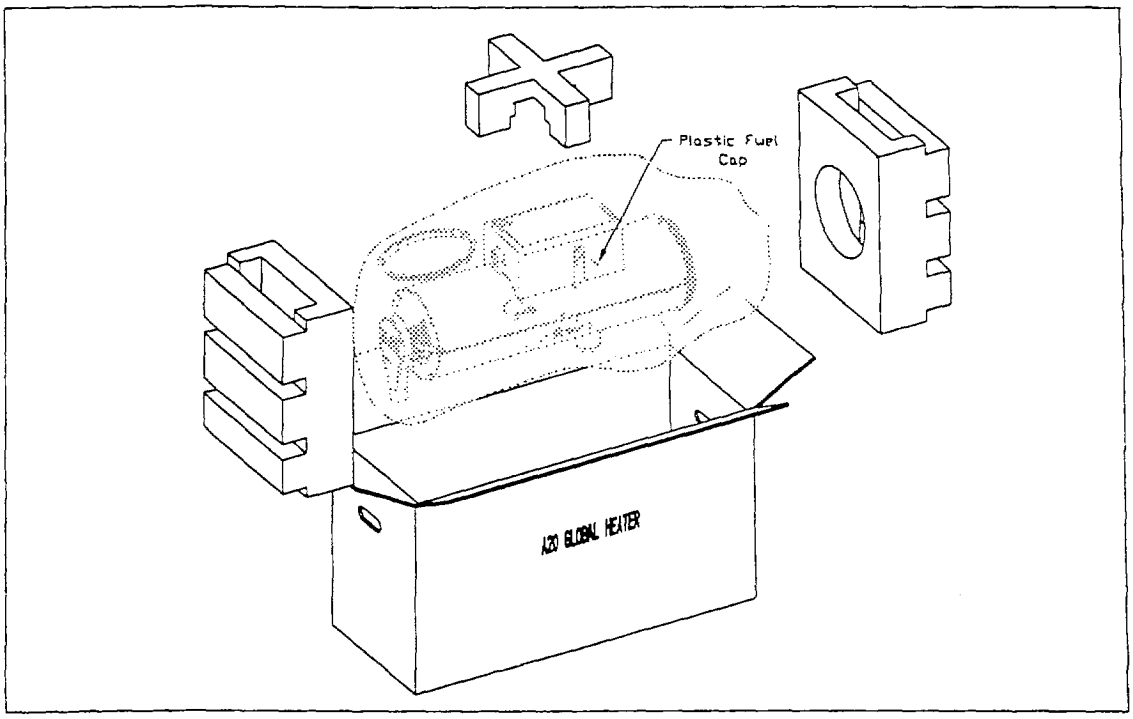

Figure 1-3. Shipping Container

If the shipping container appears damaged, inspect contents by comparing the Heater with Figure 1-1. Look for dents on the exterior of the Heater. There are no loose parts in a functional Heater.

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 avid shipping damage from the protective end packaging material.

✓ (1) Operator and Maintenance Manual (first 1000 units only).

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!

1.5 HEATER OPERATION VERIFICATION

Although each Heater has been acceptance tested at the factory prior to shipment, it is recommended that each Heater be placed on a Heater Test Stand (Model VHTS-89102, NSN 4910-01-318-4508) to verify operation prior to field installation. Follow Safety measures when using the Heater Test Stand as defined in the Operators, Unit and Direct Support Technical Maintenance Manual (TM) 9-4910-755-13&P.

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.

No special tools or test items are required for operating and maintaining the Heater. The standard tools and supplies required are outlined in Table 1-2.

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	
Supplies:	Thread lock, Loctite 242 (blue)
	Teflon thread sealant, Loctite PST 592
	Nickel anti-seize, Loctite 77164
	Primer, Loctite 770, with Adhesive Loctite 401
	Adhesive, Loctite 609
	Dow Coming 340 Heat Sink Compound
	Silicone RTV (red)
	WD-40
	Common grease (GAA)

Table 1-2. 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 46 pounds (21 Kg.)

SECTION 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 A-20 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.

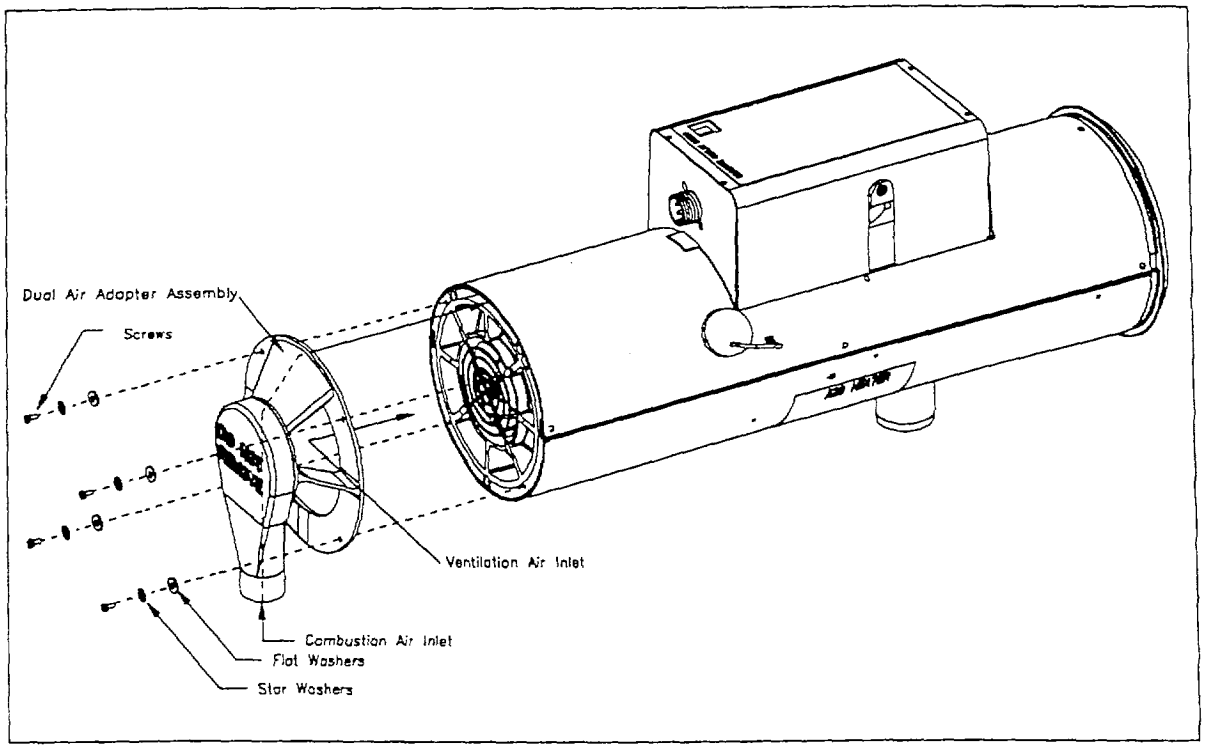

Figure 2-1. Single Air Configuration

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 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 1,100°F (593°C). (Ref. Figure 2-3).

2.4 MOUNTING

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

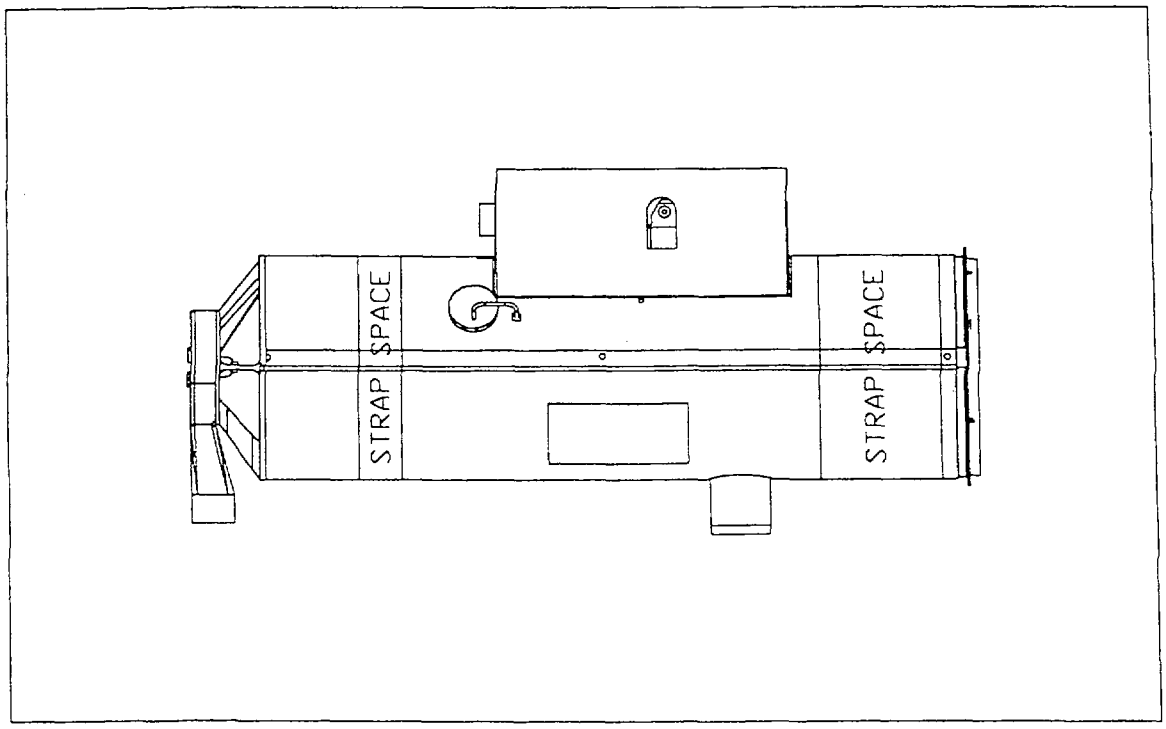

Figure 2-2. Mounting Strap Locations

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 24 VDC drawing 20 amperes of current.

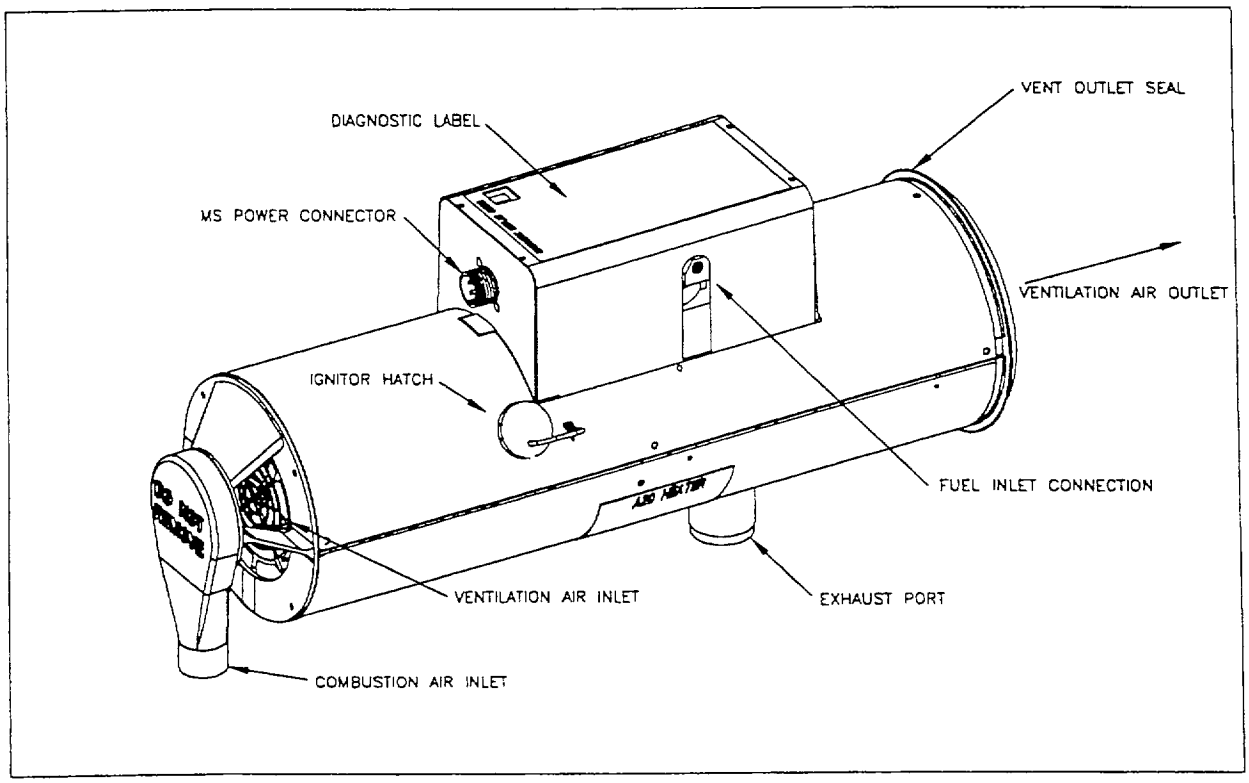

Figure 2-3. A-20 Global Heater

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

!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 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 2-1. 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.

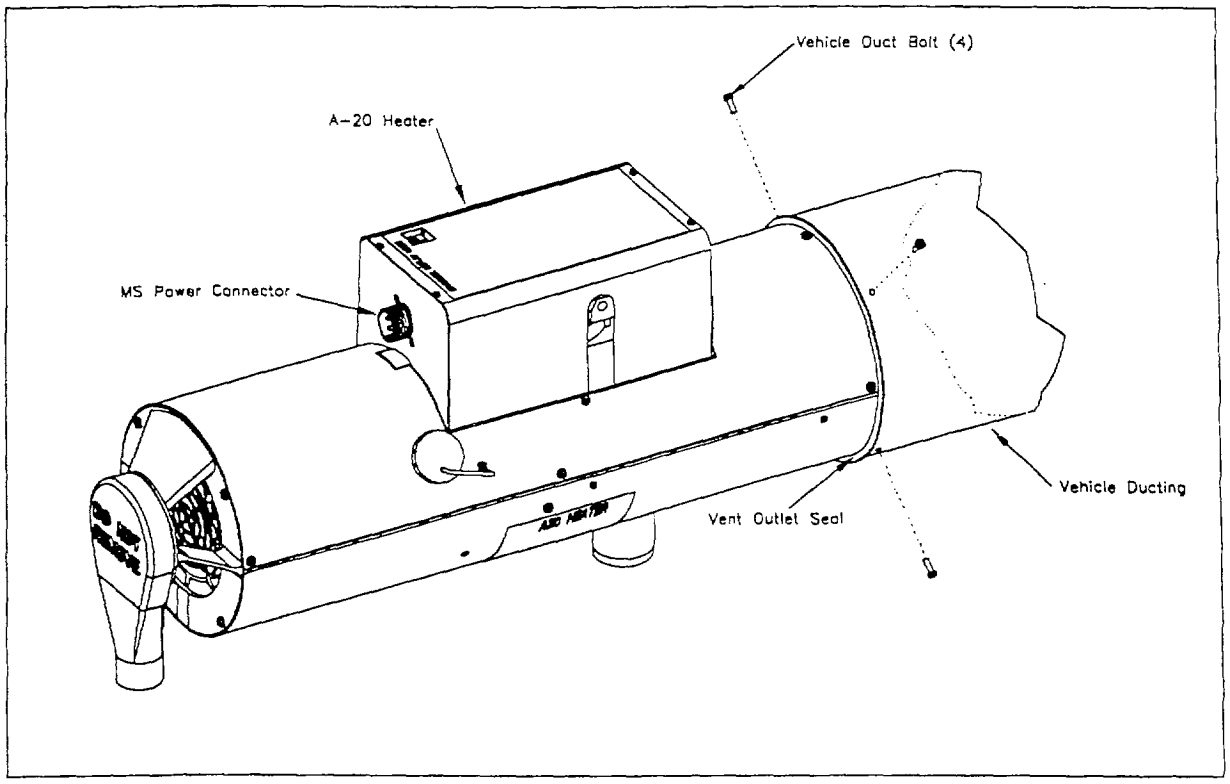

Figure 2-4. Ventilation Air Duct

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.

SECTION 3
OPERATING INSTRUCTIONS

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:	ATPD 2165

Table 3-1. Approved Control Boxes

3.1 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, and then move the switch **directly** to RUN. **The Heater will now run automatically and does not require any further actions by the operator.**

Note: to start the Heater in the M1 Tank, the Control Box Switch must be held in the "Start" position until the indicator lamp Illuminates, and then moved to the "Run" position.

3.2 STARTING SYSTEMS PROCEDURES

i. The Heater will start the Vent and Burner Fans and after checking for vent overheat condition, if none is found, display **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.

ii. The heater then enters Stage **02**. The Igniter will turn on and requires approximately 50 seconds to heat fully. During this delay the Heater will check the condition of the igniter, 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. 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 1/4 second 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 5.5.2.

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

Table 3-2. Diagnostic Display Segment Steps

iii. 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.

iv. When the Heater has achieved ignition, the Igniter automatically turns off, the Control Box Lamp illuminates and the Diagnostic Display will read **04**

v. 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**.

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

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

Table 3-3. Operating Modes

3.3 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 M1A1 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.

3.4 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.

3.4.1 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 four (4) 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 four (4) minute Purge Cycle has been completed.

3.5 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 (4) minute Purge cycle while the Diagnostic Display Code shows 00 for one minute, then cycles through the Heater Data Codes (ref. 3.6).

3.6 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 5.5.2

D1	Operation Hours
D2	Number of Starts
D3	Version Level

Table 3-4. Data Codes

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 one 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 3-5. Data Codes Mode Example

3.7 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 1/2 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 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	Over Voltage
F3	Heat Limit
F6	Ambient Over Temperature

Table 3-6. Warning Faults

C1	Igniter Fault
C2	Igniter 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
F1	Ignition Overtime
F2	Burner Flame Out
F4	Vent Air Over Heat
F5	Over Current
F7	Exhaust Over Temperature
F8	Ignition Flame Out

Table 3-7. Shut Down Faults

SECTION 4
HEATER MAINTENANCE

Failure to follow these safety precautions could result in serious injury or death to personnel and/or property damage. Refer to FM 21-11 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 Igniter, 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 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 24 VDC. 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 30 psi (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 21-11.

WARNING

Fuel underfoot is slippery and can cause falls. To avoid injury clean up spilled fuel immediately. For first aid information refer to FM 21-11.

4.1 PERIODIC SERVICE AND INSPECTION

The A-20 Global Heater is designed to operate with little maintenance. Conduct regular preventive maintenance which will help improve the life and performance of the Heater.

At the start of **every** season:

- clean the Igniter & Igniter Holder (ref. 4.4.1)
- clean the Combustion Assembly (ref. Section 5.3)

4.2 MAINTENANCE LEVEL

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

4.3 UNIT LEVEL MAINTENANCE

The following section, Igniter & Igniter Holder Maintenance (4.4.1), details the required Unit Level Maintenance for the Global A-20 Heater.

4.4.1 IGNITER & IGNITER HOLDER MAINTENANCE

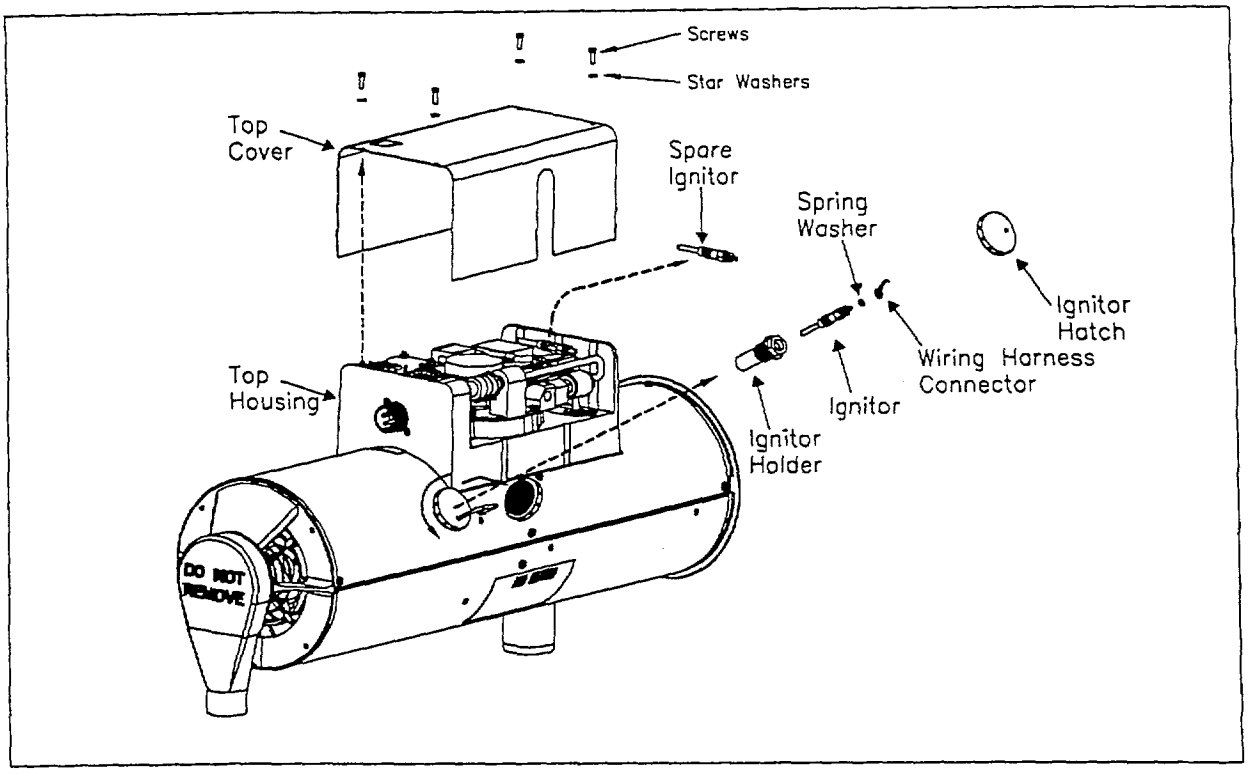

Figure 4-1. Igniter & Igniter Holder Maintenance

Removal

1. Remove Igniter Hatch by unscrewing the cap counter-clockwise.
2. Remove Igniter electrical connector wire attached to the electrical post of the Igniter. DO NOT pull or twist the connector wire. **DO NOT remove the spring washer from the electrical post of the Igniter.**
3. Using a 3/8" open ended wrench, remove Igniter threaded into the Igniter Holder.

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

4. Using a 3/4" socket, remove Igniter Holder threaded into the Burner Housing.
5. Use a wire brush to carefully remove any carbon deposits from the Igniter Holder.
6. Gently wipe the Igniter with a rag to remove any carbon buildup.

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

4.4.1 Igniter & Igniter Holder Maintenance (continued)

Installation

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

1. If a NEW Igniter is to be installed:

   i. Remove Top Cover (ref 5.1.1)
   ii. Remove spare Igniter mounted in the Top Housing.
   iii. Remove the nut on the electrical post of the Igniter, but **DO NOT remove the spring washer**. Discard Nut.
   iv. Install Top Cover (ref. 5.1.1)

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

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

3. Using a 3/4" socket, install Igniter Holder threaded into the Burner Housing.
4. Using a 3/8" open ended wrench, install the Igniter into the Igniter Holder. DO NOT over tighten.
5. Check that the spring washer is installed on the Igniter electrical post.
6. Place the electrical wire connector onto the Igniter electrical post.
7. Install Igniter 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 Igniter Hatch must be properly in place so that the Hatch gasket seals against the Top Shell to prevent air leakage during operation.

SECTION 5
HEATER REPAIR

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. 5.4.3)

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

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 Heater Ducting Vehicle
- 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.

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

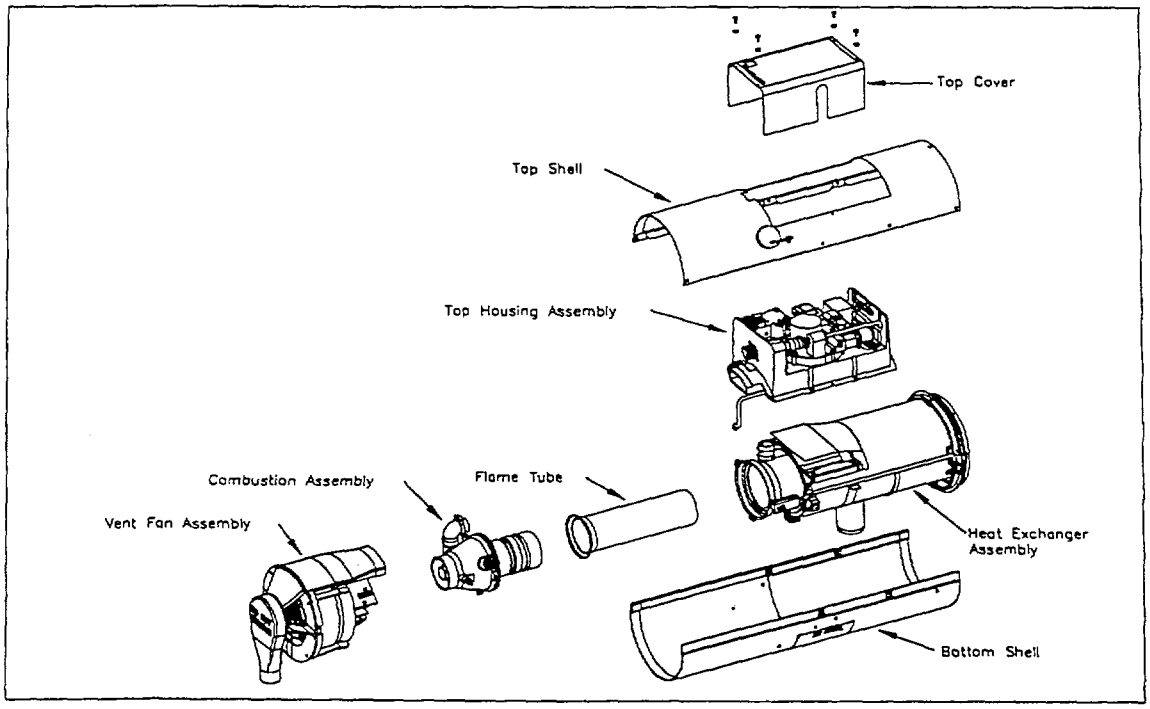

Figure 5-1. Heater, Major Assemblies

Test Stand Installation & Removal

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;

5.1 SHELL ASSEMBLY

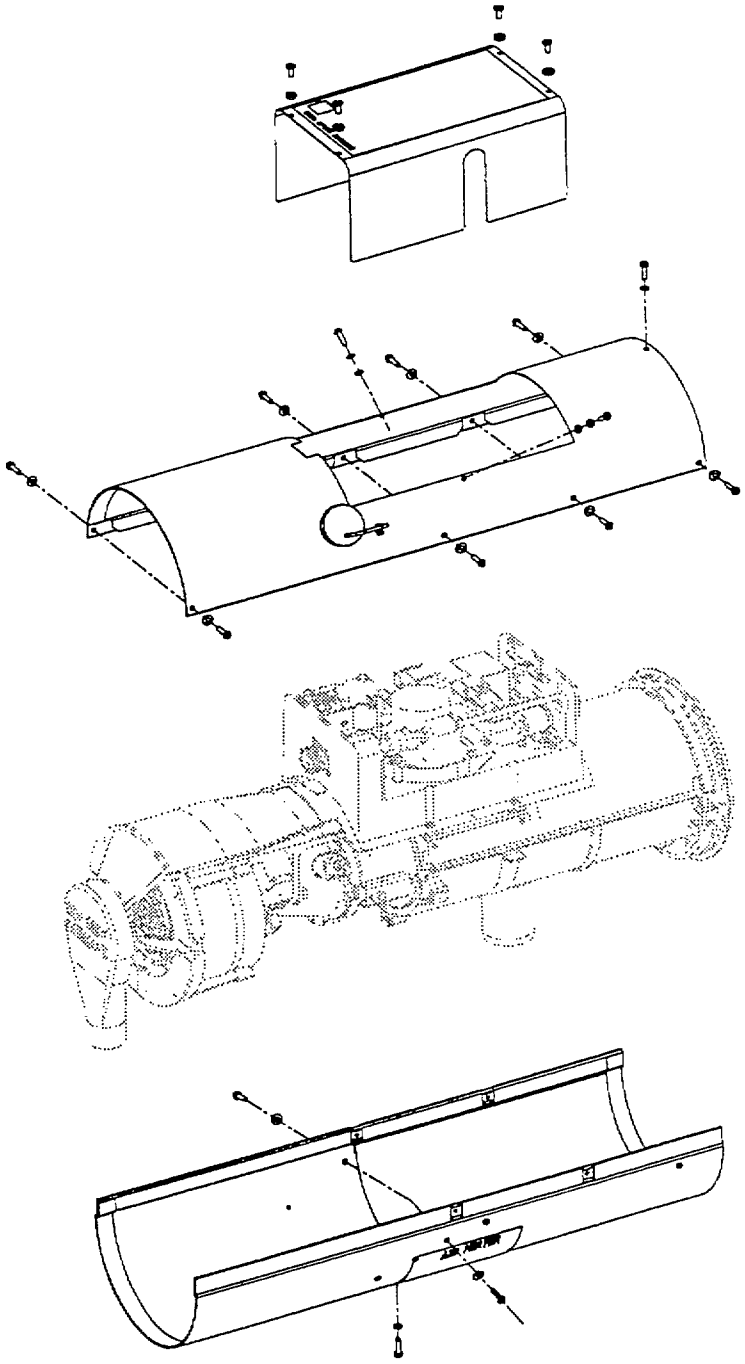

Figure 5-1.1. Shell Assembly

5.1.1 TOP COVER

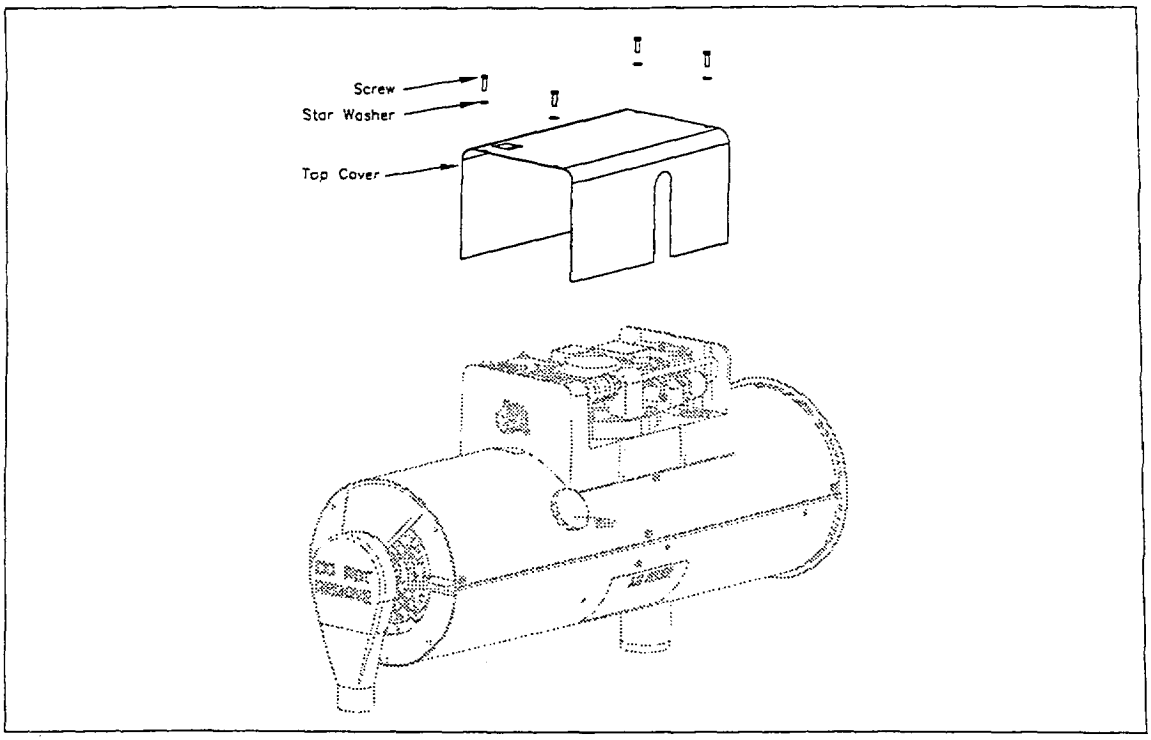

Figure 5-1.2. Top Cover

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.**

Installation

1. Align the slot in the Top Cover with the fuel inlet valve 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.**

5.1.2 TOP SHELL

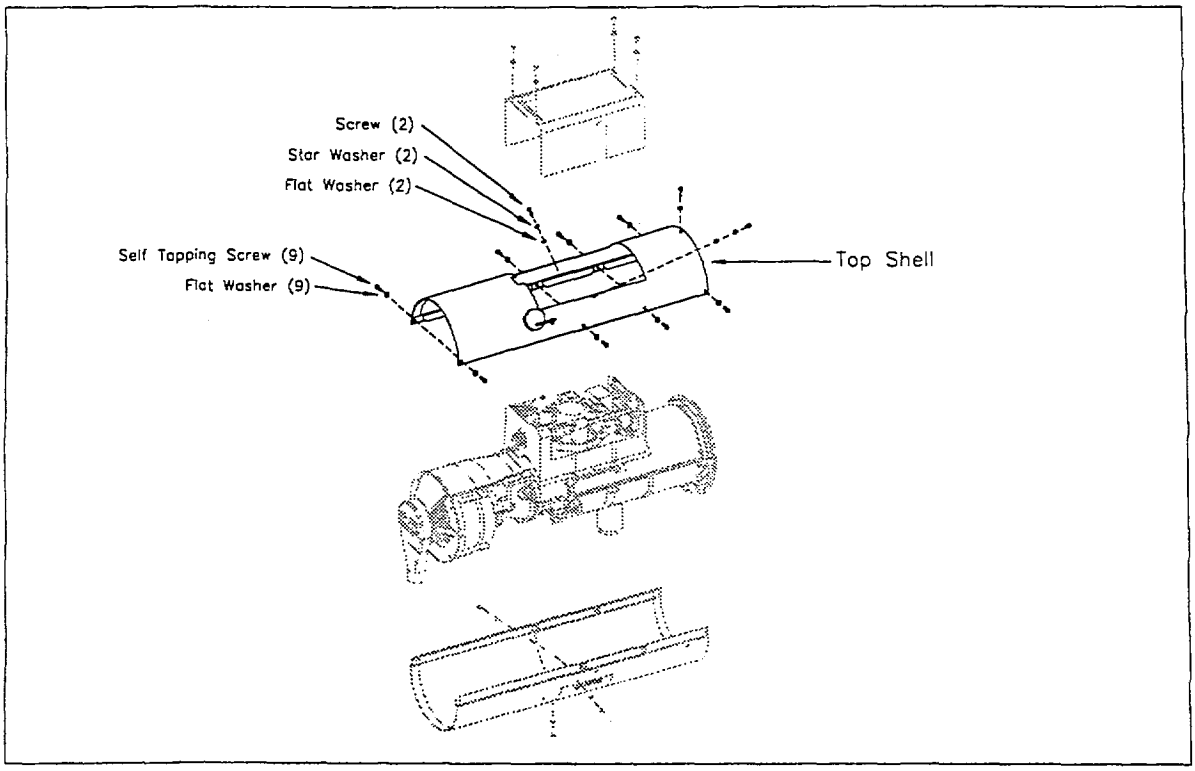

Figure 5-1.3. Top Shell

Removal

1. Unscrew counter-clockwise and remove the Igniter Hatch.
2. 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.**

5.1.2 Top Shell (Continued)

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 Igniter electrical post.
4. Check that the Igniter electrical connection is in place on the Igniter. 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 which fit inside the mating tabs on the Bottom Shell.

   Tip: Make sure the locking tabs fit together properly, then gently 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 Igniter electrical connection is in place on the Igniter. Screw the Igniter Hatch into place. DO NOT over tighten. Ensure that the Hatch is fitting properly to the shape of the Top Shell.

   Note: The Igniter Hatch must be properly in place to prevent air leakage during operation and to ensure a good electrical connection for the Igniter.

7. Place the Heater on the Test Stand and check for operation (ref. 3.1).

5.1.3 BOTTOM SHELL

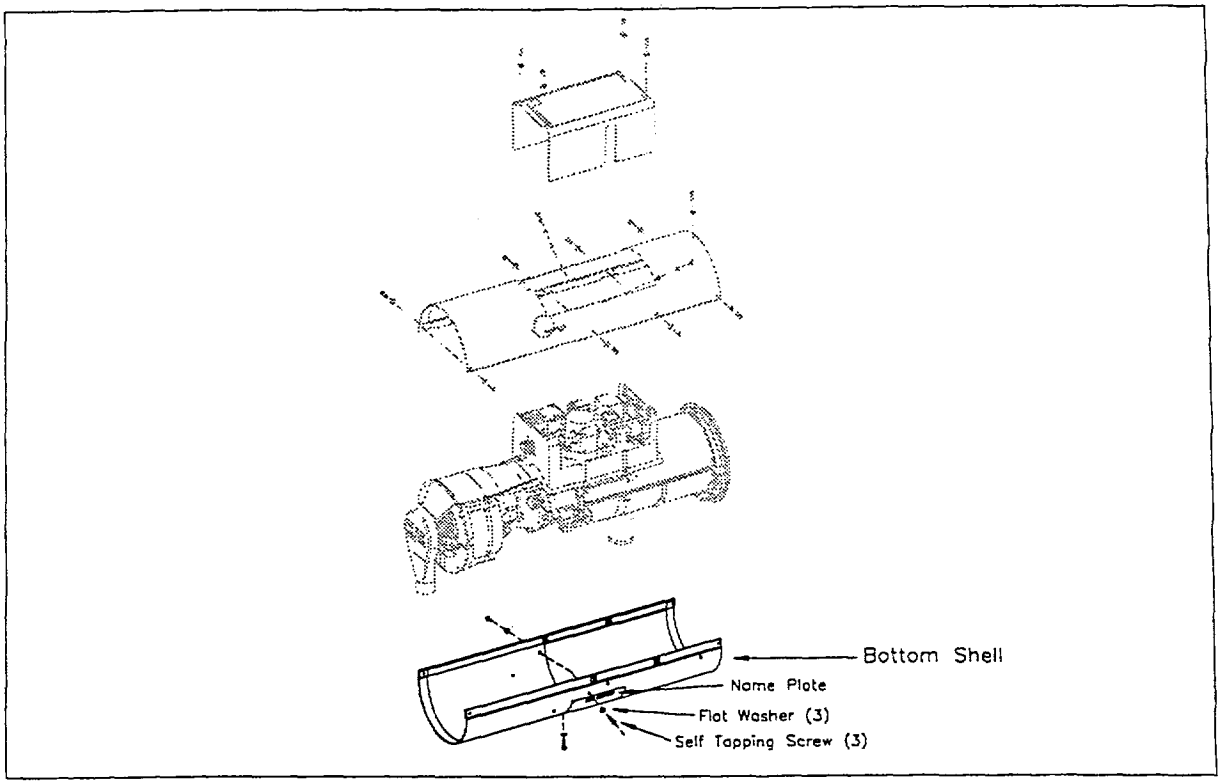

Figure 5-1.4. Bottom Shell

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Using a 1/4" nut driver or 1/4" socket, remove three (3) self tapping screws. Lift off the Bottom Shell by gripping both sides and flexing open.

Installation

Note: If the Name Plate is to be replaced:

i. Stamp Heater serial number onto replacement Name Plate using punches and stamps.

ii. 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.

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

5.1.3 Bottom Shell (continued)

Installation (continued)

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. 5.1.2)

5.1.4 IGNITER & IGNITE R HOLDER

Refer to Section 4.4.1

5.2 VENT FAN ASSEMBLY

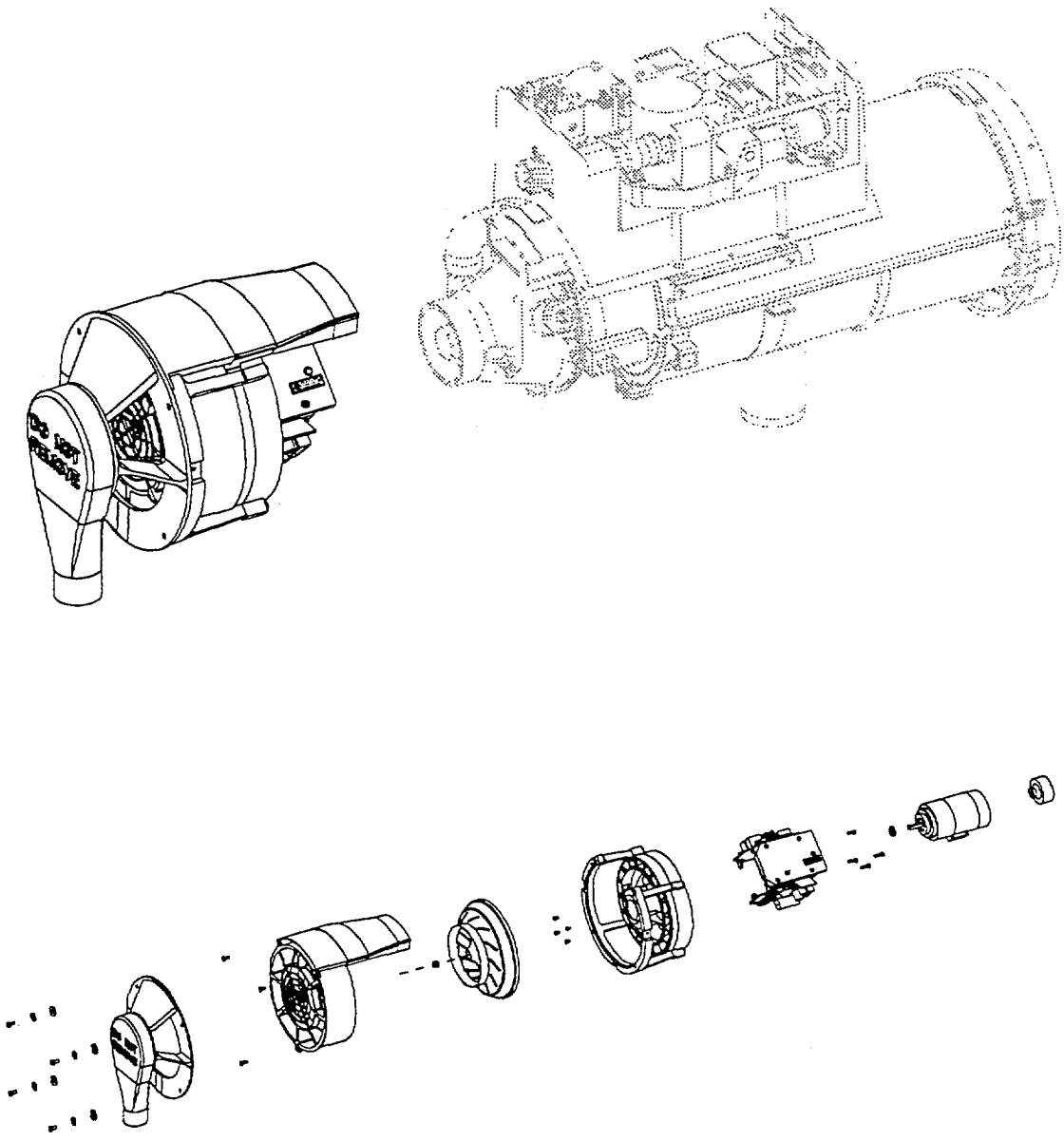

Figure 5-2.1. Vent Fan Assembly

5.2.1 VENT FAN ASSEMBLY

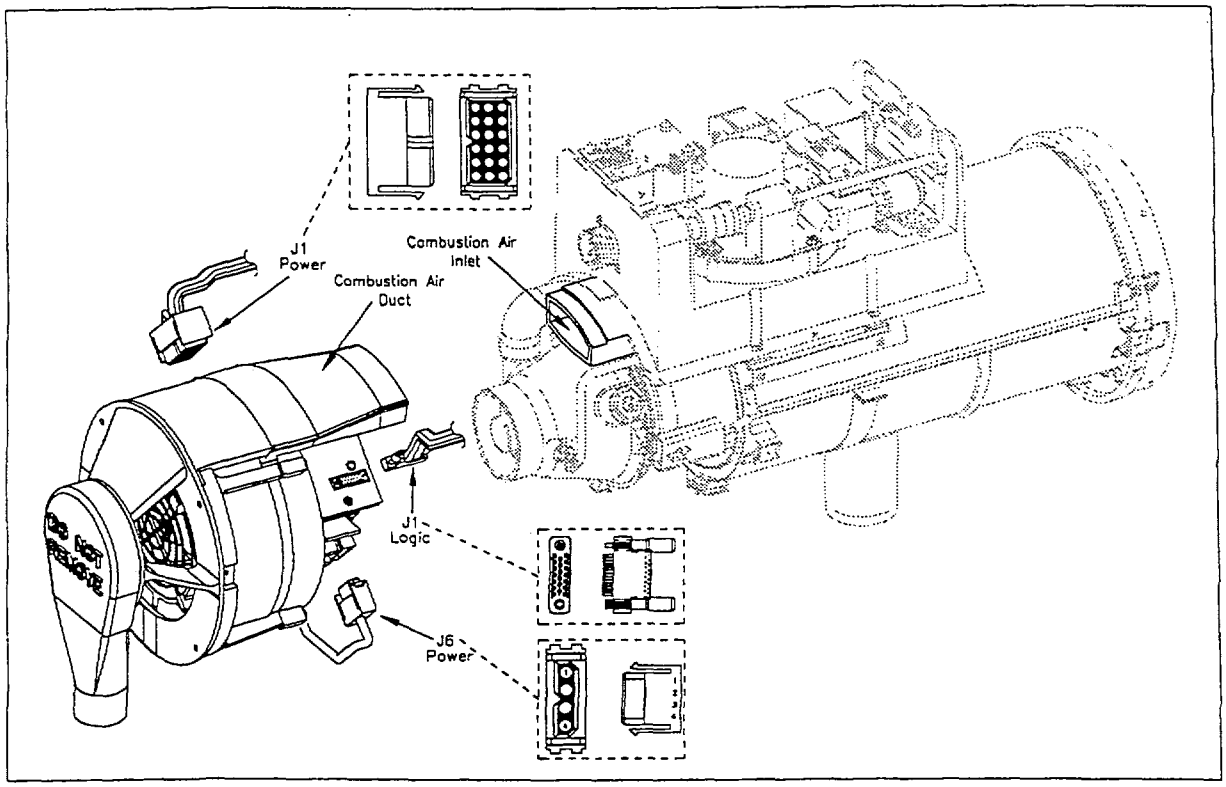

Figure 5-2.2. Vent Fan Assembly

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. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Disconnect **Power** 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.

5.2.1 Vent Fan Assembly (continued)

Removal (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 Logic Wiring Harness connection J1 to the Electronic Programmed Controller Board.

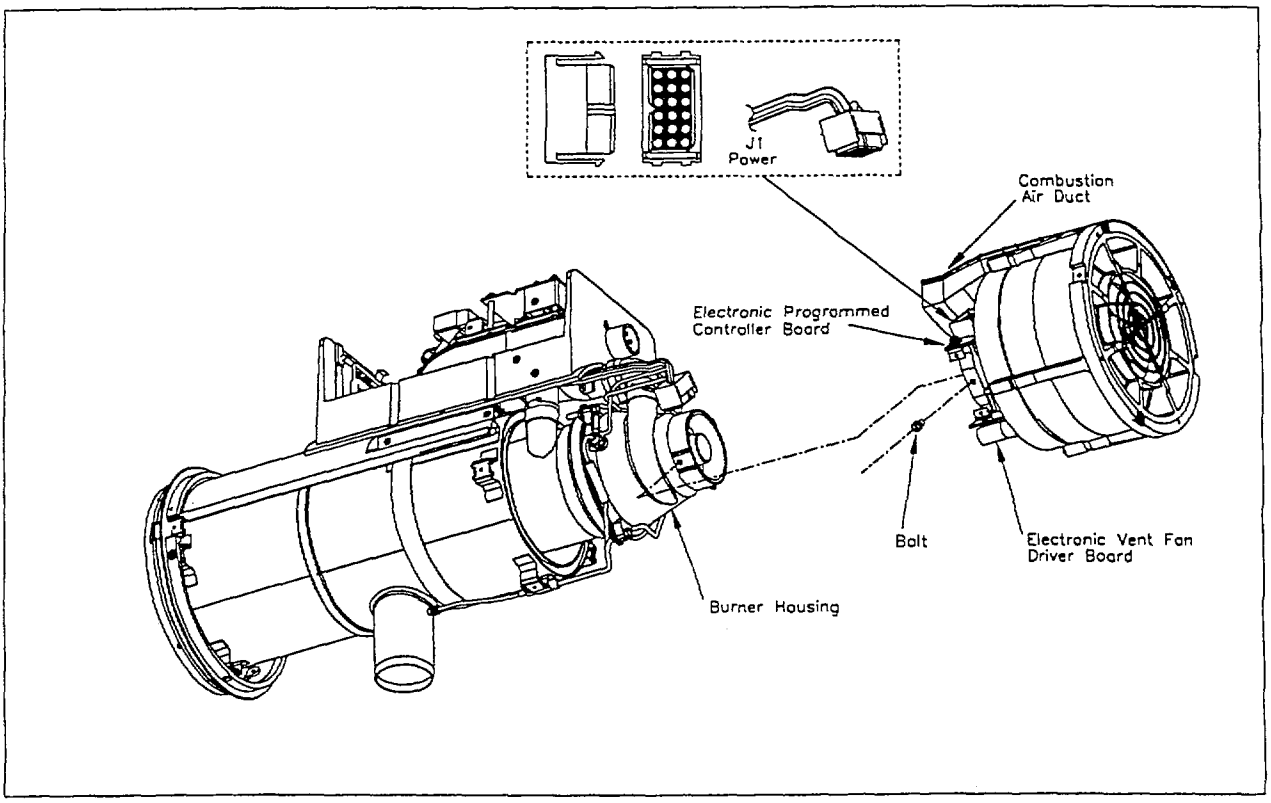

Figure 5-2.3. Bolt Removal Detail, Vent Fan Assembly

5. Use a 5/16" socket to remove the bolt which 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 remaining **Power** Wiring Harness connector J1 from the Electronic Programmed Controller by squeezing with fingers and separating.

5.2.1 Vent Fan Assembly (Continued)

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.

1. 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.

2. 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.
3. 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.
4. Tighten the bolt using a 5/16" socket. DO NOT OVER TIGHTEN. Check that the Vent Fan rotates freely.
5. Attach **Power** Wiring Harness connector **J1** to the Electronic Programmed Controller board. Ensure that the locking tabs are properly engaged.
6. Attach **Power** 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.

7. Attach **Logic** 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.
8. Install Bottom Shell (ref. 5.1.3)
9. Install Top Shell (ref. 5.1.2)

5.2.2 MOTOR MAGNET

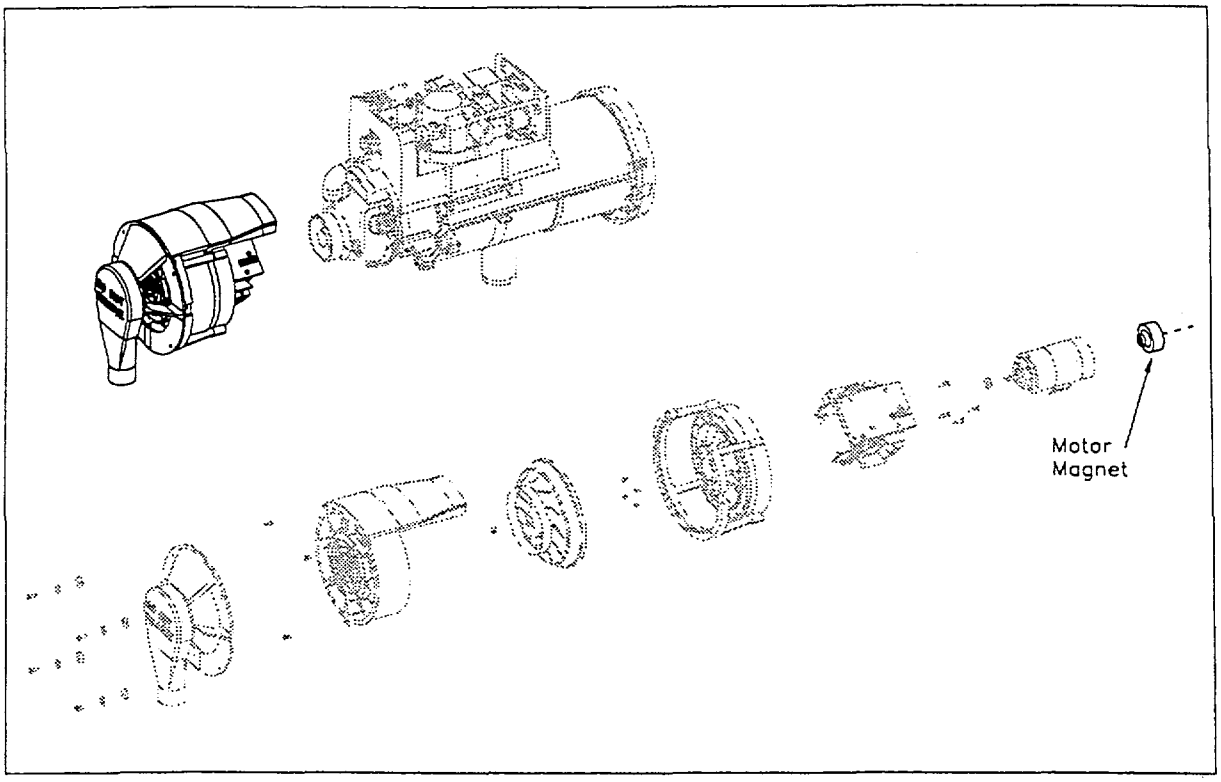

Figure 5-2.4. Motor Magnet

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: DISASSEMBLY of the Vent Fan Assembly is NOT required to remove the Motor Magnet

1. Remove Vent Fan Assembly (ref. 5.2.1)

5.2.2 Motor Magnet (continued)

Removal (continued)

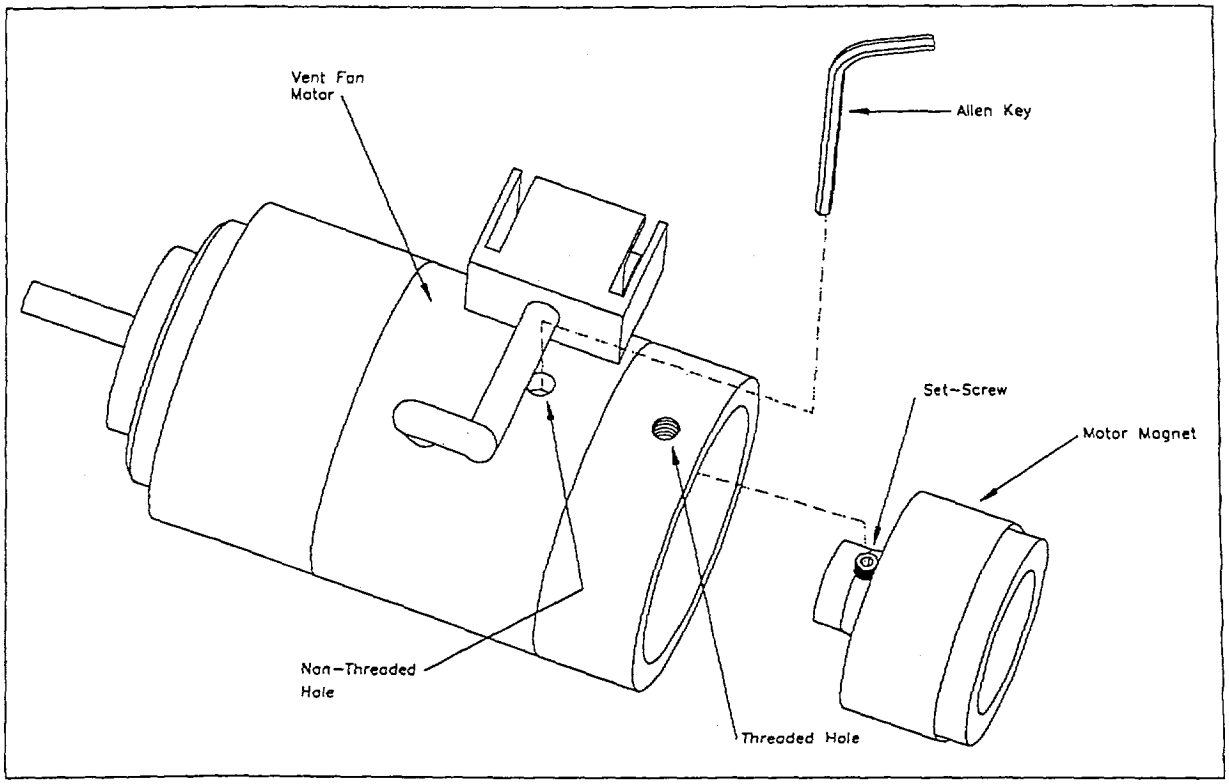

Figure 5-2.5. Motor Magnet Detail

2. 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.

3. 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.
4. Remove Motor Magnet from the Motor shaft.

Installation

1. Position the Motor Magnet, complete with set-screw, onto the shaft of the Motor.
2. Insert a 3/32" Alien 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. Install Vent Fan Assembly (ref. 5.2.1)

5.2.3 VENT FAN SHROUD

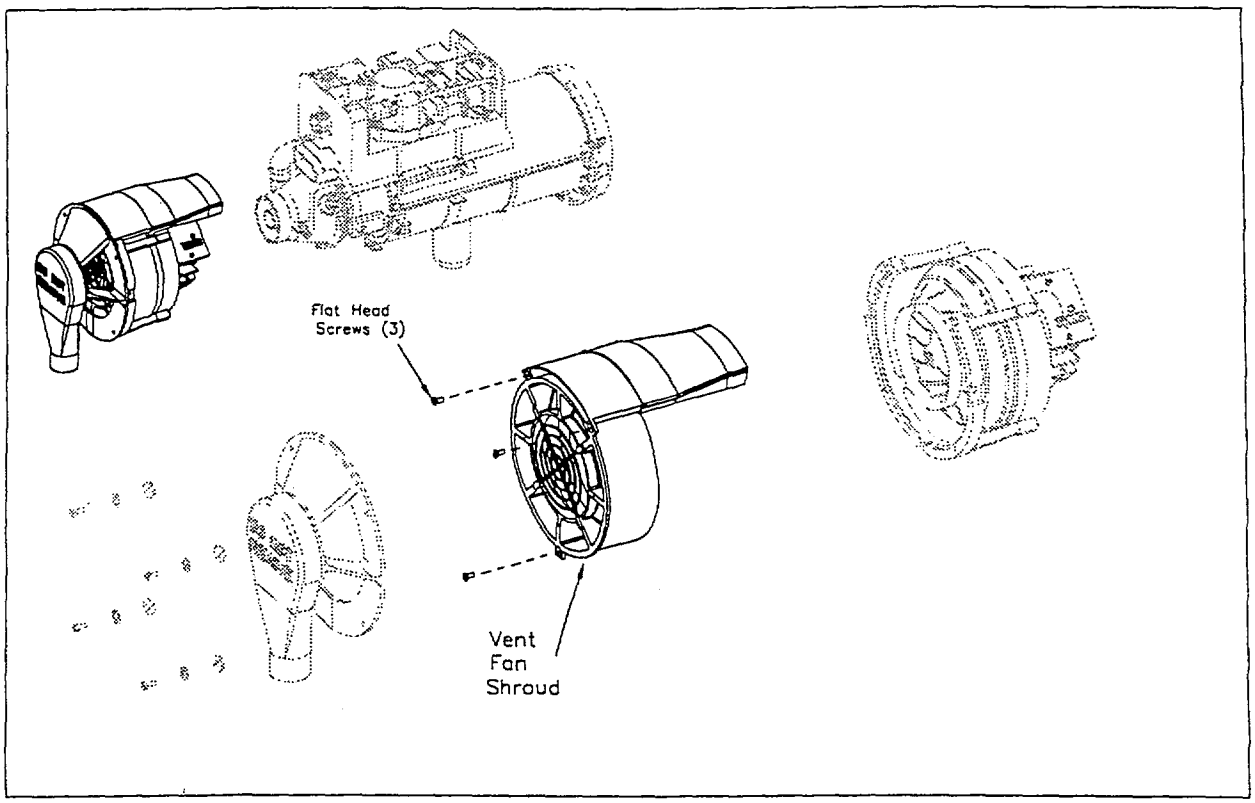

Figure 5-2.6. Vent Fan Shroud

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 (ref. 5.2.1)
2. Using a 1/4" socket or 1/4" nut driver, remove four (4) hex-head screws to detach the Dual Air Adapter. (ref. Fig. 2-1)

Note: The Dual Air Adapter gasket should remain with 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.

5.2.3 Vent Fan Shroud (continued)

Removal (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.

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 Shroud Seal on the Vent Fan Housing is in place. Re-attach with Loctite 770 and 401 if necessary.
3. Line up the Vent Fan Shroud with the Vent Fan Housing and push into place.
4. Apply Loctite 242 (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.
5. Check that the Impeller is free to rotate.
6. Apply Loctite 242 (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 washer are in place on each screw. (ref Fig. 2-1)
7. Install Vent Fan Assembly to the Heater. (ref. 5.2.1)

5.2.4 VENT FAN IMPELLER ASSEMBLY

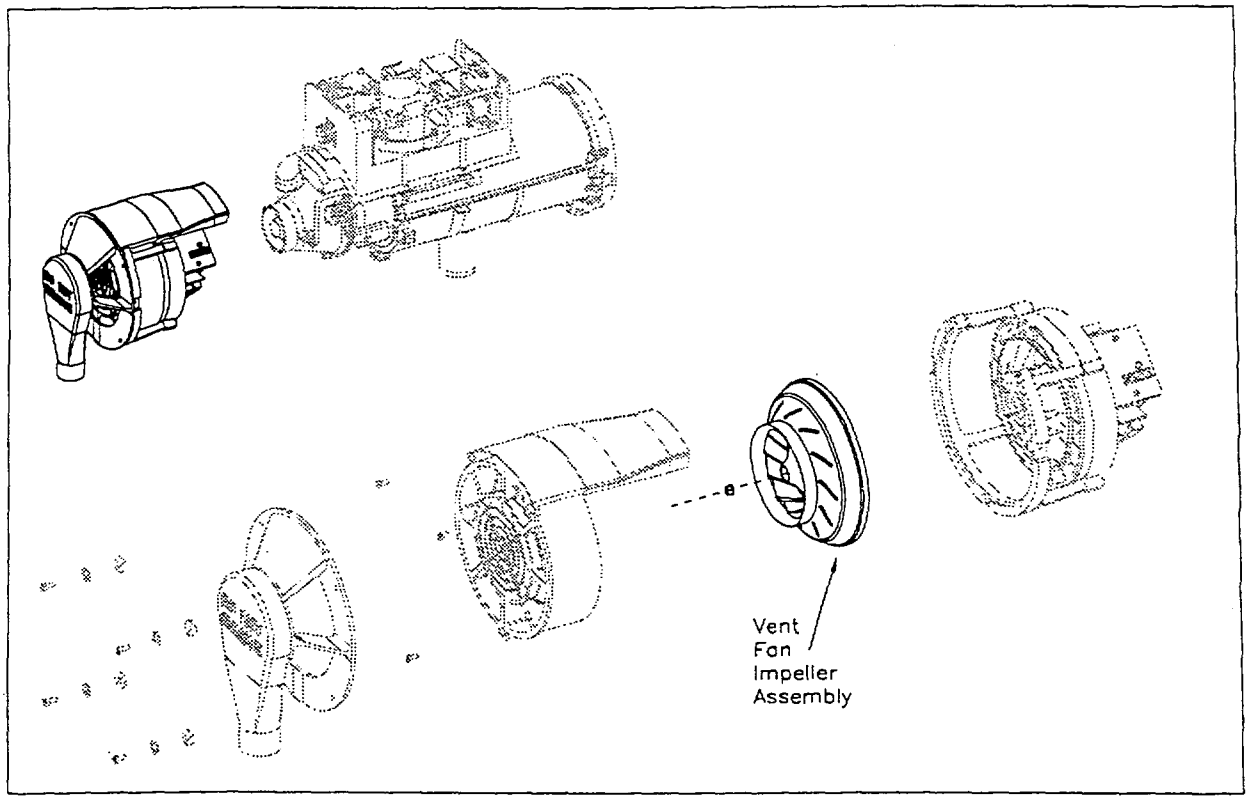

Figure 5-2.7. Vent Fan Impeller

Removal

1. Remove Vent Fan Assembly (ref. 5.2.1)
2. Remove Vent Fan Shroud (ref. 5.2.3)

!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.

5.2.4 Vent Fan Impeller Assembly (continued)

Removal (continued)

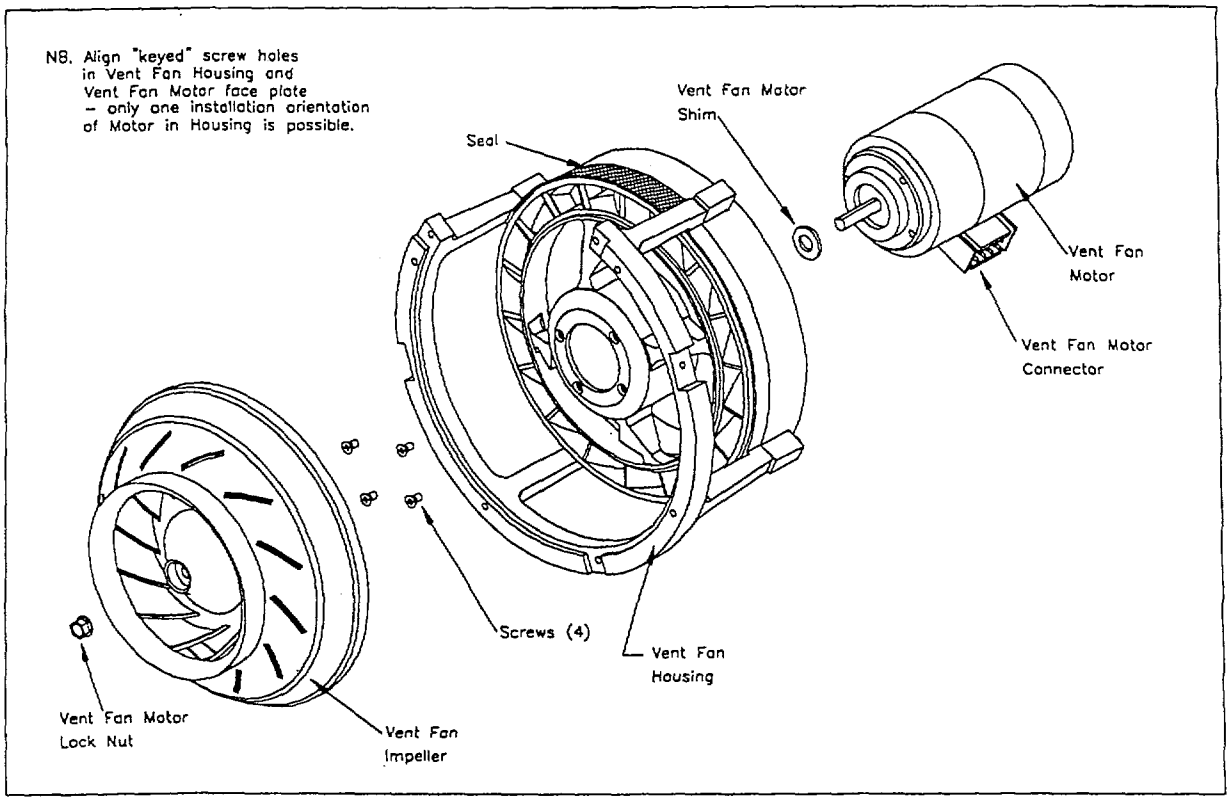

Figure 5-2.8. Detail, Vent Fan Impeller Orientation

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. Discard the lock nut.

> **Note: If Vent Fan Impeller is removed, it MUST be discarded and a new Vent Fan Impeller and Motor installed. Impeller and Motor MUST be considered a 'matched set'.**
>
> **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.

5.2.4 Vent Fan Impeller Assembly (continued)

Installation

Note: When REPLACING the Vent Fan Impeller, a NEW Vent Fan Motor MUST also be installed (ref. 5.2.5). Impeller and Motor MUST be considered a 'matched set'.

Do NOT Re-use 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. While holding the Impeller to stop it from rotating, use a 5/16" socket to secure the NEW lock nut.
3. 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.

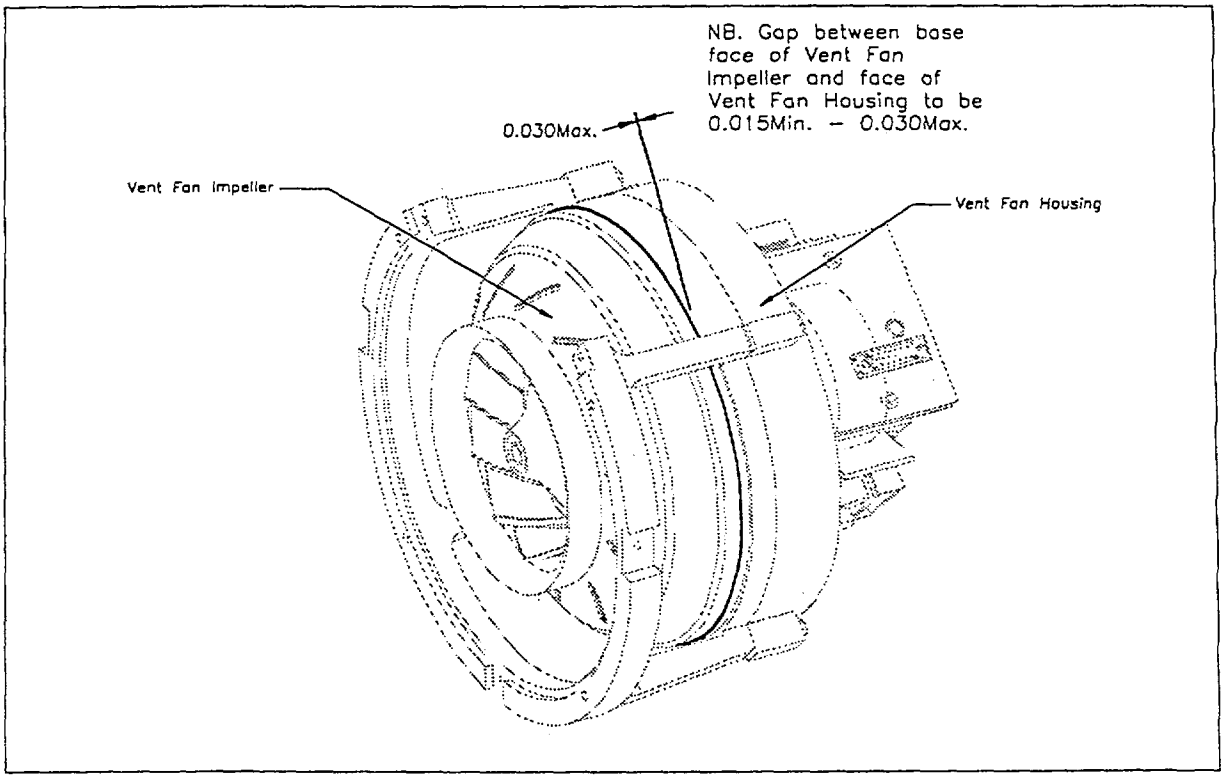

Figure 5-2.9. Detail, Vent Fan Impeller Assembly

4. Check that the Vent Fan Impeller spins freely.
5. Install Vent Fan Shroud (ref. 5.2.3)
6. Install Vent Fan Assembly to the Heater (ref. 5.2.1)

5.2.5 ELECTRONIC PROGRAMMED CONTROLLER & VENT FAN DRIVER BOARDS

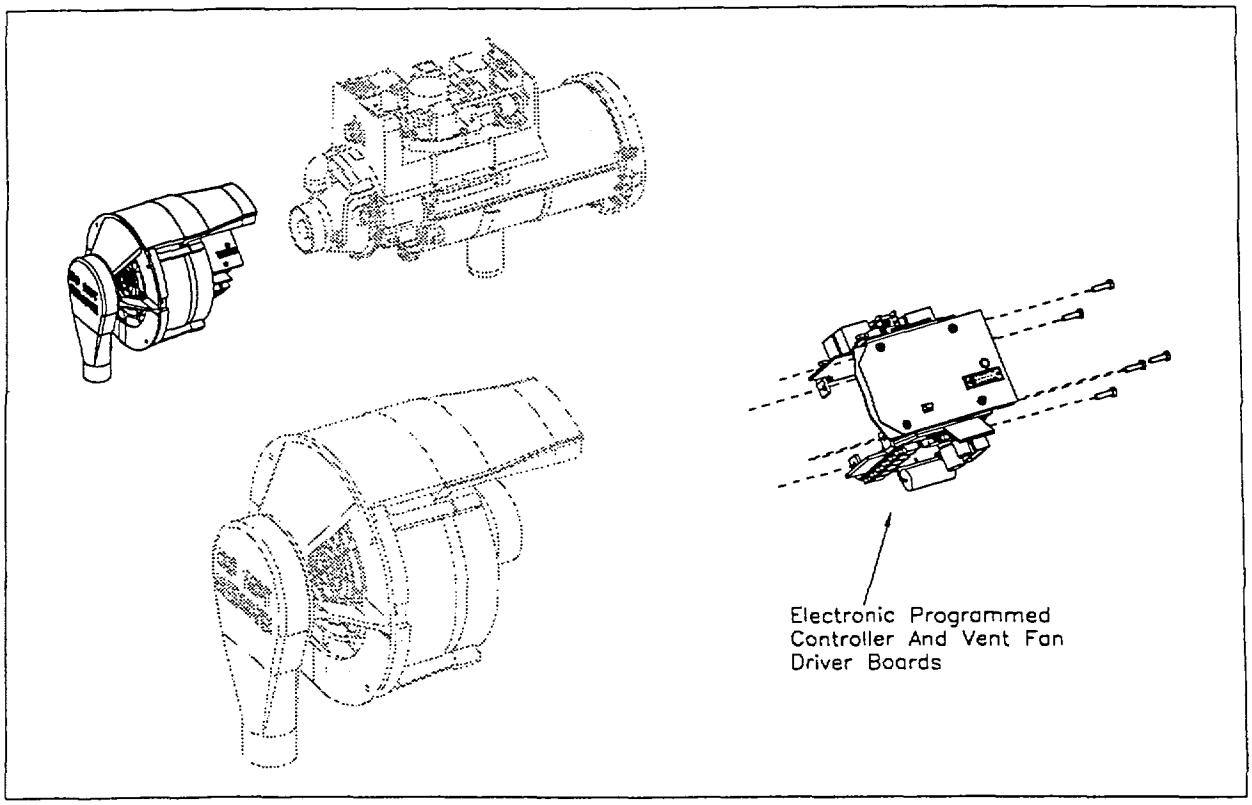

Figure 5-2.10. Electronic Programmed Controller & Vent Fan Driver Boards

Removal

1. Remove Vent Fan Assembly (ref. 5.2.1)

5.2.5 Electronic Programmed Controller & Vent Fan Driver Boards (continued)

Removal (continued)

2. Disconnect the Vent Fan Motor Connector from the Electronic Vent Fan Driver Board. (ref. Figure 5-2.11)

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

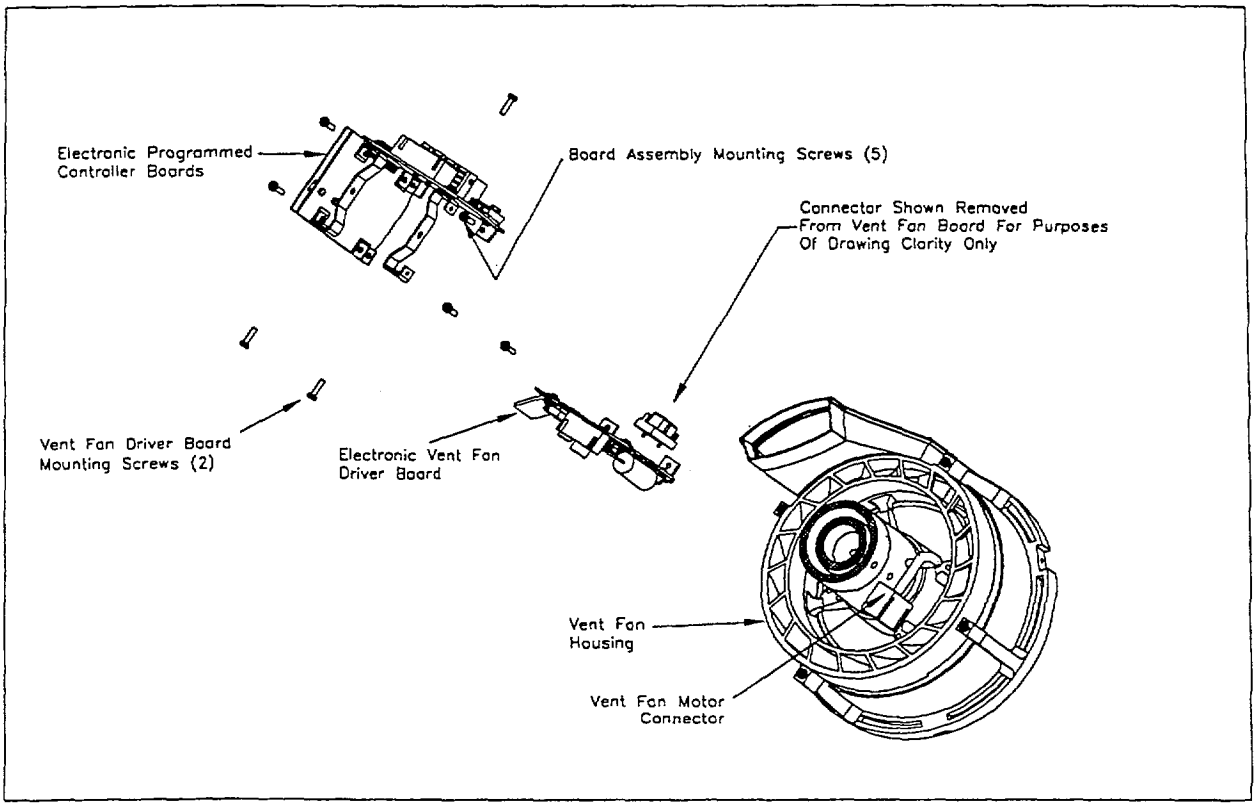

Figure 5-2.11. Detail, Removal of Printed Circuit Boards

5.2.5 Electronic Programmed Controller & Vent Fan Driver Boards (continued)

Removal (continued)

!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 which hold the printed circuit boards to the Vent Fan Housing.

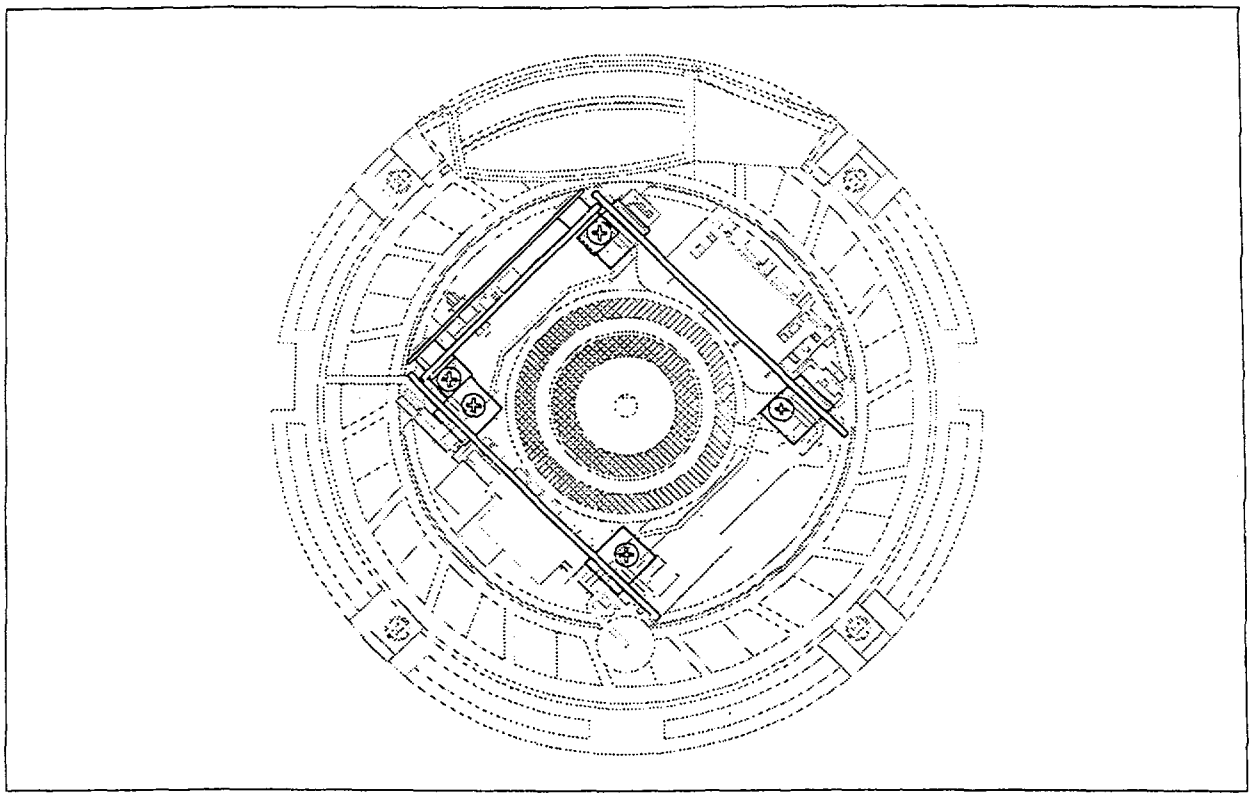

Figure 5-2.12. Detail, Screw Locations

4. Remove the Printed Circuit Board Assembly.

5.2.5.1 TO SEPARATE ELECTRONIC PROGRAMMED CONTROLLER BOARD FROM THE ELECTRONIC VENT FAN DRIVER BOARD

1. 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 5-2.11).

5.2.5 Electronic Programmed Controller & Vent Fan Driver Boards (continued)

Installation

1. If Vent Fan Driver Board and Electronic Programmed Controller Board have been taken apart:
   i. Apply Loctite 242 (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.

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.

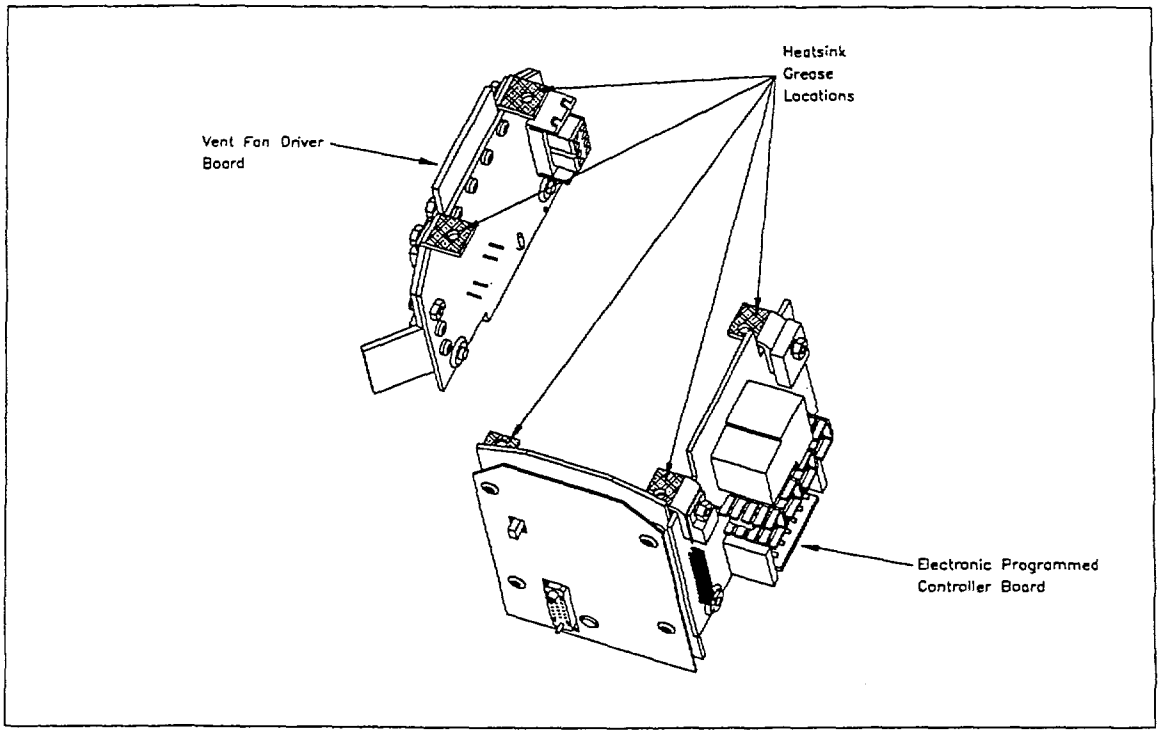

Figure 5-2.13. Detail, Circuit Board Brackets Requiring Heat-sink Compound

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 242 (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. 5.2.1)

5.2.6 VENT FAN MOTOR

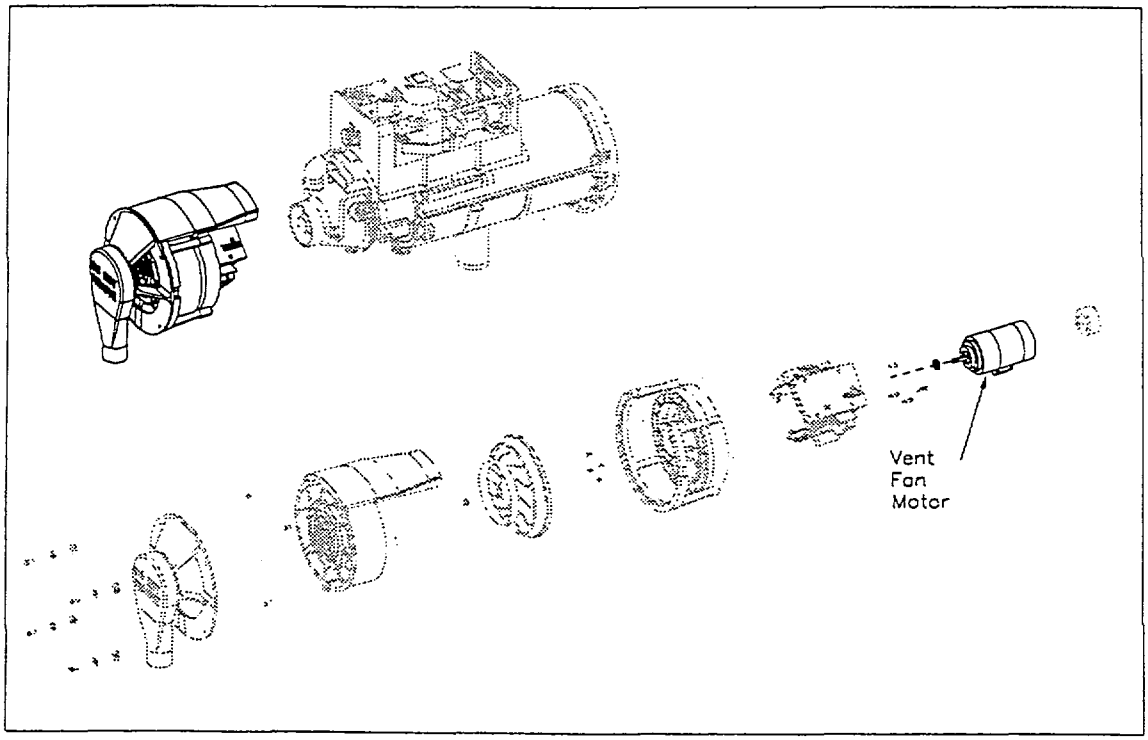

Figure 5-2.14. Vent Fan Motor

Removal

1. Remove Vent Fan Assembly (ref. 5.2.1)
2. Remove Electronic Programmed Controller & Vent Fan Driver Boards (ref. 5.5.5)
3. Remove Vent Fan Shroud (ref. 5.2.3)
4. Remove Vent Fan Impeller (ref. 5.2.4)
5. Using a #1 cross-tip screwdriver, remove four (4) #6 fat-head screws which hold the Motor to the Vent Fan Housing. Discard screws.
6. Remove Vent Fan Motor.

5.2.7 Vent Fan Motor (Continued)

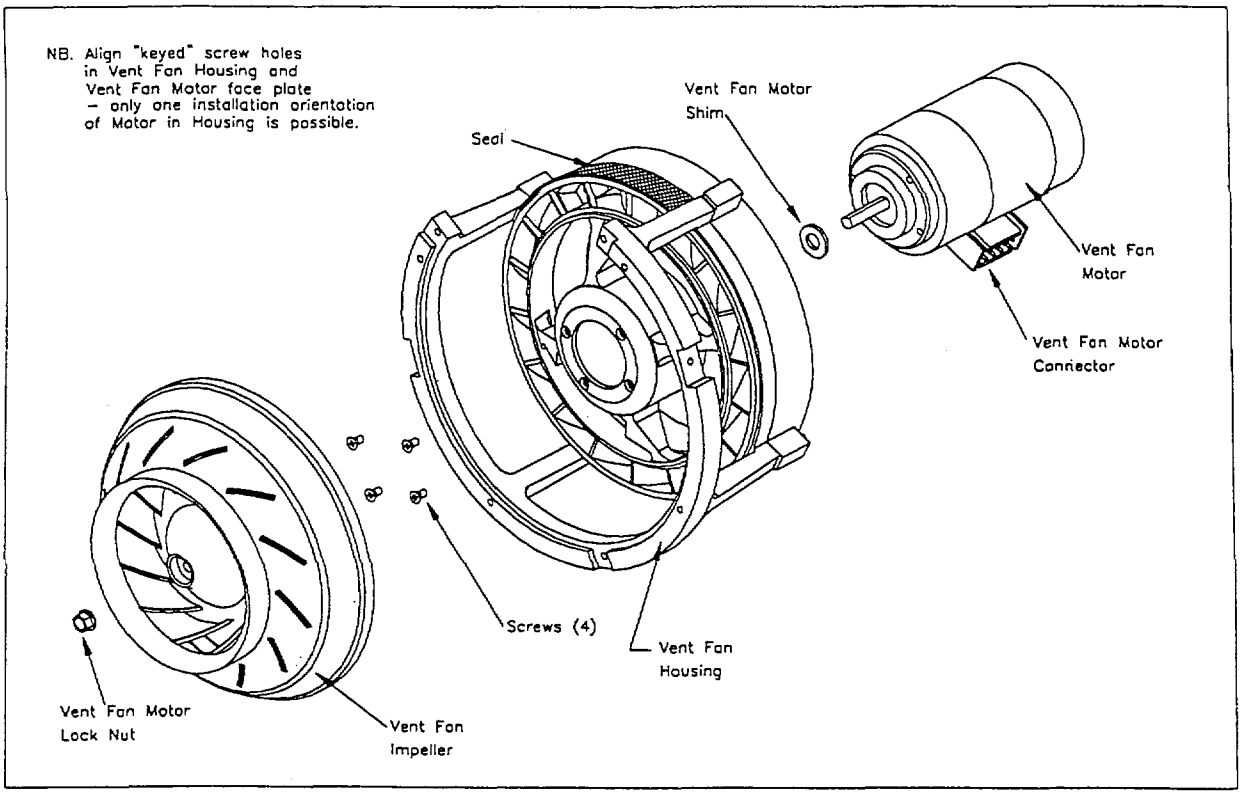

Figure 5-2.15. Detail, Vent Fan Motor Orientation

Installation

Note: When REPLACING the Vent Fan Motor, a NEW Vent Fan Impeller MUST also be installed (ref. 5.2.4). Impeller and Motor MUST be considered a 'matched set'.

Note: Inspect Driver Magnet for signs of scoring or rubbing. Replace if necessary.

Note: If the Driver Magnet is scored sufficiently as to require replacement, the Burner Housing MUST also be replaced (ref. 5.3.7)

1. Apply Loctite 242 (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 circle 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 (ref. 5.5.5)
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. 5.2.1)

5.3 COMBUSTION ASSEMBLY

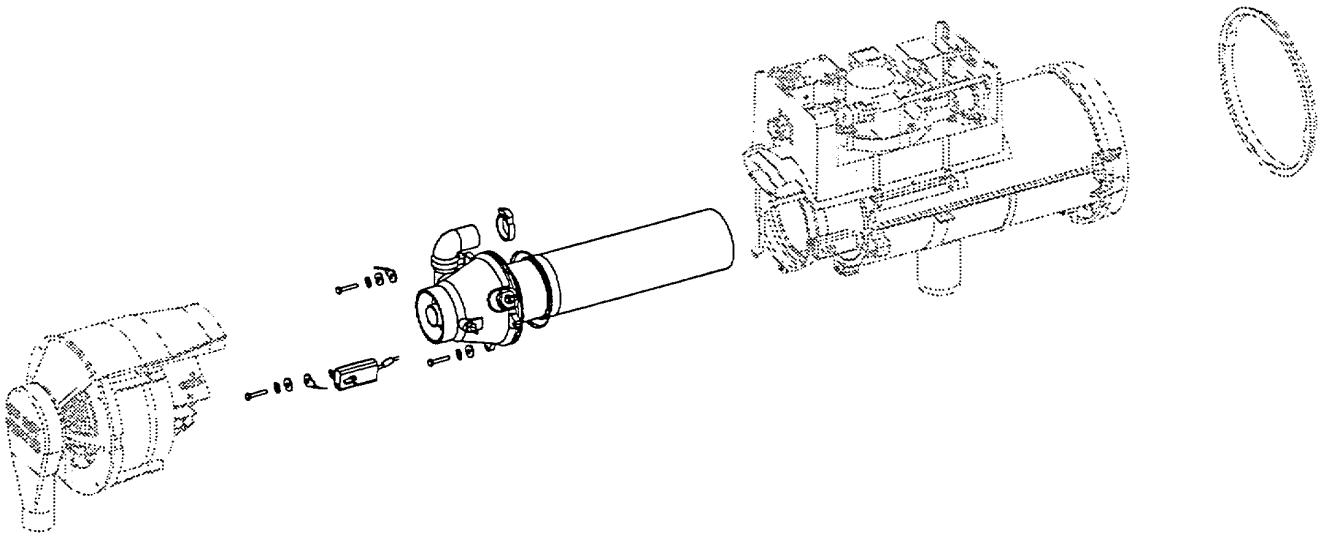

Figure 5-3.1. Combustion Assembly

5.3.1 COMBUSTOR ASSEMBLY

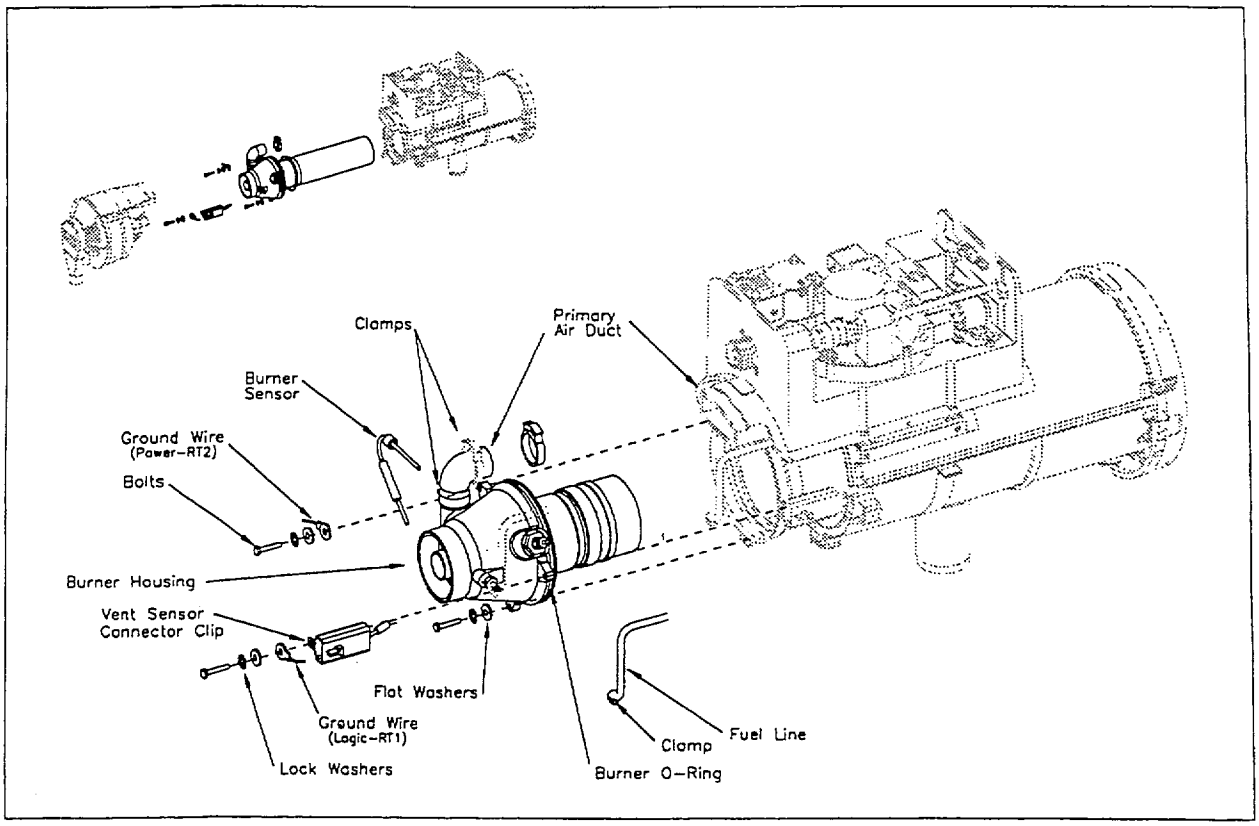

Figure 5-3.2. Combustor Assembly

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
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.

NOTE: If the fuel fitting on Top Housing is loose, Top Housing must be replaced.

5. Remove Igniter Wire from Igniter 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 609 and should NOT be removed.

7. Remove the nylon clamp holding the Primary Air Duct to the Top Housing by disengaging the locking jaws.
8. Using a 5/16" socket or nut driver, remove the three (3) hex-head bolts holding the Burner Housing to the Heat Exchanger (including flat washers, lock washers, two (2) ground wires and Vent Sensor connector clip).

5.3.1 Combustor Assembly (Continued)

Removal (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 sideways movement to release the seal. Remove Burner O-Ring from the Burner Housing and discard.**

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.
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 the 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 592) if necessary.**

7. Check that the Burner Housing 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.
9. 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 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.**

10. Install Vent Fan Assembly (ref. 5.2.1)
11. Install Bottom Shell (ref. 5.1.3)
12. Install Top Shell (ref. 5.1.2)

5.3.2 FLAME TUBE

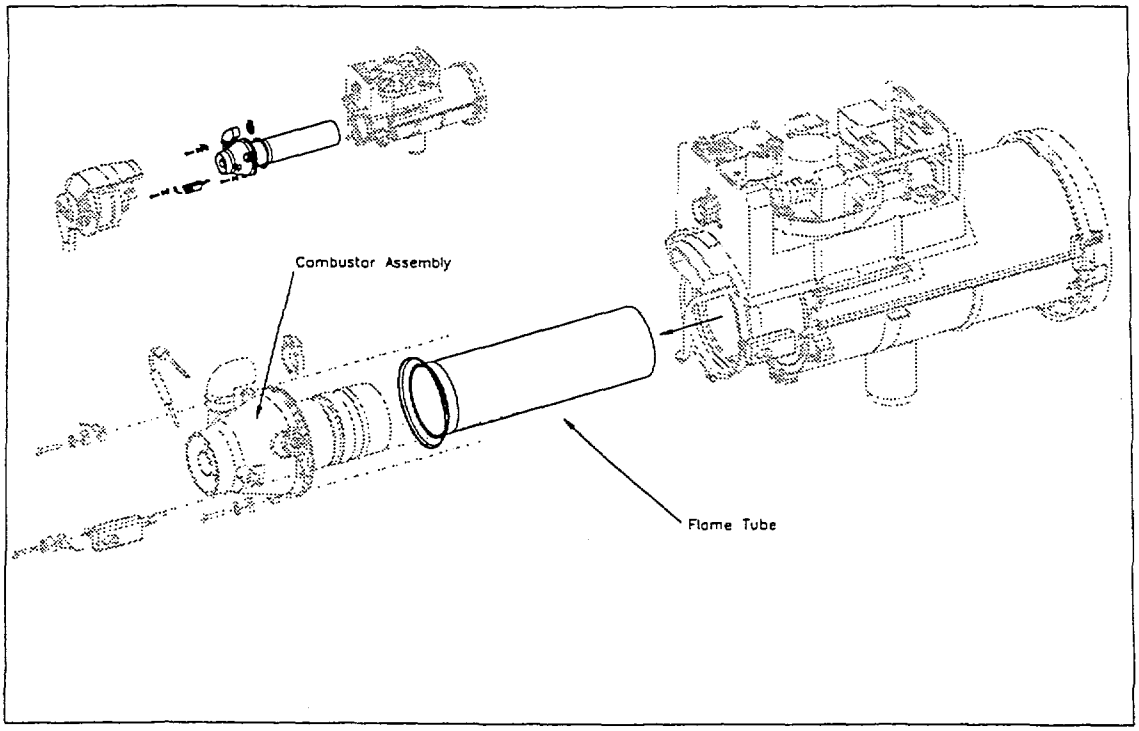

Figure 5-3.3. Flame Tube

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
4. Remove Combustor Assembly (ref. 5.3.1)
5. Pull Flame Tube from Heat Exchanger.

Installation

Note: When REPLACING the Flame Tube, the Burner Chamber MUST be replaced also (ref. 5.3.5).

1. Insert Flametube into Heat Exchanger.
2. Install Combustor Assembly (ref. 5.3.1)
3. Install Vent Fan Assembly (ref. 5.2.1)
4. Install Bottom Shell (ref. 5.1.3)
5. Install Top Shell (ref. 5.1.2)

5.3.3 IGNITER

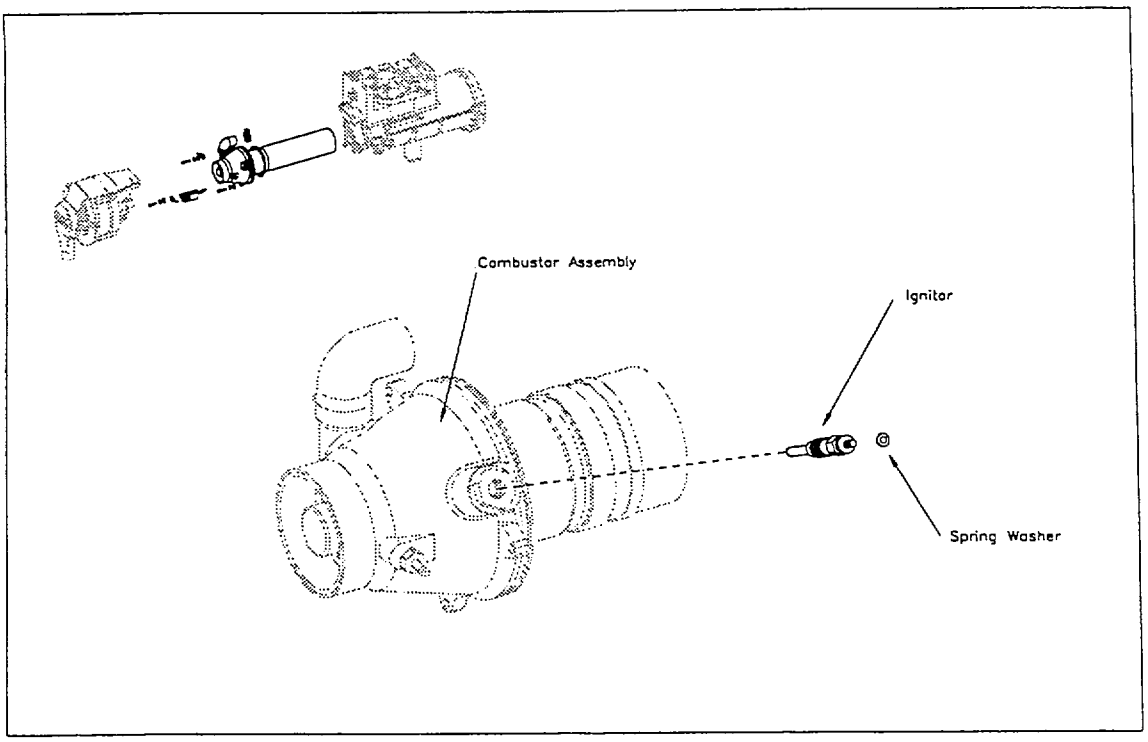

Figure 5-3.4. Igniter

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
4. Remove Combustor Assembly (ref. 5.3.1)
5. Using a 3/8" socket or wrench, remove Igniter threaded into the Igniter Holder

Installation

1. If a NEW Igniter is to be installed:
    i. Remove Top Cover (ref 5.1.1)
    ii. Remove spare Igniter mounted in the Top Housing.
    iii. Remove the shipping nut on the electrical post of the Igniter, DO NOT remove the spring washer.
    iv. Install Top Cover (ref. 5.1.1)
2. Apply Nickel anti-seize (Loctite 77164) to the threads of the Igniter.
3. Using a 3/8" socket, or open ended wrench, install the Igniter. DO NOT over tighten.

!CAUTION!

Be sure NOT to pinch or crush any wires when installing Igniter and/or Igniter Holder.

4. Install Combustor Assembly (ref. 5.3.1)
5. Install Vent Fan Assembly (ref. 5.2.1)
6. Install Bottom Shell (ref. 5.1.3)
7. Install Top Shell (ref. 5.1.2)

5.3.4 IGNITER HOLDER

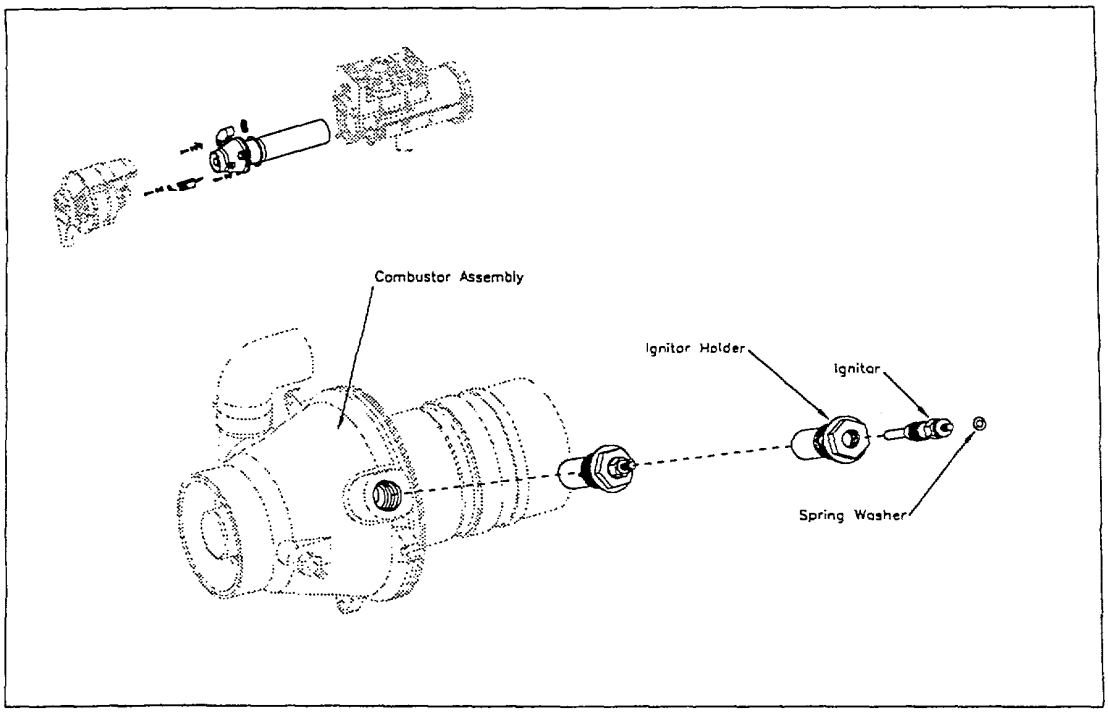

Figure 5-3.5. Igniter Holder

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
4. Remove Combustor Assembly (ref. 5.3.1)
5. Using a 3/4" deep socket, remove Igniter Holder threaded into the Burner Housing.

Cleaning

1. Remove the Igniter 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 Igniter tip.

Installation

1. Apply Nickel anti-seize (Loctite 77164) to the threads of the Igniter Holder.
2. Check that the Igniter is firmly installed into the Igniter Holder.

> **Note: If the Igniter has been removed, coat the threads with Nickel anti-seize (Loctite 77164) when installing.**
>
> **!CAUTION!**
>
> **Prior to reinstalling the Igniter Holder ensure that the threaded Igniter Holder receptacle in the Burner Housing is fully aligned with the large holes in both the Burner Chamber and the Burner Cartridge. If not, loosen the Burner Chamber retaining screws and re-align all three holes with a finger. Re-tighten the Chamber retaining screws only after the Igniter Holder has been successfully installed through all three.**

3. Using a 3/4" deep socket install the Igniter Holder. DO NOT over tighten.

5.34 Igniter Holder (continued)

Installation (continued)

4. Install Combustor Assembly (ref. 5.3.1)
5. Install Vent Fan Assembly (ref. 5.2.1)
6. Install Bottom Shell (ref. 5.1.3)
7. Install Top Shell (ref. 5.1.2)

5.3.5 BURNER CHAMBER

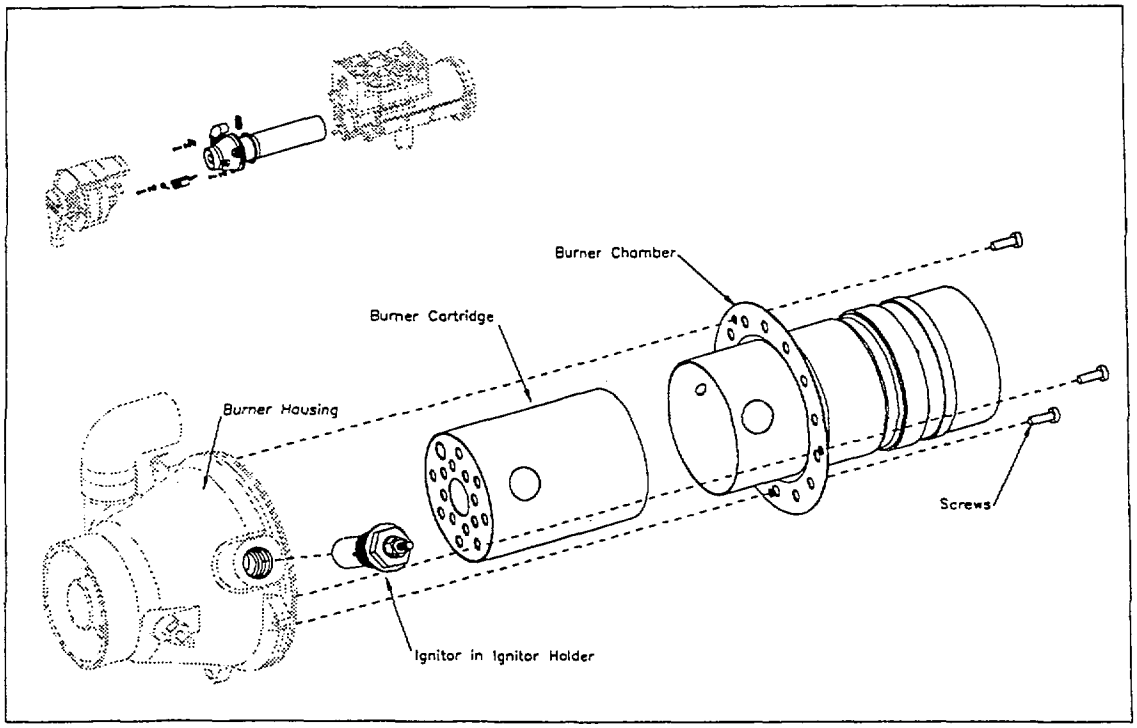

Figure 5-3.6. Burner Chamber

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
4. Remove Combustor Assembly (ref. 5.3.1)
5. Using a 3/4" deep socket or 3/4" wrench, remove Igniter Holder from the Burner Housing
6. Using a #2 cross-tip screwdriver, remove three (3) screws holding the Burner Chamber to the Burner Housing.

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

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 Fig. 5-3.7.

5.3.5 Burner Chamber (continued)

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.

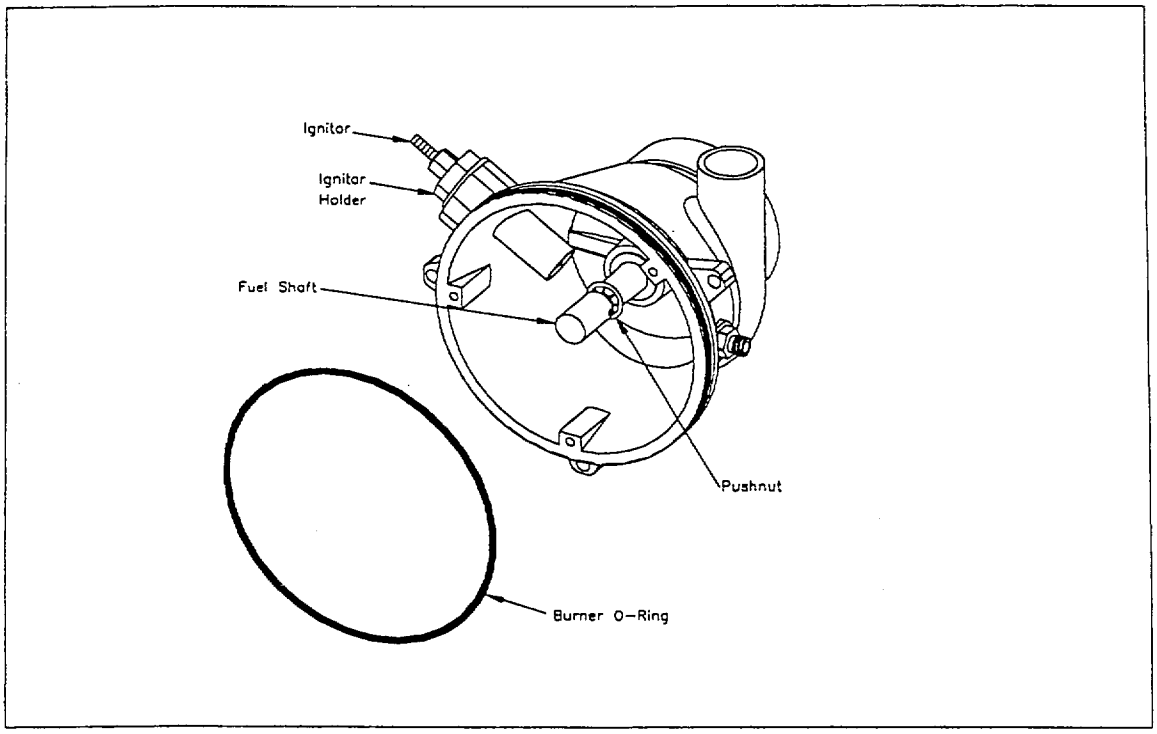

Figure 5-3.7. Burner Housing, Detail

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 5-3.10)

5.3.5 Burner Chamber (continued)

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 Igniter Holder.
2. Insert the Burner Cartridge into the Burner Chamber, ensuring the two large holes in each pad line up.
3. Insert the Burner Cartridge with the Burner Chamber into the Burner Housing and at the same time screw in the Igniter Holder ensuring the Igniter Holder enters the large hole in the other two parts.

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

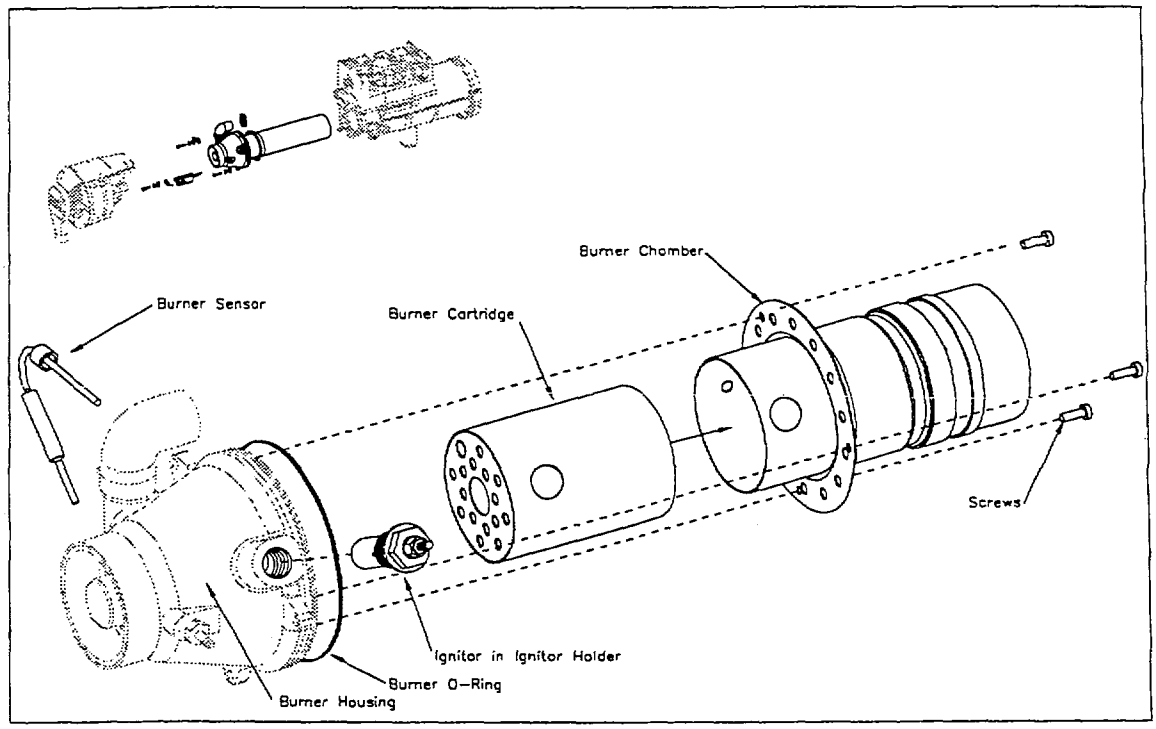

Figure 5-3.8. Burner Cartridge, Chamber, Wick, Igniter and Igniter Holder - aligned

4. Apply Loctite 242 (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.
5. Secure the Igniter 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 5-3.7.)
7. Install Combustor Assembly (ref. 5.3.1)
8. Install Vent Fan Assembly (ref. 5.2.1)
9. Install Bottom Shell (ref. 5.1.3)
10. Install Top Shell (ref. 5.1.2)

5.3.6 BURNER CARTRIDGE

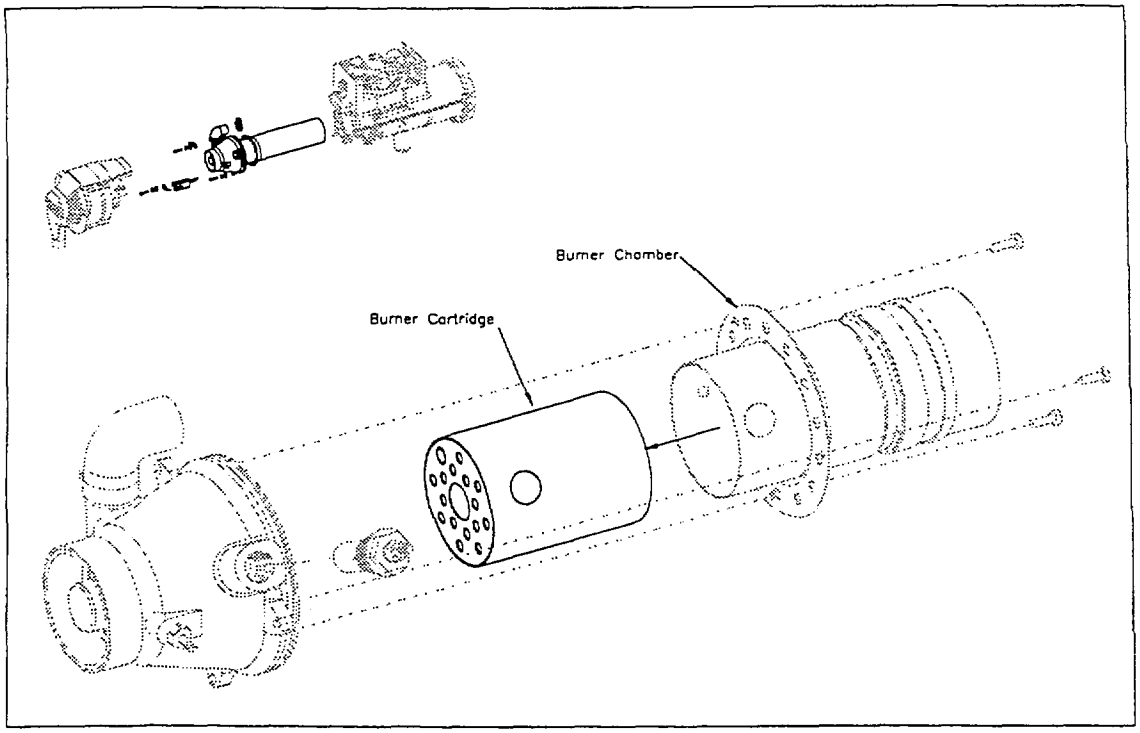

Figure 5-3.9. Burner Cartridge

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
4. Remove Combustor Assembly (ref. 5.3.1)
5. Remove Combustion Chamber (ref. 5.3.5)

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

6. Remove the burner Cartridge from inside the Burner Chamber

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

5.3.6 Burner Cartridge (continued)

Removal (continued)

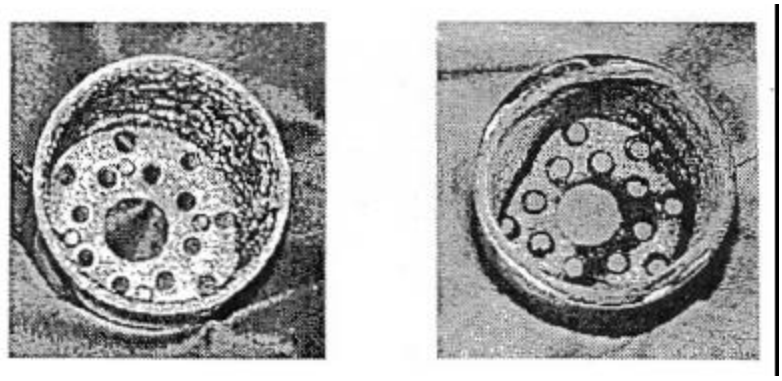

Figure 5-3.10. New Burner Wick (left); 50% deteriorated Burner Wick (right)

!CAUTION!

Do NOT use any metallic objects to clean the Push Nut or the Fuel Shaft. Compressed air jets and/or cleaning-spray (carburetor cleaner) are 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 scraping away the deposits taking care not to damage the Fuel shaft and the Push Nut on the Fuel Shaft.

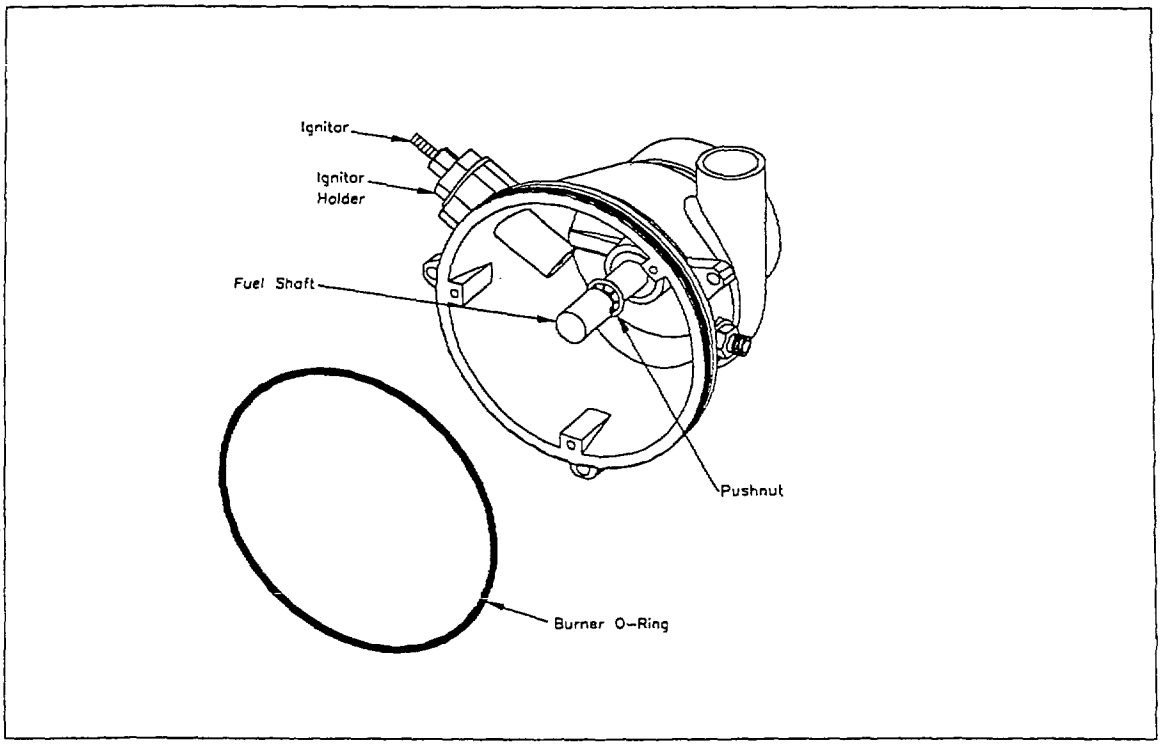

Figure 5-3.11. Burner Housing, Detail

5.3.6 Burner Cartridge (continued)

Installation

1. Apply Nickel anti-seize, Loctite 77164 to the threads on the Igniter Holder.
2. Insert the Burner Cartridge into the Burner Chamber, ensuring the two large 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 Igniter Holder ensuring the Igniter Holder enters the large hole in the other two parts. When all parts are lined up secure the Igniter Holder using a 3/4" deep socket.

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

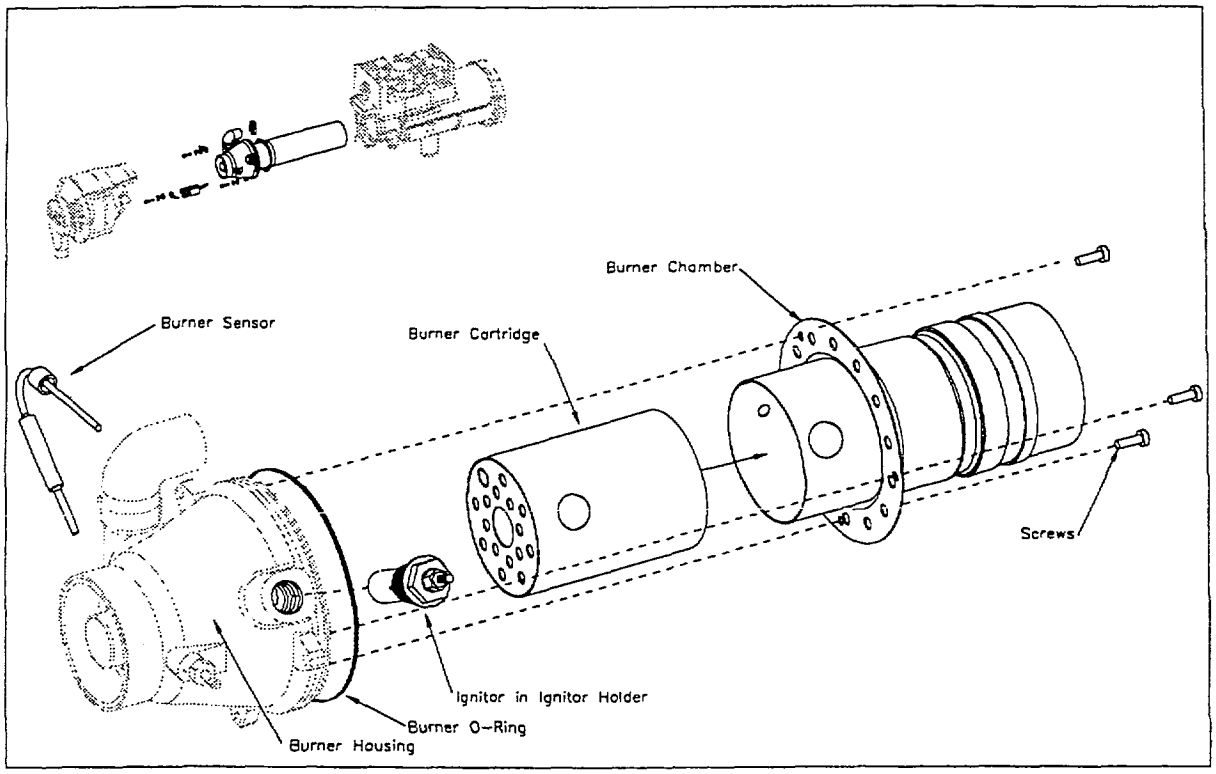

Figure 5-3.12. Burner Cartridge, Chamber, Wick, Igniter and Igniter Holder - aligned

4. Apply Loctite 242 (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.
5. Coat a new Burner O-Ring with GAA grease and install the O-Ring onto the Burner Housing.
6. Install Combustor Assembly (ref. 5.3.1)
7. Install Vent Fan Assembly (ref. 5.2.1)
8. Install Bottom Shell (ref. 5.1.3)
9. Install Top Shell (ref. 5.1.2)

5.3.7 BURNER HOUSING

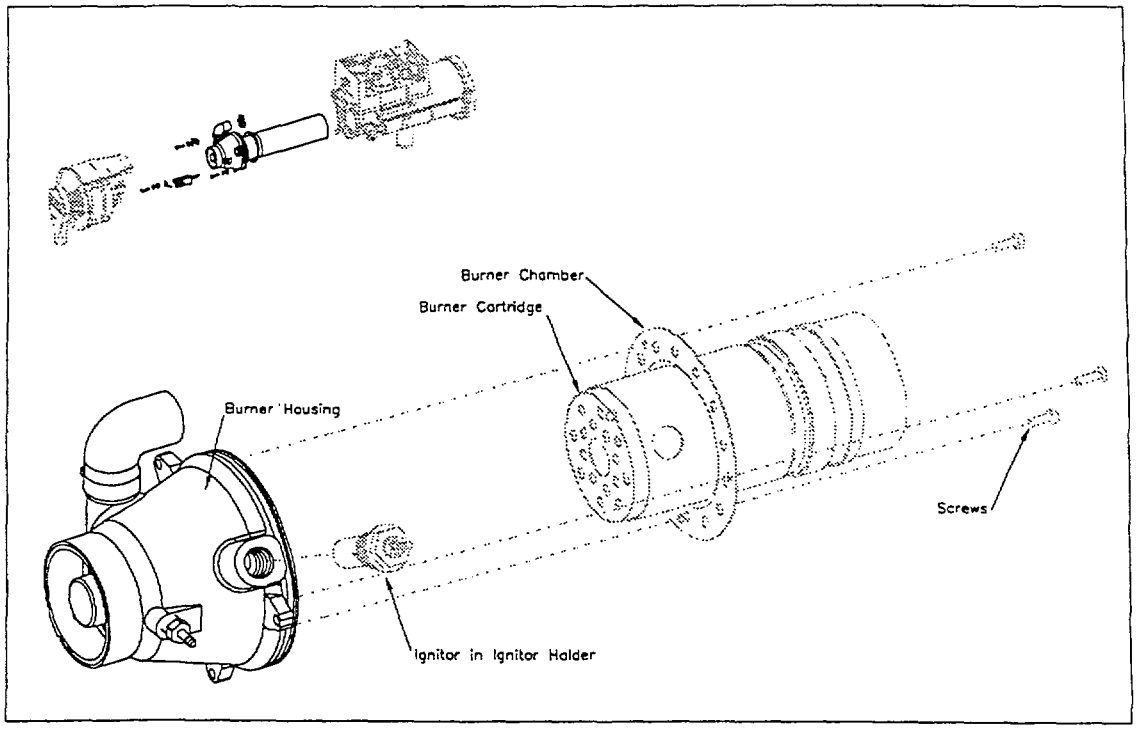

Figure 5-3.13. Burner Housing

Removal

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
3. Remove Vent Fan Assembly (ref. 5.2.1)
4. Remove Combustor Assembly (ref. 5.3.1)
5. Using a 3/4" deep socket, remove Igniter 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 Chamber (with Cartridge) from the Burner Housing.

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 5-3.10).

5.3.7 Burner Housing (continued)

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.

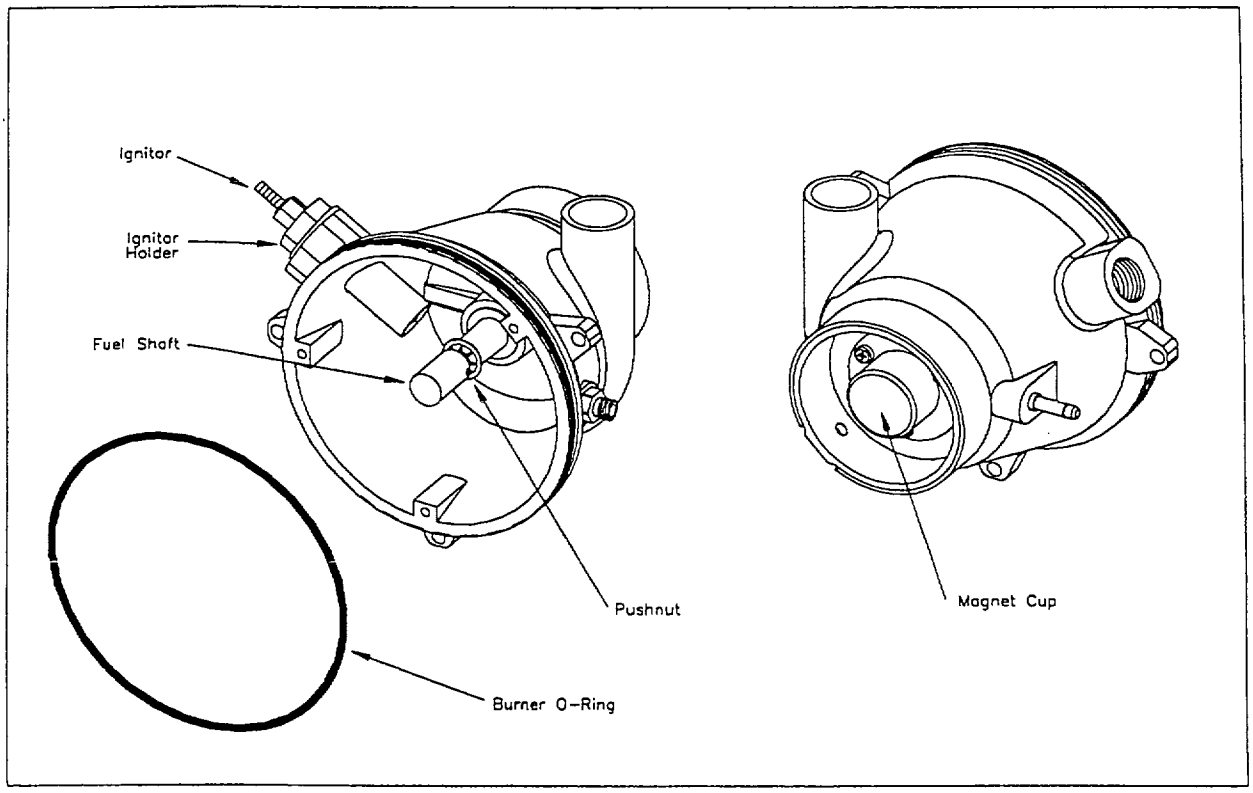

Figure 5-3.14. Detail, Fuel Shaft

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. 5.2.7)

5.3.7 Burner Housing (continued)

Installation

1. Apply Nickel anti-seize, Loctite 77164 to the threads on the Igniter Holder.
2. Insert the Burner Cartridge into the Burner Chamber, ensuring the two large 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 Igniter Holder ensuring the Igniter Holder enters the large hole in the other two parts. When all parts are lined up secure the Igniter Holder using a 3/4" deep socket.

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

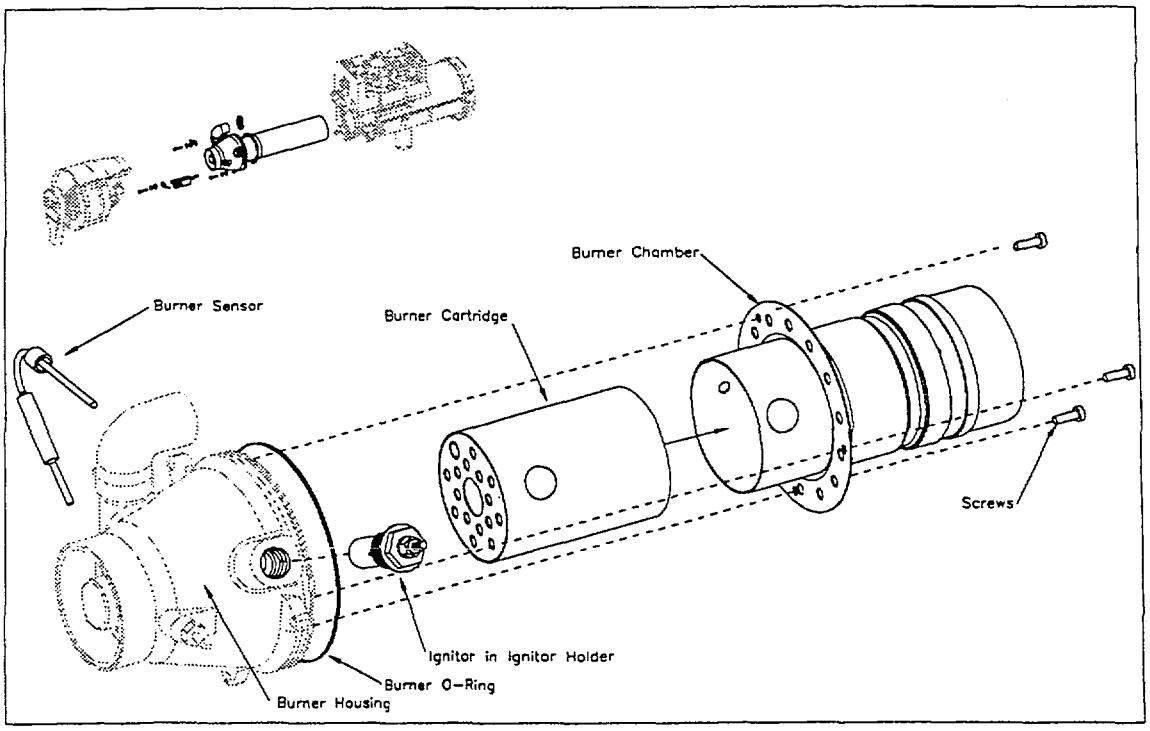

Figure 5-3.15. Burner Cartridge, Chamber, Wick, Igniter and Igniter Holder - aligned

4. Apply Loctite 242 (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.
5. Coat a new Burner O-Ring with GAA grease and install the O-Ring onto the Burner Housing.
6. Install Combustor Assembly (ref. 5.3.1)
7. Install Vent Fan Assembly (ref. 5.2.1)
8. Install Bottom Shell (ref. 5.1.3)
9. Install Top Shell (ref. 5.1.2)

5.4 HEAT EXCHANGER ASSEMBLY

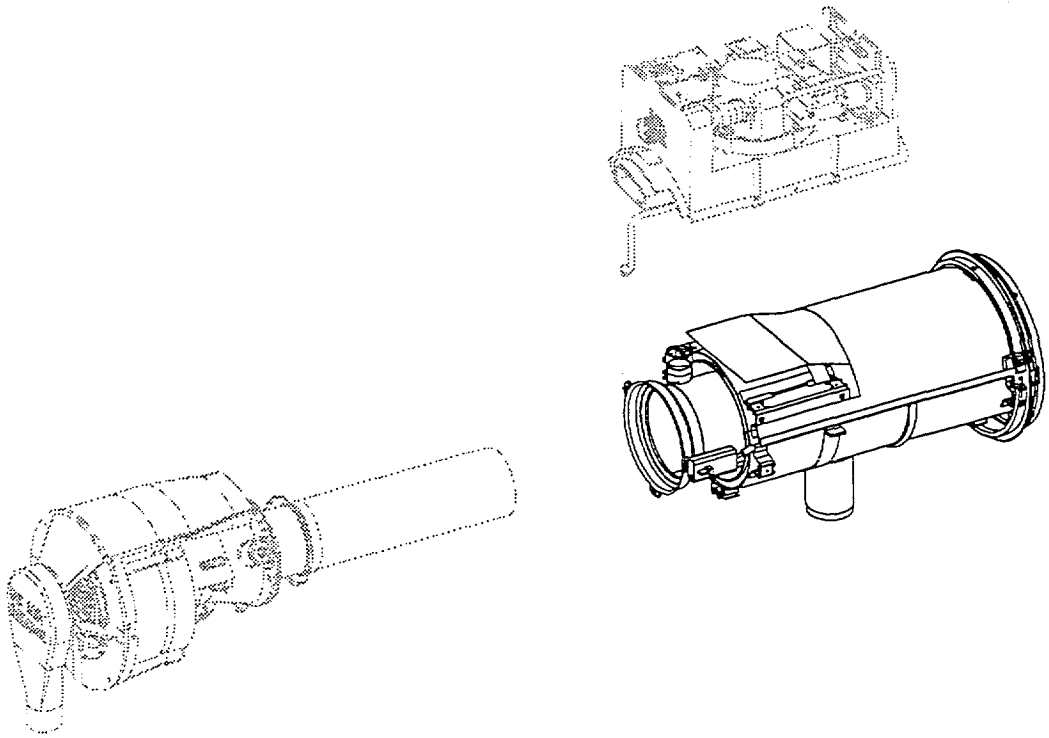

Figure 5-4.1. Heat Exchanger Assembly

5.4.1 HEAT EXCHANGER

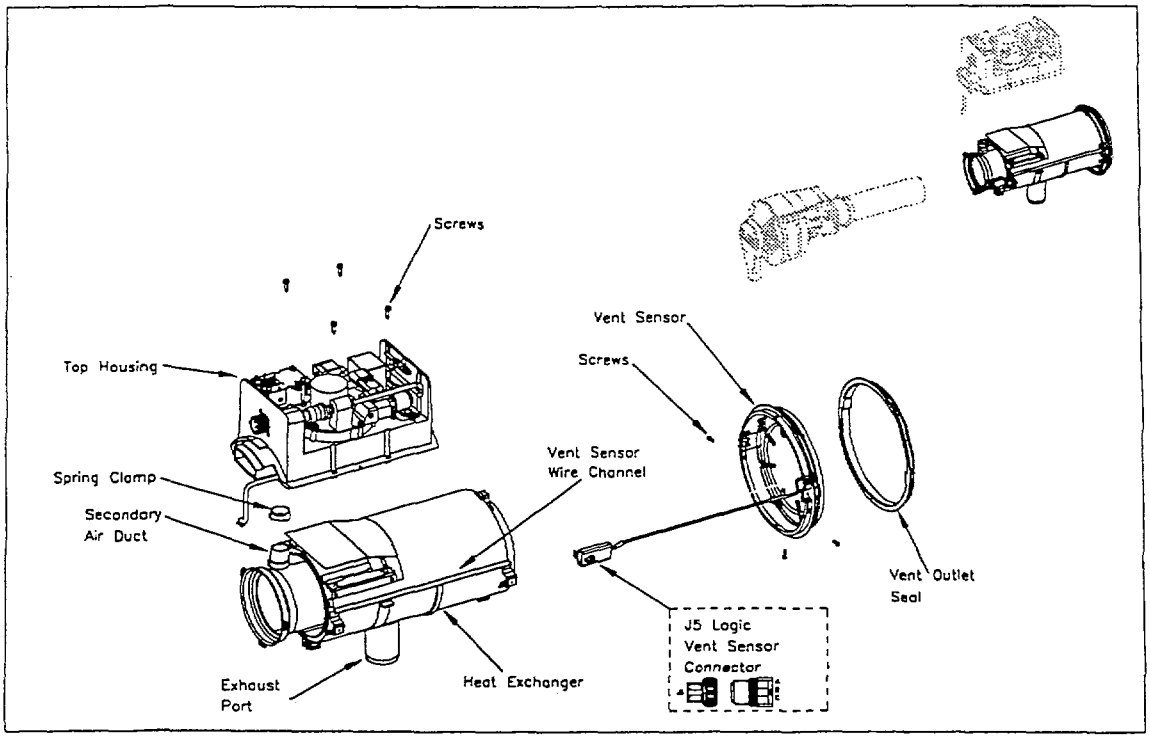

Figure 5-4.2. Heat Exchanger Assembly

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 practices.

For steps 6-12, the Heater can be set with the Diagnostic Label facing downwards.

1. Remove Top Cover (ref. 5.1.1)
2. Remove Top Shell (ref. 5.1.2)
3. Remove Bottom Shell (ref. 5.1.3)
4. Remove Vent Fan Assembly (ref. 5.2.1)
5. Remove Combustor Assembly (ref. 5.3.1)
6. Remove Flame Tube (ref. 5.3.2)
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.
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.

5.4.1 Heat Exchanger (continued)

Removal (continued)

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.

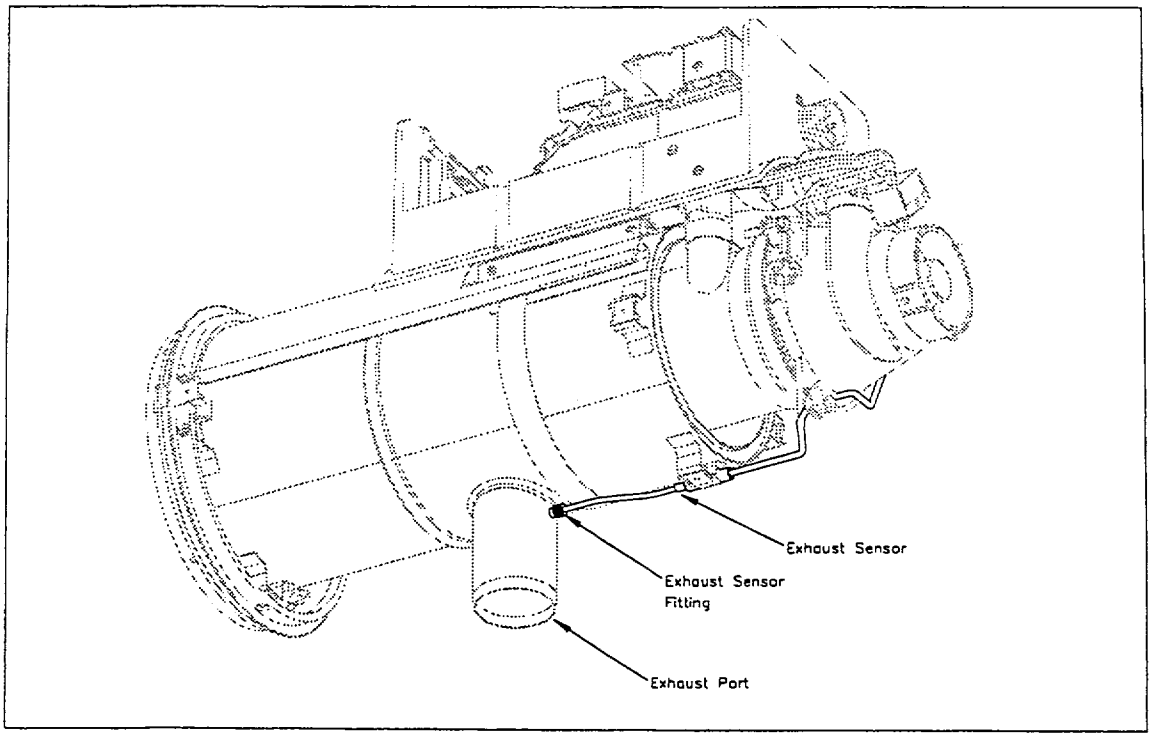

Figure 5-4.3. Heat Exchanger Assembly, Exhaust Sensor Fitting Location

!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 which 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.

5.4.1 Heat Exchanger (continued)

Installation

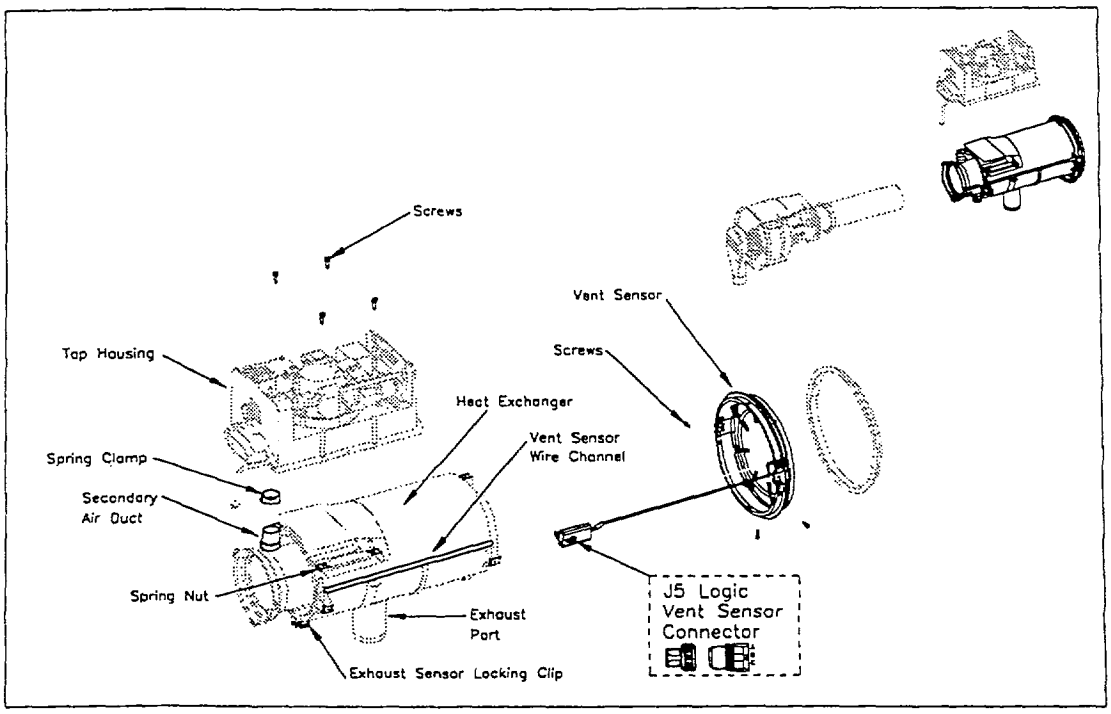

Figure 5-4.4. Heat Exchanger Assembly, Installation

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 Fig. 5-4.4 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.

5.4.1 Heat Exchanger (continued)

Installation (continued)

9. 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.
10. 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.
11. Connect the Vent Sensor connector (**J5**) to the Wiring Harness. Ensure the locking tab is engaged.
12. Insert Flame Tube (ref. 5.3.2)
13. Install Combustor Assembly (ref. 5.3.1)
14. Install Vent Fan Assembly (ref. 5.2.1)
15. Install Bottom Shell (ref. 5.1.3)
16. Install Top Shell (ref. 5.1.2)
17. Install Top Cover (ref. 5.1.1)

5.4.2 VENT SENSOR ASSEMBLY

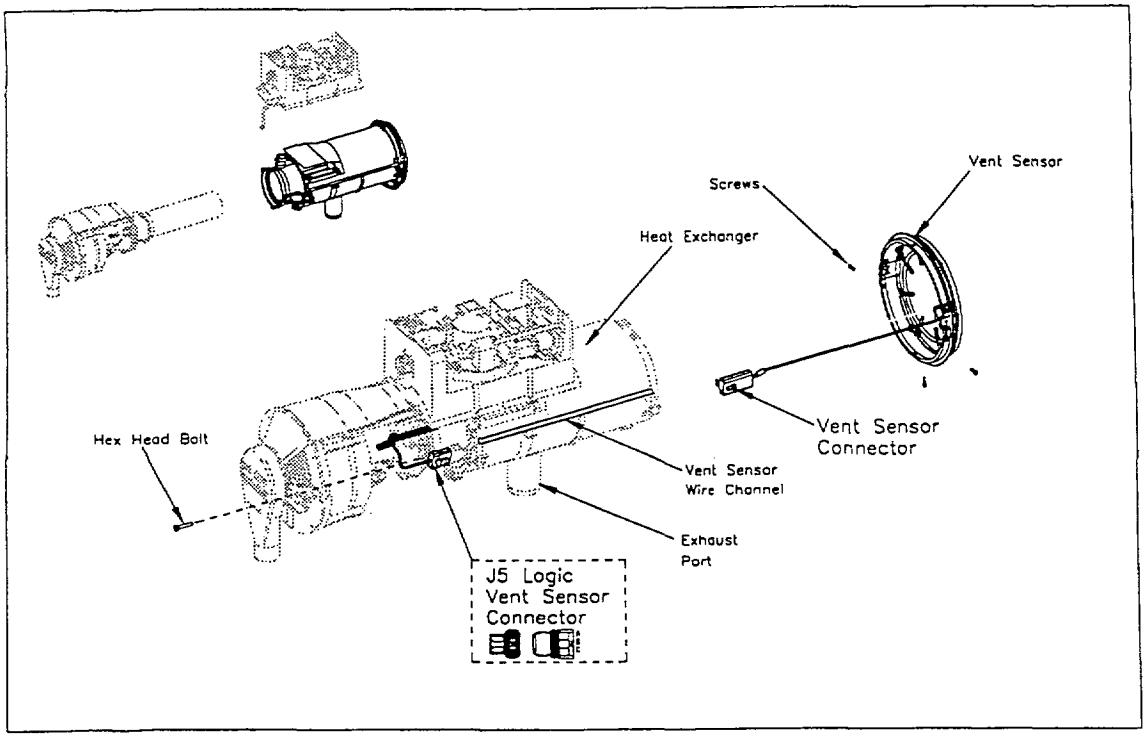

Figure 5-4.5. Vent Sensor Assembly

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 practices.

1. Remove Top Shell (ref. 5.1.2)
2. Remove Bottom Shell (ref. 5.1.3)
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.

5.4.2 Vent Sensor Assembly (continued)

Installation

Note: Vent Sensor MUST be aligned as shown in fig. 5-4.4 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 **Logic** Wiring Harness. Ensure the locking tab is engaged.
6. Install Bottom Shell (ref. 5.1.3)
7. Install Top Shell (ref. 5.1.2)

5.4.3 VENT OUTLET SEAL

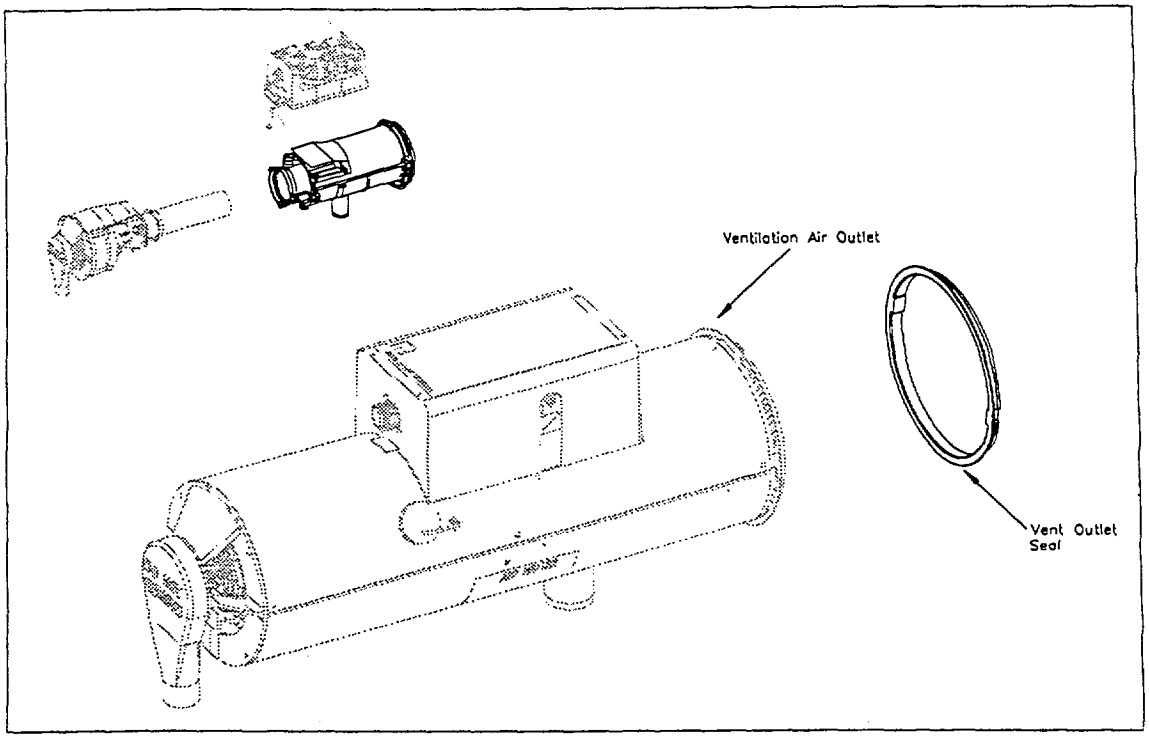

Figure 5-4.6. Vent Outlet Seal

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

Removal

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

Installation

1. Position new Vent Outlet Seal over Vent Outlet end of Heater so that "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.

5.5 TOP HOUSING ASSEMBLY

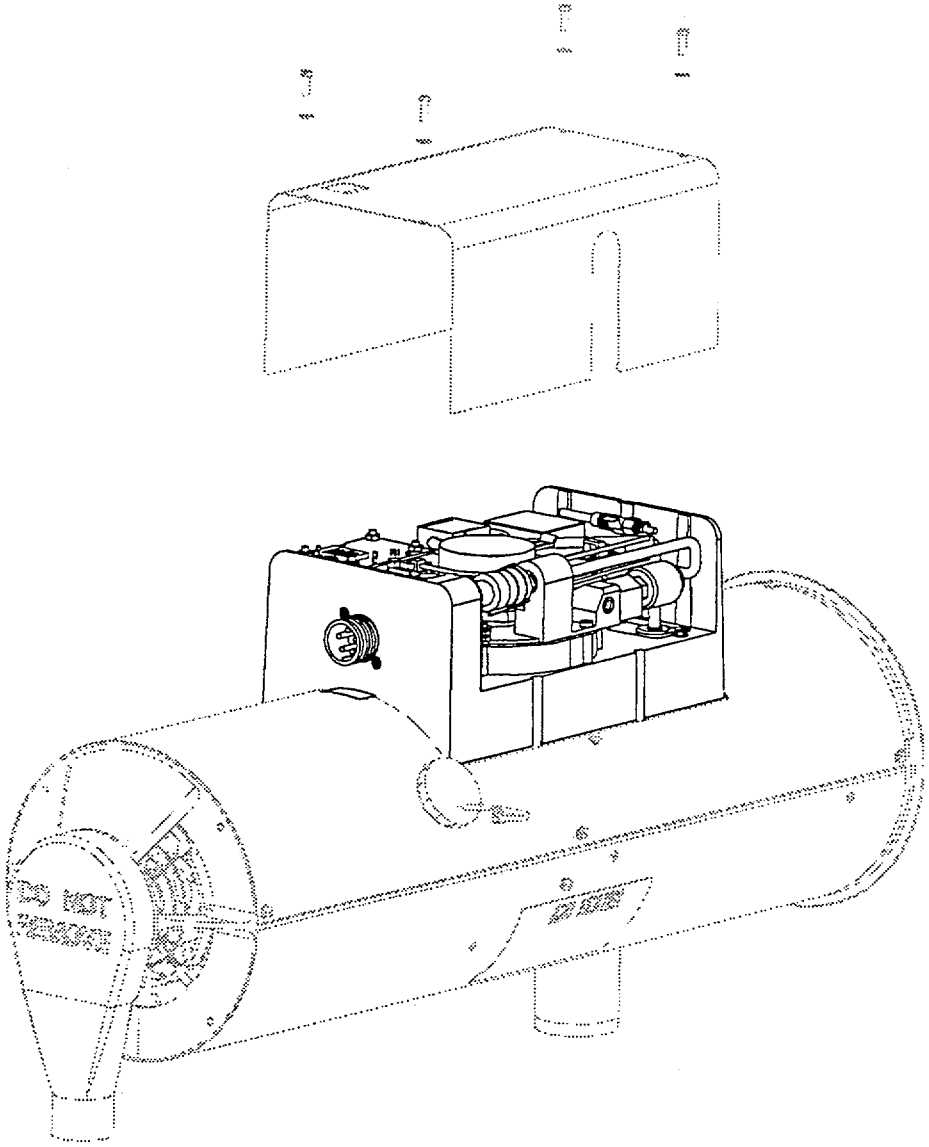

Figure 5-5.1. Top Housing Assembly

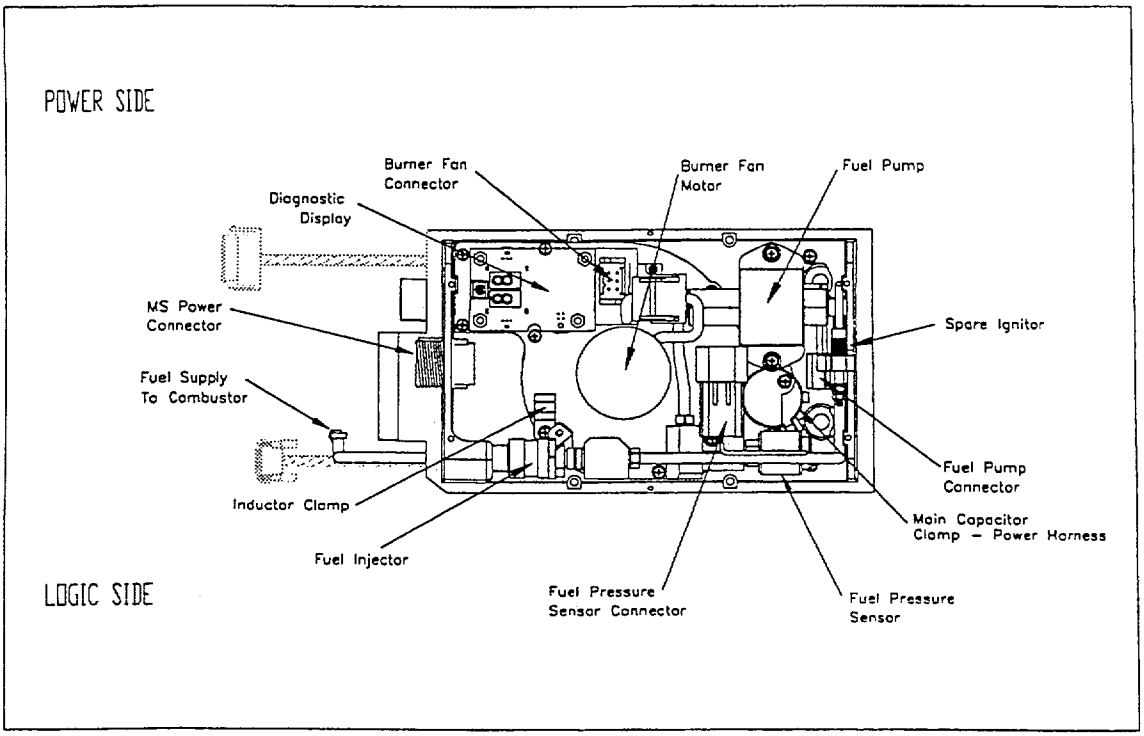

Figure 5-5.2. Top Housing, Top View

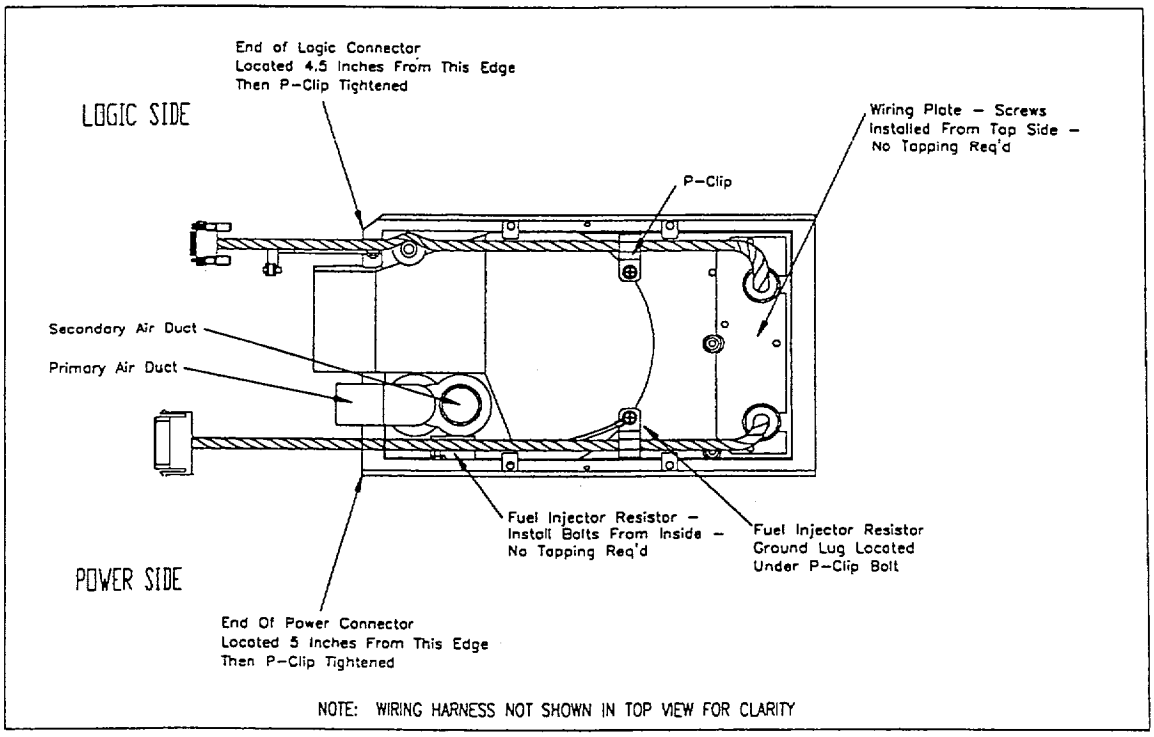

Figure 5-5.3. Top Housing, Bottom View

5.5.1 FUEL PRESSURE SENSOR

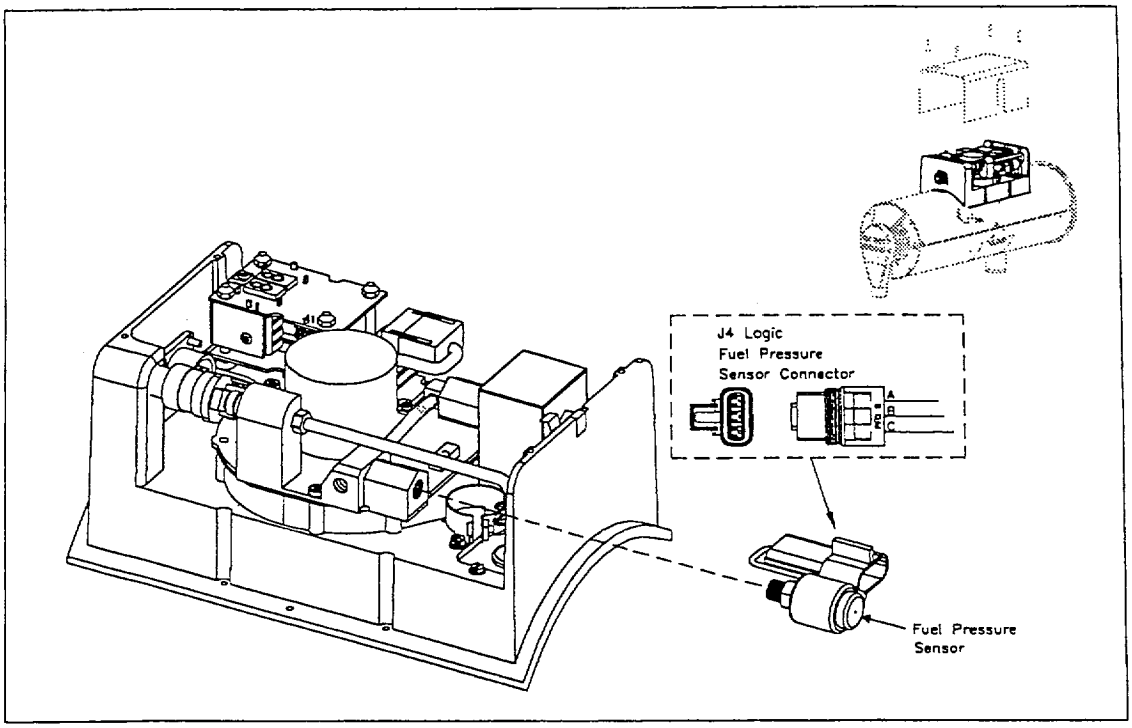

Figure 5-5.4. Fuel Pressure Sensor

Removal

1. Remove Top Cover (ref. 5.1.1)
2. Disconnect Fuel Pressure Sensor connector (**J4**) from the **Logic** Wiring Harness.

!CAUTION!

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

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

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

5.5.1 Fuel Pressure Sensor (continued)

Installation

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

!CAUTION!
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 **Logic** Wiring Harness.
4. Start the Heater and check that there are NO fuel leaks from the fuel connections (ref. Figure 5-5.9)
5. Install Top Cover (ref. 5.1.1)

5.5.2 DIAGNOSTIC DISPLAY

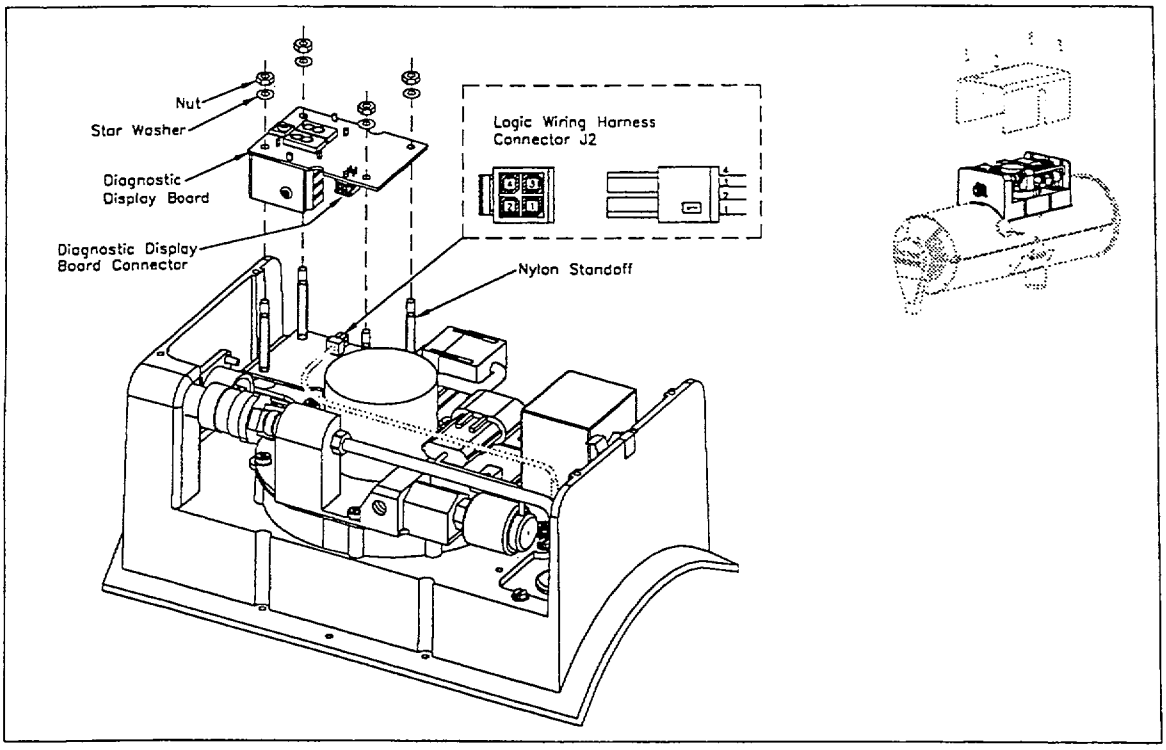

Figure 5-5.5. Diagnostic Display

Removal

1. Remove Top Cover (5.1.1)
2. Disconnect the **Logic** 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) nuts and star washers. Remove the Diagnostic Display Board taking care to leave the four (4) nylon standoffs in place.

Installation

1. Place the Diagnostic Display Board onto the threaded posts ensuring that the four (4) nylon standoffs are in place.

   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 242 (blue) to each of the four (4) threaded posts.
3. Install one (1) star washer and one (1) nut on each post and finger tighten.. When tight, use a 5/16" socket to further tighten each nut 1/4 turn. DO NOT OVER TIGHTEN.
4. Install Connector (**J2**) from the **Logic** Wiring Harness to the Diagnostic Display Board.
5. Install Top Cover (ref. 5.1.1)

5.5.3 FUEL PUMP

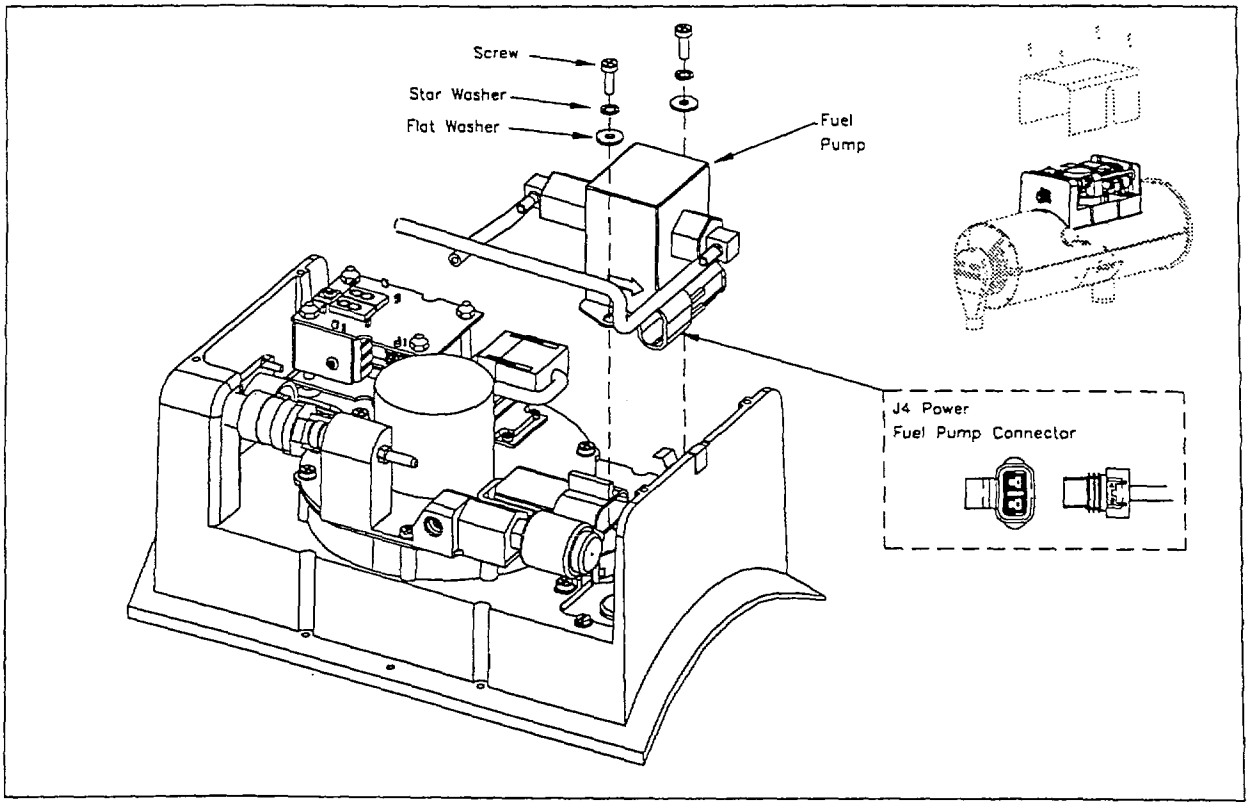

Figure 5-5.6. Fuel Pump

Removal

1. Remove Top Cover (ref. 5.1.1)
2. Disconnect Fuel Pump connector (**J4**) from the **Power** Wiring Harness.

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

3. Disconnect the Two (2) fuel lines from the Burner Fan Plate Assembly fuel fittings taking care to avoid fuel spills.
4. Using a #2 cross-tip screwdriver, unscrew the two (2) screws and star washers which 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.**

5. Remove Fuel Pump.

5.5.3 Fuel Pump (continued)

Installation

1. Install Fuel Pump into the Top Housing and connect the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings.

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

   Note: WD-40 may be used as a lubricant to aid installing the fuel lines.

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

2. Apply Loctite 242 (blue) to the two (2) machine screws.
3. Using a #2 cross-tip screwdriver, secure the Fuel Pump in place with the two (2) screws, flat washers, and star washers.
4. Attach **Power** Wiring Harness connector (**J4**) to the Fuel Pump ensuring the connector locking tab is property engaged.
5. Using a 9/16" open ended wrench, connect the fuel supply to the Heater.
6. Connect vehicle power cable to the Heater **MS Power** connector (Control Box Connection).
7. Start the Heater and check that there are NO fuel leaks from the fuel connections (ref. Figure 5-5.9)
8. Install Top Cover (ref. 5.1.1)

5.5.4 BURNER FAN PLATE ASSEMBLY

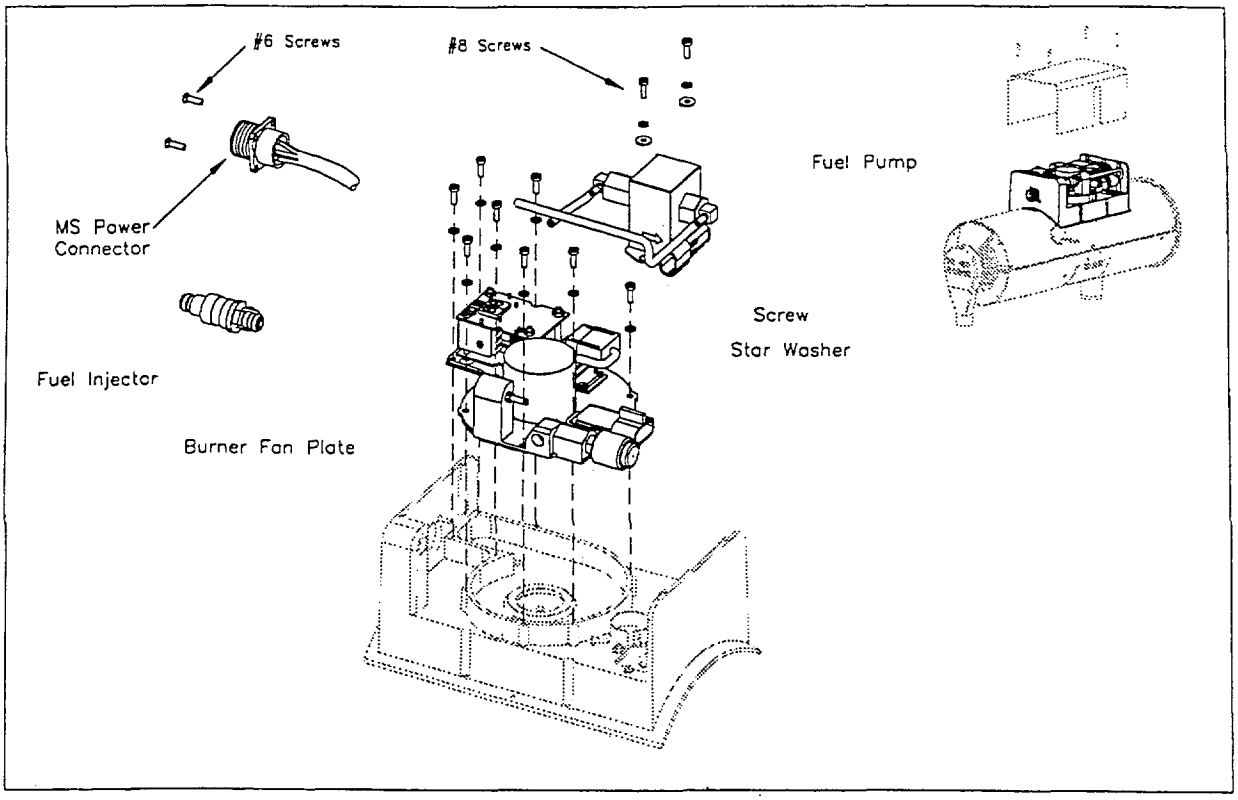

Figure 5-5.7. Burner Fan Plate Assembly

Removal

1. Remove vehicle power cable from **MS Power** connector.
2. Remove Top Cover (ref. 5.1.1)
3. Remove **Logic** Wiring Harness connectors from the Fuel Pressure Sensor (**J4**) (ref. 5.5.1), and the Diagnostic Display (**J2**) (ref. 5.5.2).
4. Remove **Power** Wiring Harness connectors from the Fuel Injector (J5), (ref. 5.5.5) and the Burner Fan Driver Board (**J3**) (ref. 5.5.6).

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.

5. Remove the two (2) fuel lines from the Burner Fan Plate fuel fittings.
6. Remove Fuel Pump (ref. 5.5.3)
7. Using a #1 cross-tip screwdriver, unscrew the two (2) screws which hold the **MS Power** connector (**J2**) to the Top Housing.

!CAUTION!
Note screw sizes and locations for reassembly;

5.5.4 Burner Fan Plate Assembly (continued)

Removal (continued)

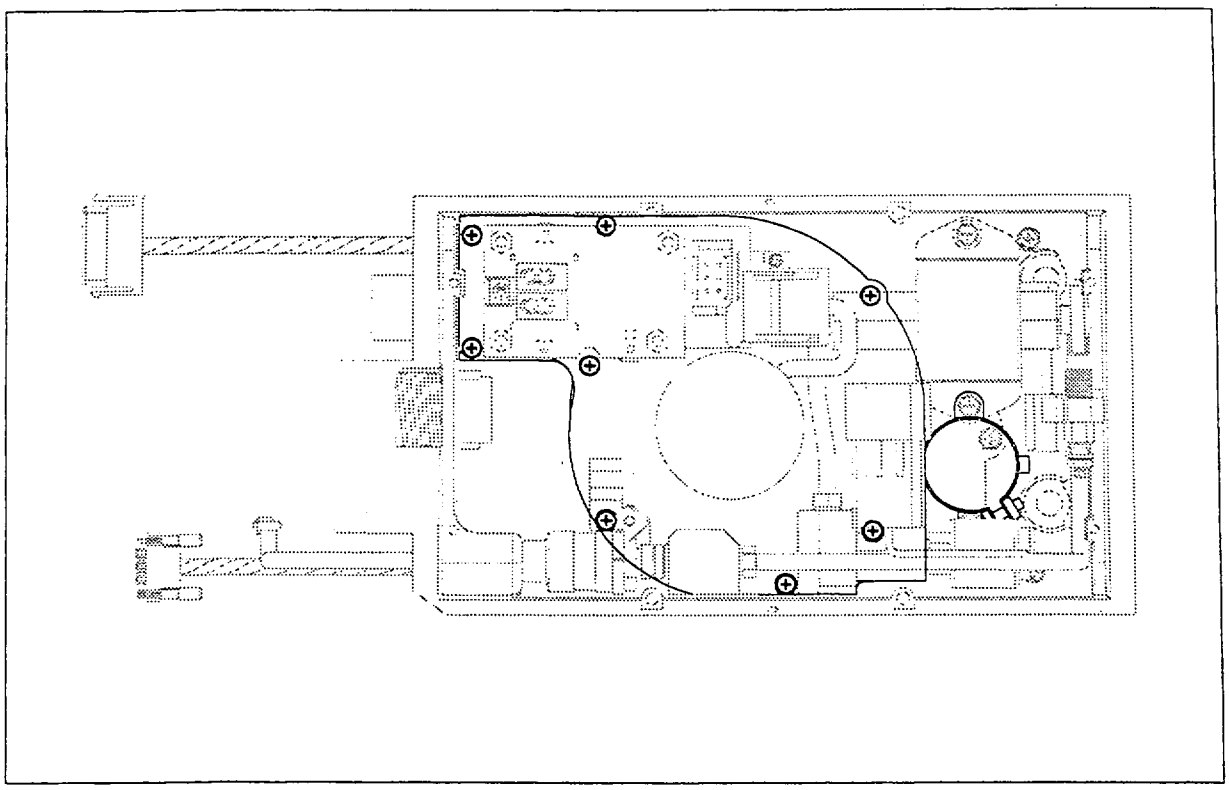

Figure 5-5.8. Burner Fan Plate, Screw Locations

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

8. 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.
9. Free the **Power** Main Capacitor (**C2**) by loosening the bolt on the side of the Main Capacitor clamp.
10. 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.

11. If REPLACING Burner Fan Plate, remove the Diagnostic Display (ref. 5.5.2) and Fuel Pressure Sensor (ref. 5.5.1) for re-installation.

5.5.4 Burner Fan Plate Assembly (continued)

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 242 (blue) to eight (8) screws and star washers, and use a #2 cross-p 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 (ref. 5.5.3).
8. Install the two (2) fuel lines to the Burner Fan Plate Assembly fuel fittings.
9. Install Fuel Pressure Sensor (ref. 5.5.1)

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. 5.5.2)
11. Attach **Logic** Wiring Harness connectors for the Fuel Pressure Sensor (**J4**), and the Diagnostic Display (**J2**). Ensure all connectors are properly engaged.
12. Attach the **Power** 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. 5.1.1)

5.5.4 Burner Fan Plate Assembly (continued)

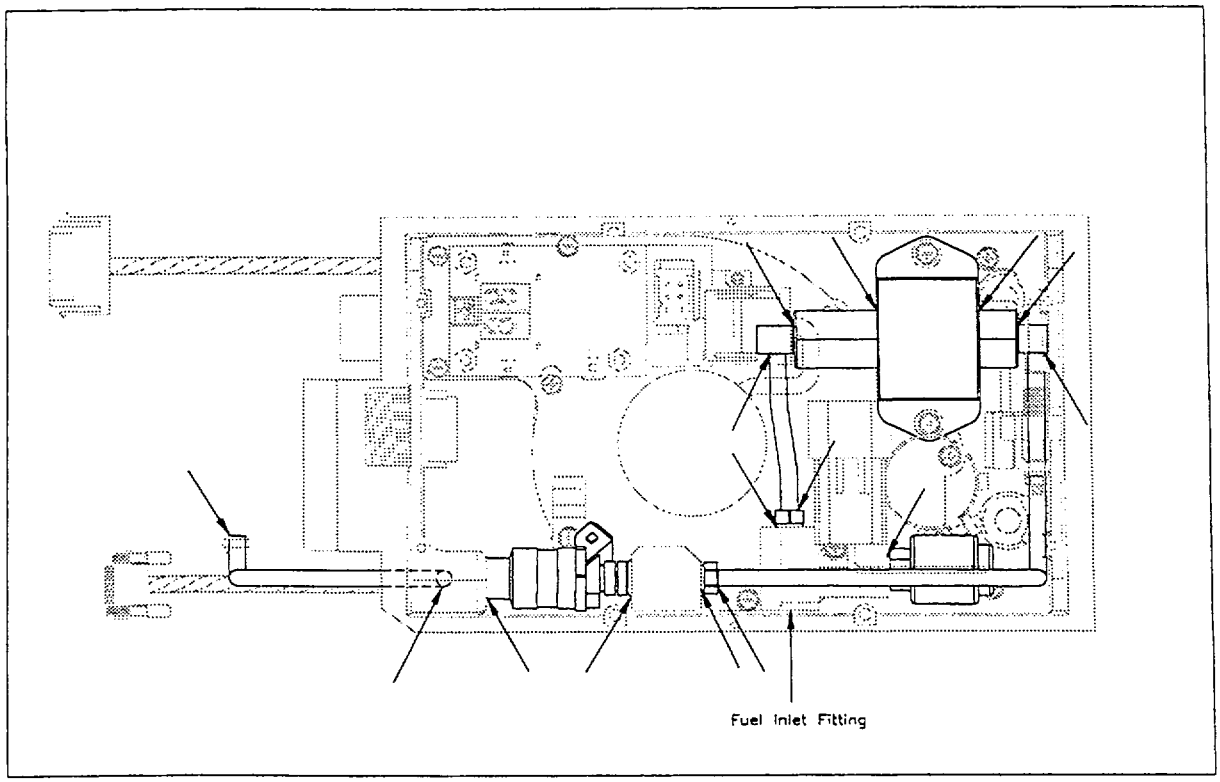

Figure 5-5.9. Fuel Leak Check Points

5.5.5 FUEL INJECTOR

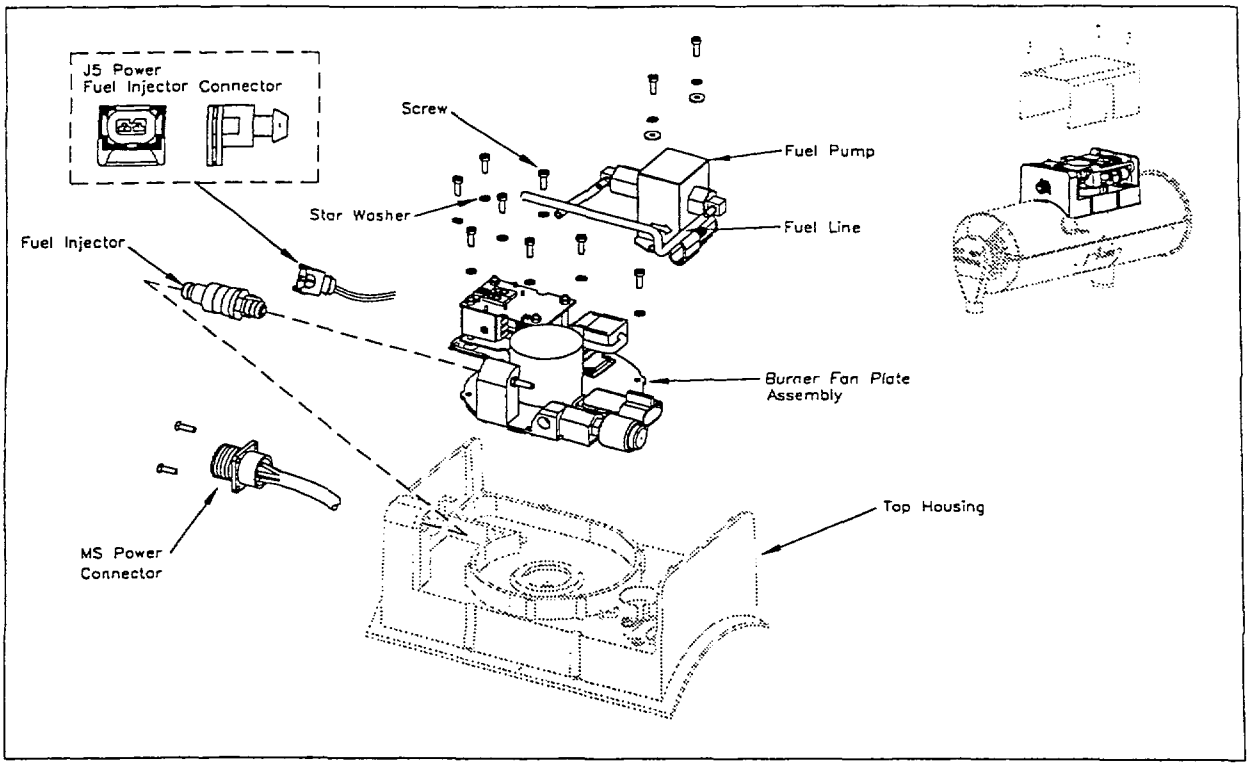

Figure 5-5.10. Fuel Injector

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. 5.5.3)
7. Using a #1 cross-tip screwdriver, unscrew the two (2) screws which 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 damp.
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 warpage of the Impeller.

5.5.5 Fuel Injector (continued)

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 (ref. 5.5.3).
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 (ref. Figure 5-5.9).
10. Install Top Cover (ref. 5.1.1)

5.5.6 Power & Logic Wiring Harnesses

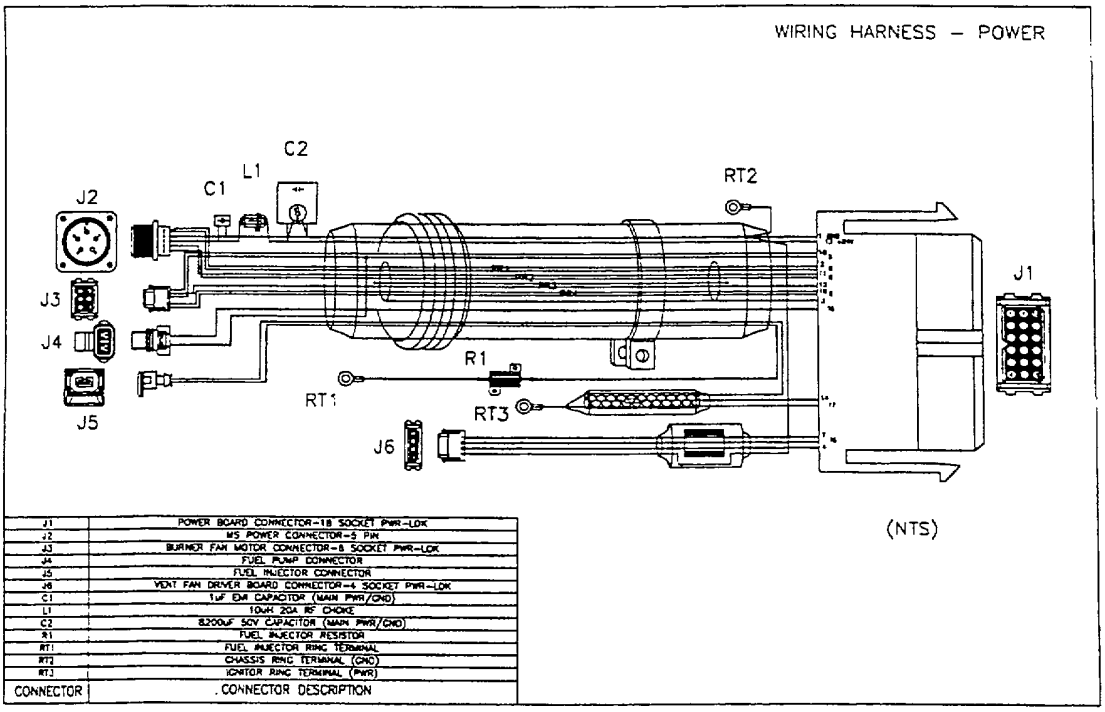

Figure 5-5.11. Power Wiring Harness

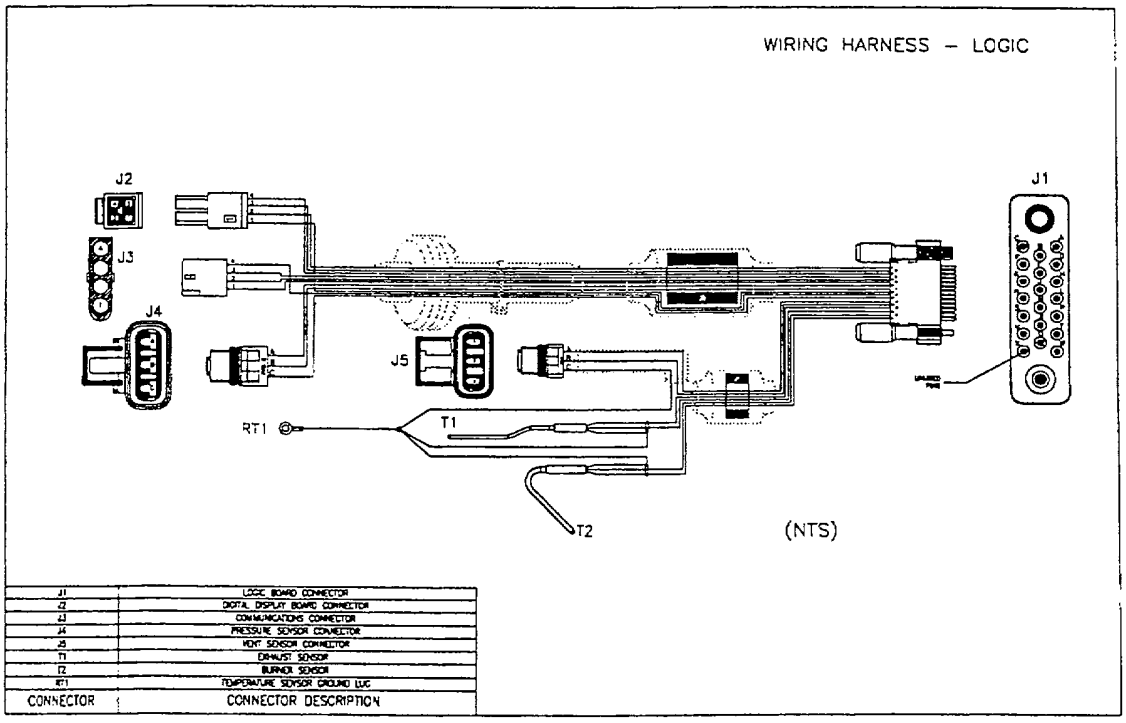

Figure 5-5.12. Logic Wiring Harness

5.5.6 Power and Logic Wiring Harnesses (continued)

Removal

1. Remove Top Cover (ref. 5.1.1)
2. Remove Top Shell (ref. 5.1.2)
3. Remove Bottom Shell (ref. 5.1.3)
4. Remove Vent Fan Assembly (ref. 5.2.1)
5. Remove Combustor Assembly (ref. 5.3.1)
6. Using a 7/16" open ended wrench, remove the Exhaust Sensor from the Exhaust Port.
7. Detach Logic 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 damps 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 Hoses. Place the Top Housing on its side with the fuel inlet fitting facing upwards:

9. Using a #2 cross-tip screwdriver, remove the four (4) screws which hold the Top Housing to the Heat Exchanger Lift the Top Housing away from the Heat Exchanger.
10. Remove **Power** 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 which 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.
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. 5.5.3) to allow access to Wiring Harness Plate.
16. Using a #2 cross-Up 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.

5.5.6 Power and Logic Wiring Harnesses (continued)

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 Power and Logic Harnesses are installed on their respective sides of the Top Housing.

2. Install **Power** Wiring Harness connectors **J1**, **J6** and Resistor **R1** down through the top of the Top Housing at the Fuel Pump end.
3. Install **Logic** 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 242 (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 **Power** 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 crosstip 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 B. Using Loctite 242 (blue) and a screwdriver, tighten the screw holding the Power Inductor (L1) clamp to the Burner Fan Plate.
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 E
    - 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 242 (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 242 (blue), a #2 cross-tip screwdriver and a screw. Do not tighten P-clip screw until following final length adjustments.

5.5.6 Power and Logic Wiring Harnesses (continued)

Installation (continued)

15. Using a screwdriver and Loctite 242, tighten the two (2) screws holding the Fuel Injector Resistor (**R1**) to the underside of the Top Housing.
16. Install Fuel Pump Assembly (ref. 5.5.3).
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 **Power** 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.
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. 5.3.1).
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 **Logic** Wiring Harness to the Vent Sensor connector. Ensure that the locking tab is engaged.
26. Install Vent Fan Assembly (ref. 5.2.1)
27. Install Bottom Shell (ref. 5.1.3)
28. Install Top Shell (ref. 5.1.2)
29. Install Top Cover (ref. 5.1.1)

SECTION 6
TROUBLESHOOTING

This section explains the diagnostic system used by the A-20 Global Heater to aid in the determination and repair of heater malfunctions, as well as guides the user through a step by step procedure to rectify problems based on the particular diagnostic code given.

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 A-20 Global Heater.

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

Note: ❒❒ - (i.e. NO DISPLAY) If the Diagnostic Display appears blank and the Heater is operating, the Diagnostic Display circuit has failed, see 5.5.2.

6.1.1 **"C" Codes** - Component Failures

Component Failure codes are designed to identify hardware faults.

C1	Igniter Fault	**C6**	Vent Sensor Fault
C2	Igniter Short	**C7**	Fuel Pressure Sensor Fault
C3	Vent Fan Fault	**C8**	Controller Fault
C4	Burner Fan Fault	**C9**	Fuel Pump Fault
C5	Burner/Exhaust Sensor 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	**E4**	Reverse Burner Air Flow
E2	Low Fuel Pressure	**E5**	Inlet Over Pressure
E3	Low Burner Air Flow	**E6**	Over 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	**F5**	Over Current
F2	Burner Flame Out	**F6**	Ambient Over Temperature
F3	Heat Limit	**F7**	Exhaust Over Temperature
F4	Vent Air Over Heat	**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 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 1/2 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 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 6-2 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	Over Voltage
F3	Heat Limit
F6	Ambient Over Temperature

Table 6-1. Warning Faults

C1	Igniter Fault
C2	Igniter 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
F1	Ignition Overtime
F2	Burner Flame Out
F4	Vent Air Over Heat
F5	Over Current
F7	Exhaust Over Temperature
F8	Ignition Flame Out

Table 6-2. Shut Down Faults

6.3 TROUBLE SHOOTING - 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
- If a fault is encountered during Start Up and Ignition is not achieved in the allowable 3 1/2 minutes, the Heater will automatically shut down, flash the Control Box Lamp, and display the component fault.

!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.

C1 - IGNITER FAILURE

C1	Igniter is not connected		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Check that Igniter Hatch is installed correctly	4.4.1	Install Igniter Hatch Restart Heater
2	Check that Wire is Connected to Igniter	4.4.1	Check spring washer on Igniter post. Place wire on Post Replace Hatch Cover Restart Heater
3	Defective Igniter	4.4.1	Replace Igniter 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 Power Wiring Harness Restart Heater

C2 - IGNITER SHORT

C2	Igniter is not properly connected or is shorted		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Check that Igniter Hatch is installed correctly	4.4.1	Install Igniter Hatch Replace Igniter Wire on Igniter Restart Heater
2	Check that Igniter wire is connected to Igniter	4.4.1	Check spring washer on Igniter post Place wire on Post Replace Hatch Cover Restart Heater
3	Defective Igniter	4.4.1	Replace Igniter Restart Heater
4	Detective Electronic Programmed Controller Board	5.2.5	Replace Electronic Programmed Controller Restart Heater
5	Defective Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Heater

C3 - VENT FAN FAULT

C3	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 Power Wiring Harness	5.2.5 5.5.6	Reconnect to Power 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 Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Heater

C4 - BURNER FAN FAULT

C4	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** circulating through the heater, then check all electrical connections to the Burner Fan Restart Heater 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 Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Heater
4	Defective Electronic Programmed Controller	5.2.5	Replace Electronic Programmed Controller Restart Heater

C5 - BURNER SENSOR FAULT

C5	Burner Sensor signal is outside normal limits		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Defective Logic Wiring Harness	5.5.6	Replace Logic Wiring Harness Restart Heater
2	Defective Electronic Programmed Controller Board	5.2.5	Replace Programmed Controller Board Restart Heater

C6 - VENT SENSOR FAULT

C6	Vent Thermal-Pickup circuit has failed		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Check that Vent Sensor is connected to the Logic Wiring Harness. Inspect wires at connector and Vent Sensor.	5.4.2	Reconnect Vent Sensor to Logic Wiring Harness Restart Heater
2	Defective Vent Sensor	5.4.2	Replace Vent Sensor Restart Heater
3	Defective Logic Wiring Harness	5.5.6	Replace Logic Wiring harness Restart Heater
4	Defective Electronic Programmed Controller Board	5.2.5	Replace Electronic Controller Board Restart Heater

C7 - FUEL PRESSURE SENSOR FAULT

C7	Fuel pressure sensor circuit has failed		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Check that Electrical connector attached to Fuel Pressure Sensor	5.5.1	Reconnect Fuel Pressure Heater to Power Wiring Harness Restart Heater
2	Defective Fuel Pressure Sensor	5.5.1	Replace Programmed Controller Restart Heater
3	Defective Electronic Programmed Controller Board	5.2.5	Replace Programmed Controller Restart Heater
4	Defective Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Sensor

Note: If a C7 Fault occurs during Run mode (07 or 14), the Heater will continue to operate if possible, and alternately display the C7 code and the appropriate Run mode (07 or 14)

C8 - CONTROLLER FAULT

C8	Controller has failed		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Defective Electronic Programmed Controller Board	5.2.5	Replace Electronic Programmed Controller Restart Heater

C9 - FUEL PUMP FAULT

C9	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 Power 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 Power Wiring Harness	5.5.6	Replace Power 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.

CA - FUEL INJECTOR FAULT

CA	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 Power 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 Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Heater
5	Defective Electronic Programmed Controller Board	5.2.5	Replace Electronic Programmed Controller Restart Heater

E1 - LOW VOLTAGE

E1	Voltage supplied top 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 Power Wiring Harness Restart Heater
4	Defective Electronic Vent Fan Driver Board	5.2.5	Replace Electronic Vent Fan Driver Board Restart Heater
5	Defective Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Heater

E2 - LOW FUEL PRESSURE

E2	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		Fill fuel tank with fuel Restart Heater
6	Ensure that Fuel Pressure Sensor is connected to Power Wiring Harness	5.5.1	Reconnect Fuel Pressure Sensor to Power Wiring Harness Restart Heater
7	Defective Fuel Pressure Sensor	5.5.1	Replace Fuel Pressure Sensor Restart Heater
8	Defective Power Wiring Harness	5.5.6	Replace Power Wiring Harness Restart Heater

E3 - LOW BURNER AIR FLOW

E3	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

Note: Obstructions to look for in combustion or exhaust ducting include: frost, mud, water, foreign objects, soot, rodents, small birds, etc.

E4 - REVERSE BURNER AIR FLOW

E4	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	5.3	Remove carbon and clean Combustion Assembly Restart Heater
	Check condition of Flame Tube and Burner Chamber	5.3.2 5.3.5	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

E5 - INLET OVER PRESSURE

E5	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)

E6 - OVER VOLTAGE

E6	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

F1 - IGNITION OVERTIME

F1	The heater-was unable to establish ignition in the 3 1/2 minute time limit		
	CHECK/POSSIBLE CAUSE	**REF.**	**REPAIR**
1	Check that wire is installed onto Igniter and that Igniter Hatch is installed correctly	4.4.1	Install Wire on Igniter Post Install Igniter Hatch Restart Heater
2	Check that Igniter Holder is clean	4.4.1	Clean Igniter Holder Restart Heater
3	Check that Igniter is wet with fuel		If Igniter is dry then proceed to steps 3-9 If Igniter 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		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 Logic Wiring Harness	5.5.6	Replace Logic Wiring Harness Restart Heater

F2 - BURNER FLAME OUT

F2	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		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 Logic Wiring Harness	5.5.6	Replace Logic Wiring Harness Restart Heater
12	Defective Electronic Programmed Controller Board	5.2.5	Replace Electronic Programmed Controller Restart Heater

F3 - HEAT LIMIT

F3	Vent Outlet temperature has exceeded the upper temperature limits of 340°F (171°C)		
	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

F4 - VENT AIR OVERHEAT

F4	The Ventilation 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

F5 - OVER CURRENT

F5	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 Logic Wiring Harnesses	5.5.6	Replace both Logic and Power Wiring Harnesses Restart heater
3	Defective Electronic Programmed Controller Board	5.2.5	Replace Electronic Programmed Controller Restart Heater

F6 - INLET OVERHEAT

F6	Ambient temperature has exceeded a safe operating temperature of 115°F(46°C) and is beyond the operating limits of the Heater. Operating Fault Code will flash when ambient temperature exceeds 104°F (40°C).		
	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.
2	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.
3	Reverse air flow conditions	vehicle TM 2.2 2.3 2.7	Install ducting correctly. Restart Heater

F7 - EXHAUST OVERHEAT

F7	Exhaust temperature has exceeded a safe operating temperature of 1300°F (704°C) and is beyond the operating limits of the Heater.		
	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

F8 - IGNITION FLAME OUT

F8	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 Igniter Holder	4.4.1	Clean carbon from Igniter Holder Restart Heater
2	Check that Igniter Hatch is installed correctly	4.4.1	Install Igniter Hatch Restart Heater
3	Check that Wire is Connected to Igniter	4.4.1	Check spring washer on Igniter post. Place wire on Post Replace Hatch Cover Restart Heater
4	Defective Igniter	4.4.1	Replace Igniter Restart Heater
5	Check fuel system and fuel supply	2.6	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 Housing	5.3.7	Remove carbon and clean Burner Housing
9	Defective Flame Tube and Burner Chamber	5.3.2 5.3.5	Replace Flame Tube and Burner Chamber Restart Heater
10	Defective Burner Housing	5.3.7	Replace Burner Housing Restart heater
11	Defective Fuel Injector	5.5.5	Replace Fuel Injector Restart Heater
12	Defective Logic Wiring Harness	5.5.6	Replace Logic Wiring Harness Restart Heater
13	Defective Electronic Programmed Controller Board	5.2.5	Replace Electronic Programmed Controller Restart Heater

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 9-2350-230-	Tank, Combat full Tracked, 120mm.
TM 9-2350-232-	Reconnaissance Airborne Assault Vehicle 152mm Gun/Launcher, M60
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, Improved Tow 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 9-5420-202	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.

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1. Services- Inspect, test, service, adjust, aline, calibrate, and/or replace.

2. 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).

3. 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 maintenance under consideration.

4. 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 "usable 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) Group No.	(2) Components/Assembly	(3) Maint. Function	(4) Maintenance Level					(5) Tools & Equip	(6) Remarks
			Unit		DS	GS	Depot		
			C	O	F	H	D		
22	Body, Chassis, 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) Group No.	(2) Components/Assembly	(3) Maint. Function	(4) Maintenance Level					(5) Tools & Equip	(6) Remarks
			Unit		DS	GS	Depot		
			C	O	F	H	D		
22	Body, Chassis, 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		
	Igniter	Inspect		0.1	0.1	0.1	0.1		
		Remove/ Replace		0.2	0.1	0.1	0.1		
	Holder, Igniter	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) Group No.	(2) Components/Assembly	(3) Maint. Function	(4) Maintenance Level					(5) Tools & Equip	(6) Remarks
			Unit		DS	GS	Depot		
			C	O	F	H	D		
22	Body, Chassis, 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		
1	O, F	Tool Kit, Mechanic Gen	5180-00-177-7033	
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 242, 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		WD-40	cn
11	F	9150-01-197-7688	Grease (GAA)	tu
		9150-01-197-7689		cn
12	O	9320-01-053-8266	Tape, Teflon	ro
13	F	5975-01-067-3359	Tie Wraps	ea
14	F		Dow Corning 55 O-Ring lub., 1864947	tu

APPENDIX D
UNIT, DIRECT SUPPORT
GENERAL SUPPORT MAINTENANCE
REPAIR PARTS AND SPECIAL TOOLS LISTS

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 Unit and Direct Support maintenance of the Personnel Heater, Model A20. It authorizes the requisitioning, issue, and disposition of spares, repair pats, 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.

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.

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/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).
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.
- 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., 5385-01-574-1476) 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 let 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

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

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

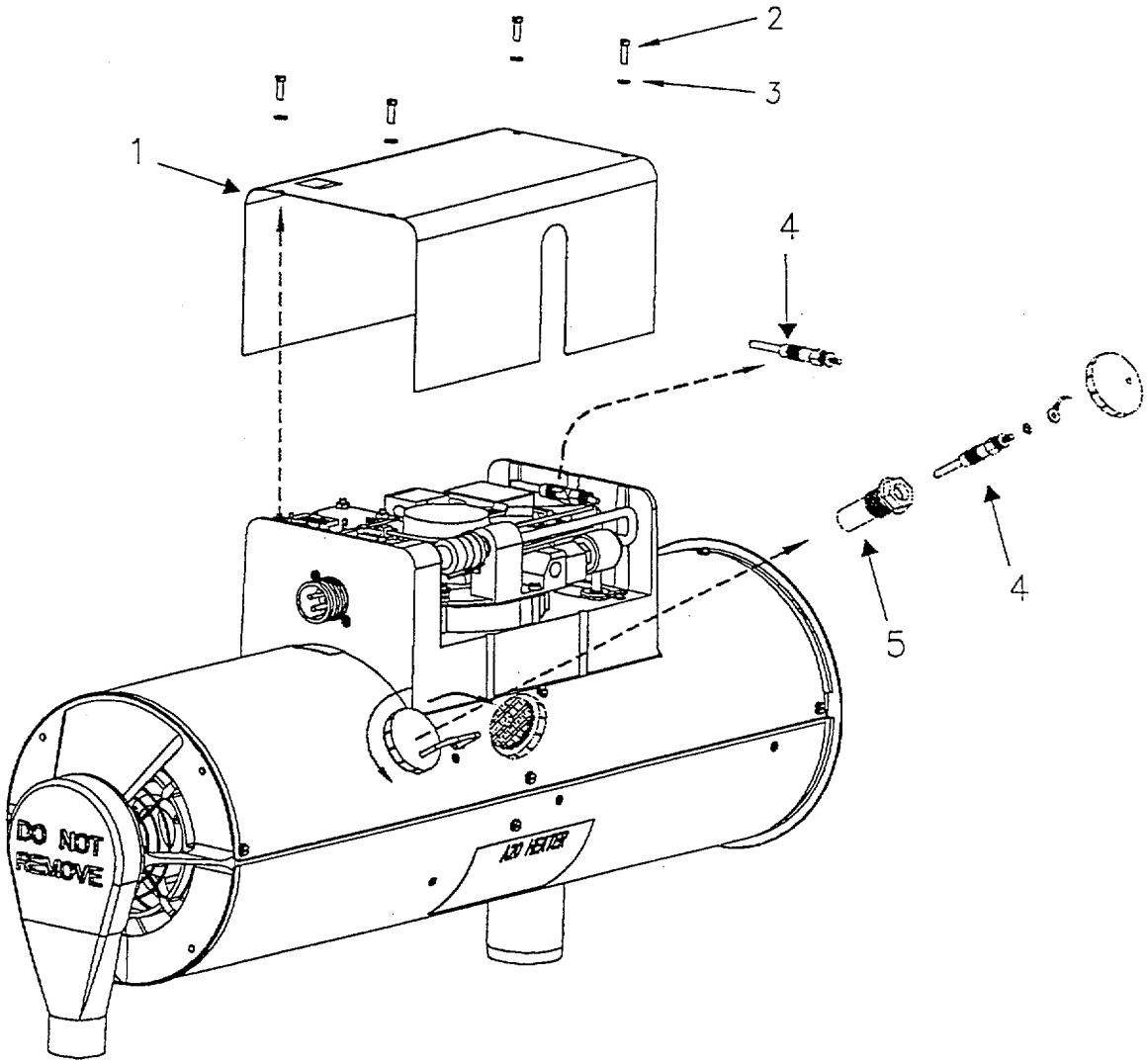


Figure D-1. Igniter and Cover Assembly

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-1 IGNITER AND COVER ASSEMBLY	
1.	PAOZZA	2540-21-920-1458	38334	30018	COVER, TOP ASSEMBLY	1
2.	PAOZZA	5305-00-211-8193	96906	MS51849-54	SCREW, 8-32x1/2, HEX	4
3.	PAOZZA	5310-00-559-0070	96906	MS35333-38	WASHER, STAR	4
4.	PAOZZA	4520-01-452-7358	38334	30014	IGNITER SPARK FUEL	2
5.	PAOZZA	4720-01-459-9077	38334	30013	HOLDER, IGNITER	1

END OF FIGURE

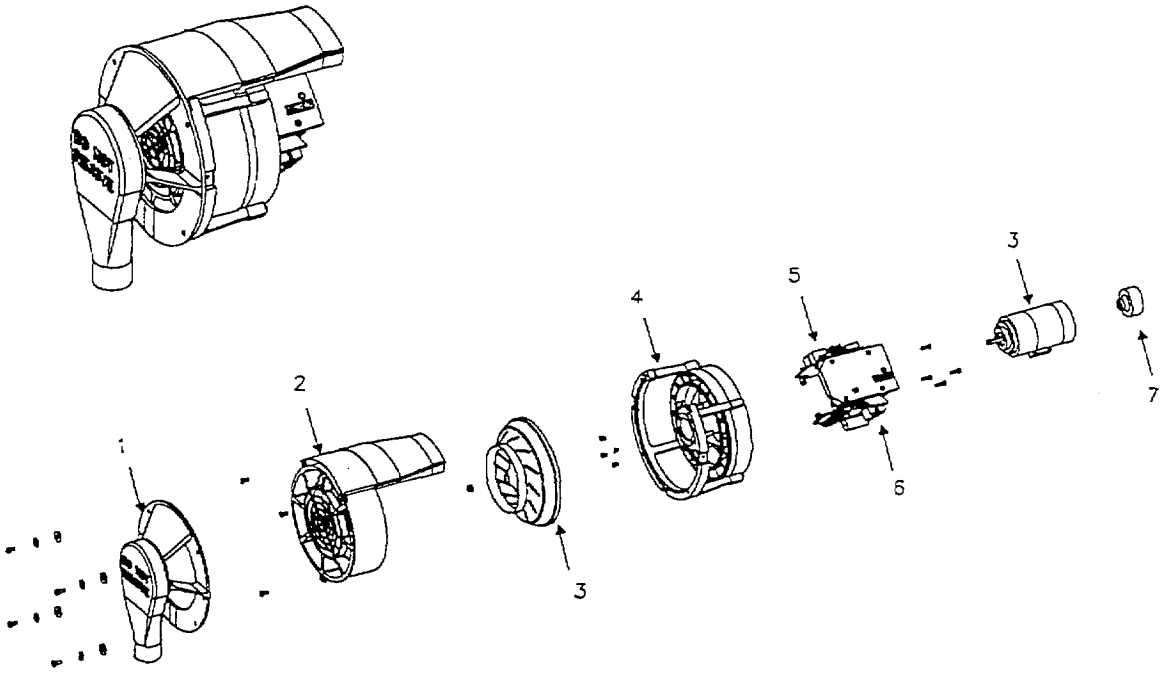


Figure D-2. Vent Housing Assembly

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-2 VENT HOUSING ASSEMBLY	
1.	PAOZZA	1270-21-920-1381	38334	30026	ADAPTER, DUAL AM	1
2.	PAFZZA	2540-21-920-1459	38334	30016	SHROUD, VENT FAN	1
3.	PAFZZA	6105-21-920-1063	38334	30000	MOTOR, VENT FAN KIT	1
4.	XAFZZA		38334	10247	HOUSING, VENT FAN	1
5.	PAFDDA	4140-01-453-2512	38334	30001	PCB, VENT FAN	1
6.	PAFDDA	7050-21-920-1157	38334	30003	CONTROLLER, PANEL	1
7.	PAFZZA	2540-01-K65-4738	38334	30002	DRIVER MAGNET	1

END OF FIGURE

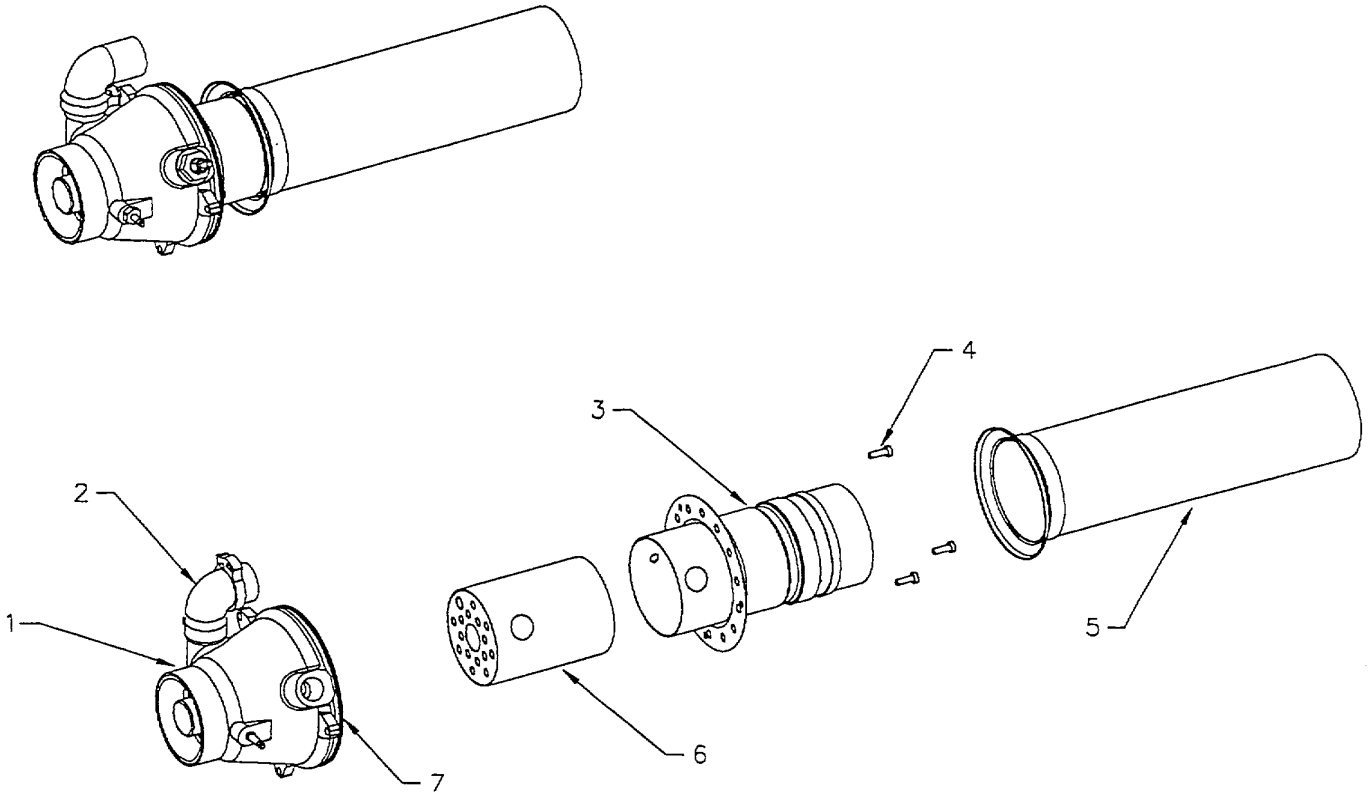


Figure D-3. Burner Assembly

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-3 BURNER ASSEMBLY	
1.	PAFZZA	4530-01-452-7356	38334	30011	BASE ASSEMBLY, BURNER	1
2.	KFFZZA	2540-21-920-1462	38334	10149	DUCT SECONDARY, PART OF KIT 30007	1
3.	PAFZZA	4520-01-K67-0971	38334	30022	HOLDER, FLAME	1
4.	PAFZZA	5305-00-211-8193	96906	MS51849-54	SCREW, 8-32X1/2”, PHILLIPS HEAD	1
5.	PAFZZA	4710-21-920-2920	38334	30021	TUBE, FLAME	1
6.	PAFZZA	4530-01-K65-4901	38334	30012	CARTRIDGE, BURNER	1
7.	PAFZZA	5330-21-920-6765	38334	30023	O RING, BURNER	1

END OF FIGURE

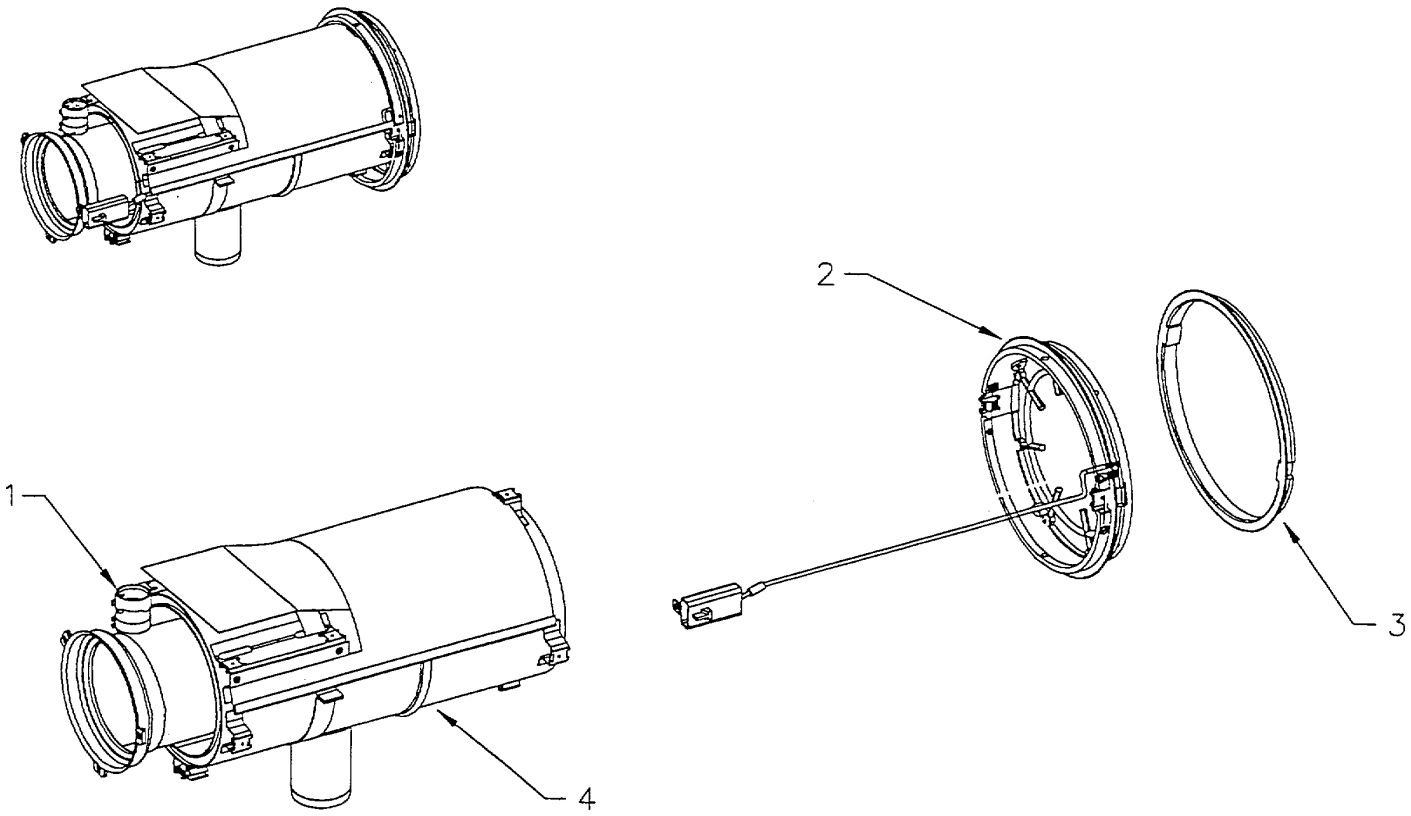


Figure D-4. Heat Exchanger Assembly

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-4 HEAT EXCHANGER ASSEMBLY	
1.	KFFZZA	2540-21-920-1462	38334	10150	DUCT, PRIMARY PART OF KIT 30007	1
2.	PAFZZA	6110-21-920-1072	38334	30005	CAST, THERMAL PICKUP	1
3.	PAFZZA	5330-21-920-3240	38334	30025	SEAL, OUTPUT MOLDED	1
4.	PAFZZA	2540-21-920-1461	38334	30006	EXCHANGER, HEAT	1

END OF FIGURE

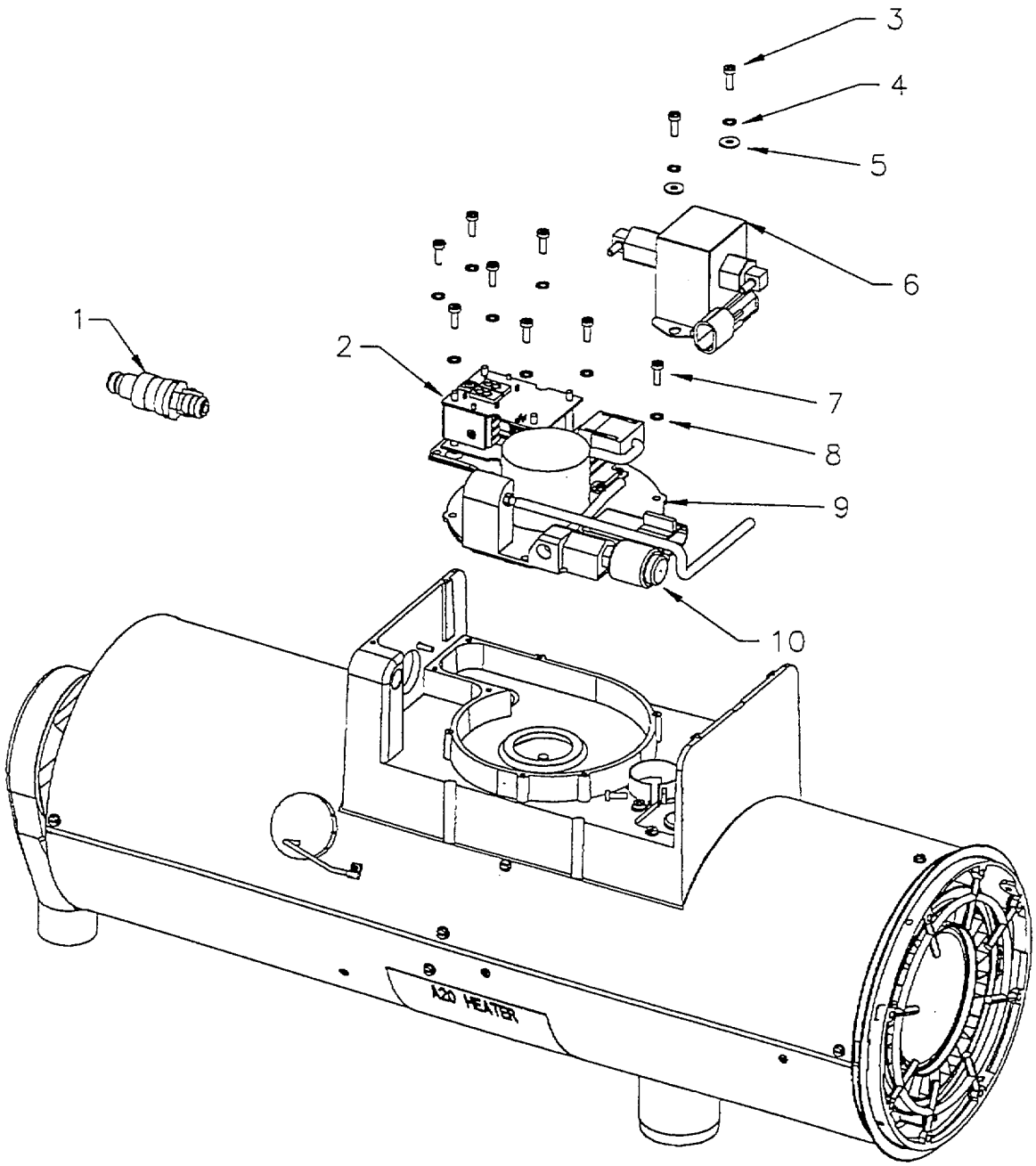


Figure D-5. Top Housing Assembly

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 22 WINTERIZATION EQUIPMENT	
					FIGURE D-5 TOP HOUSING ASSEMBLY	
1.	PAFFZA	2910-01-K67-0969	38334	10031	INJECTOR, FUEL	1
2.	PAFDDA	5998-01-K65-4899	38334	30010	DISPLAY, DIAGNOSTIC	1
3.	PAFZZA	5305-00-984-6192	96906	MS35206-224	SCREW, 10-32X1, PHILLIPS, PAN HEAD	3
4.	PAFZZA	5310-00-559-0070	96906	MS35333-38	WASHER, # 8 STARWASHER	3
5.	PAFZZA	5310-00-765-3197	96906	MS27183-41	WASHER, FLAT	3
6.	PAFZZA	2540-21-920-8126	38334	30008	PUMP, FUEL	1
7.	PAFZZA	5305-00-984-6192	96906	MS35206-244	SCREW, 10-32X1, PHILLIPS, PAN HEAD	4
8.	PAFZZA	5310-00-559-0070	96906	MS35333-39	WASHER, # 8 STARWASHER	4
9.	PAFZZA	4520-01-454-0194	38334	30015	PLATE ASSEMBLY, BURNER PAN	1
10.	PAFZZA	5930-21-920-6704	38334	30017	SENSOR, FUEL PRESSURE	1

END OF FIGURE

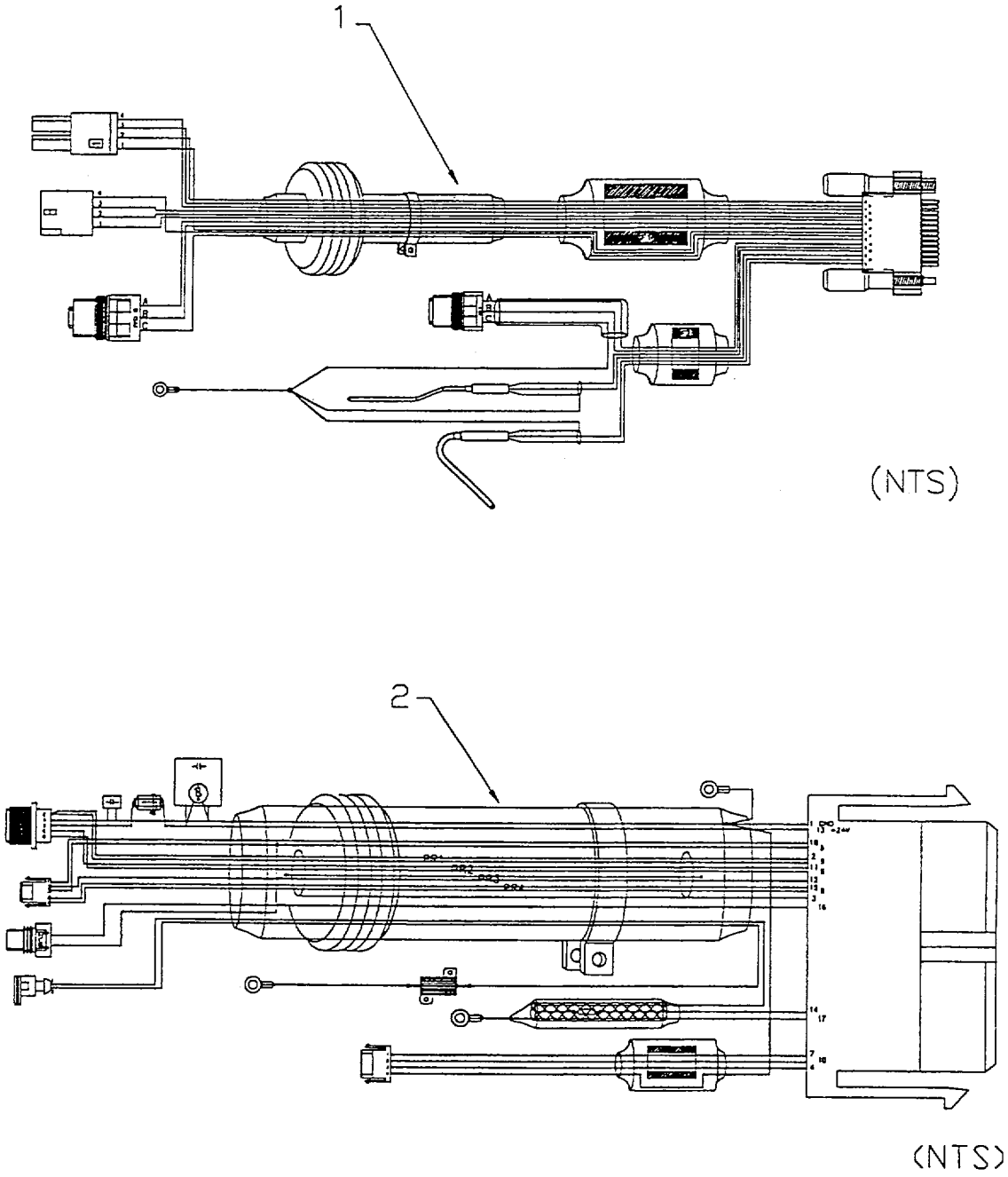


Figure D-6. Logic and Power Wiring Harnesses

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-6 LOGIC AND POWER WIRING HARNESS	
1.	PAFFZA	6150-21-920-1548	38334	30004	WIRING HARNESS, BLA	1
2.	PAFFZA	6150-21-920-3242	38334	30009	WIRING HARNESS, POWER	1

END OF FIGURE

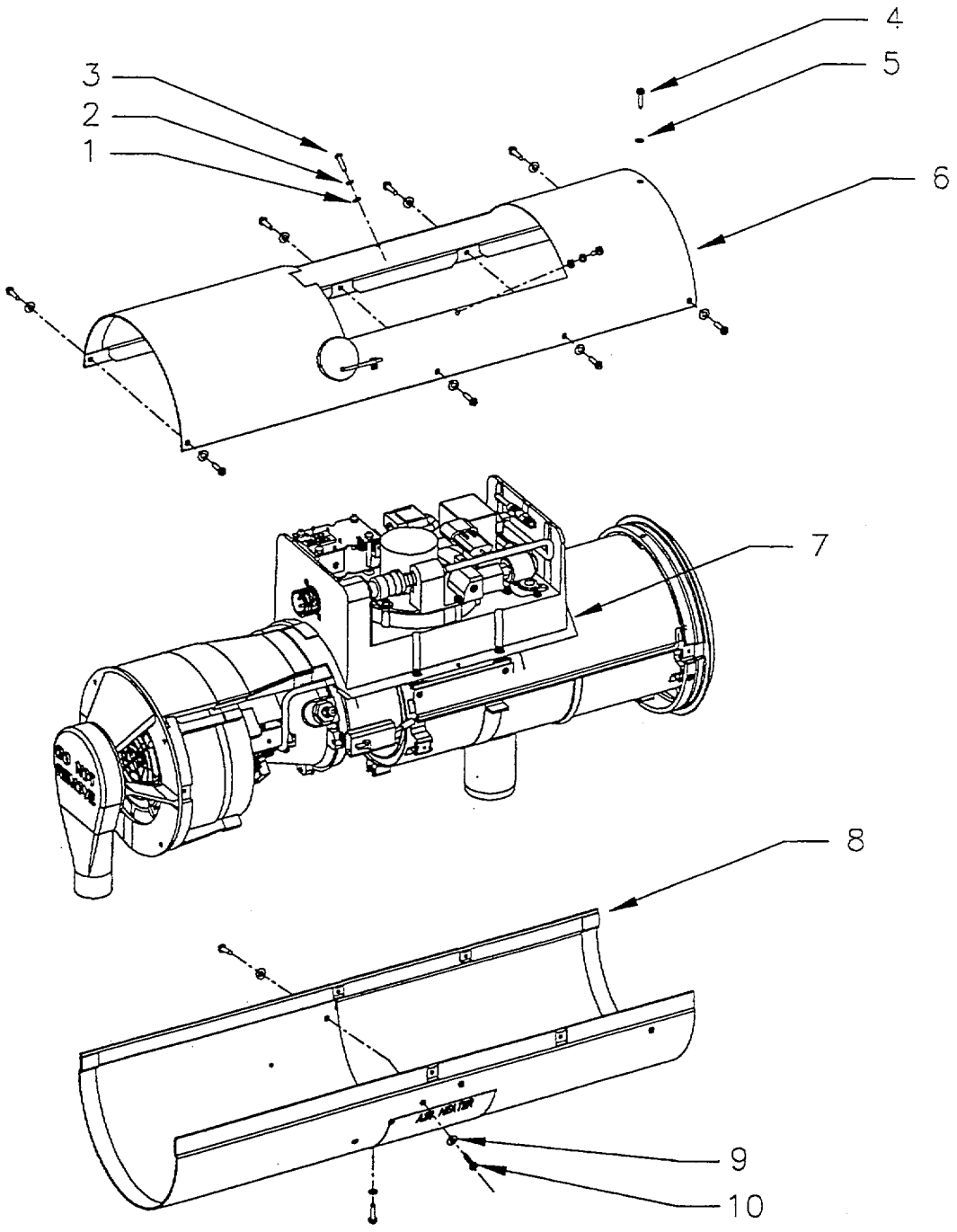


Figure D-7. Shell Assembly

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE D-7 SHELL ASSEMBLY	
1.	PAFZZA	5310-00-765-3197	96906	MS27183-41	WASHER, FLAT	1
2.	PAFZZA	5310-00-045-3296	96906	MS35388-43	WASHER LOCK, #10	1
3.	PAFZZA	5305-00-211-8193	96906	MS51849-54	SCREW, 8-32X1/2	1
4.	PAFZZA	5305-00-054-6670	96906	MS51957-45	SCREW, 8AX3/4	9
5.	PAFZZA	5310-00-559-0070	96906	MS35333-38	WASHER # 8 STAR	9
6.	PAFZZA	2540-21-920-1457	38334	30019	SHELL, TOP	1
7.	PAFZZA	5330-21-920-6771	38334	30024	GASKET, FAN, BURNER	1
8.	PAFZZA	2540-21-920-1455	38334	30020	SHELL, BOTTOM	1
9.	PAFZZA	5310-00-765-3197	96906	MS27183-41	WASHER, # 8 FLAT	1
10.	PAFZZA	5305-00-432-4172	96906	MS51861-37	SCREW, #8AX3/4	3

END OF FIGURE

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NO.	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2207 WINTERIZATION EQUIPMENT	
					FIGURE KIT REPAIR KITS	
	PAFZZA	2540-21-920-1462	38334	30007	PARTS KIT, DUCT ASSEMBLY	
				10149	DUCT, SECONDARY	
				10150	DUCT, PRIMARY	
		1				

END OF FIGURE

CROSS REFERENCE INDEXES
NATIONAL STOCK NUMBER INDEX

STOCK NUMBER	PART NUMBER	CAGEC	FIGURE	ITEM
5310-00-045-3296	MS35388-43	96906	7	2
5305-00-054-6670	MS51957-45	96906	7	4
5305-00-211-8193	MS51849-54	96905	1	2
			3	4
			7	3
5310-00-559-0070	MS35333-38	96906	1	3
			5	4
			5	8
			7	5
5310-00-765-3197	MS27183-41	96906	5	5
			7	1
5305-00-984-6192	MS35206-244	96906	5	3
	10149	38334	3	2
	10150	38334	4	1
	10247	38334	2	4
4930-01-K65-4897	30008	38334	5	6
5998-01-K65-4899	30010	38334	5	2
4530-01-K65-4901	30012	38334	3	6
2540-01-K65-6642	30017	38334	5	10
2540-01-K65-6738	30002	38334	2	7
2910-01-K67-0969	30027	38334	5	1
4530-01-452-7356	30011	38334	3	1
4520-01-452-7358	30014	38334	1	4
4140-01-453-2512	30001	38334	2	5
4520-01-454-0194	30015	38334	5	9
4720-01-459-9077	30013	38334	1	5
4520-01-920-2929	30022	38334	3	3
6105-21-920-1063	30000	38334	2	3
6110-21-920-1072	30005	38334	4	2
7050-21-920-1157	30003	38334	2	6
1270-21-920-1381	30026	38334	2	1
2540-21-920-1455	30020	38334	7	8
2540-21-920-1457	30019	38334	7	6
2540-21-920-1458	30018	38334	1	1
2540-21-920-1459	30016	38334	2	2
2540-21-920-1461	30006	38334	4	4
2540-21-920-1462	30007	38334	KIT	1
6150-21-920-1548	30004	38334	6	1
4710-21-920-2920	30021	38334	3	5
5330-21-920-3240	30025	38334	4	3
6150-21-920-3242	30009	38334	6	2
5330-21-920-6765	30023	38334	3	7
5330-21-920-6771	30024	38334	7	7

CROSS REFERENCE INDEXES
NATIONAL STOCK NUMBER INDEX

STOCK NUMBER	PART NUMBER	CAGEC	FIGURE	ITEM
5310-00-765-3197	MS27183-41	96906	5	5
			7	1
5305-00-984-6192	MS35206-244	96906	5	3
			7	3
5310-00-559-0070	MS35333-38	96906	1	3
			5	4
			5	8
			7	5
5310-00-045-3296	MS35388-43	96906	7	2
5305-00-211-8193	MS51849-54	96905	1	2
			3	4
			7	3
5305-00-054-6670	MS51957-45	96906	7	4
	10149	38334	3	2
2540-21-920-1462	10150	38334	4	1
	10247	38334	2	4
6105-21-920-1063	30000	38334	2	3
4140-01-453-2512	30001	38334	2	5
2540-01-K65-6738	30002	38334	2	7
7050-21-920-1157	30003	38334	2	6
6150-21-920-1548	30004	38334	6	1
6110-21-920-1072	30005	38334	4	2
2540-21-920-1461	30006	38334	4	4
2540-21-920-1462	30007	38334	KIT	1
4930-01-K65-4897	30008	38334	5	6
6150-21-920-3242	30009	38334	6	2
5998-01-K65-4899	30010	38334	5	2
4530-01-452-7356	30011	38334	3	1
4530-01-K65-4901	30012	38334	3	6
4720-01-459-9077	30013	38334	1	5
4520-01-452-7358	30014	38334	1	4
4520-01-454-0194	30015	38334	5	9
2540-21-920-1459	30016	38334	2	2
2540-01-K65-6642	30017	38334	5	10
2540-21-920-1458	30018	38334	1	1
2540-21-920-1457	30019	38334	7	6
2540-21-920-1455	30020	38334	7	8
4710-21-920-2920	30021	38334	3	5
4520-01-920-2929	30022	38334	3	3
5330-01-920-6765	30023	38334	3	7
5330-01-920-6771	30024	38334	7	7
5330-21-920-3240	30025	38334	4	3
1270-21-920-1381	30026	38334	2	1
2910-01-K67-0969	30027	38334	5	1

APPENDIX E

Control Flow Charts

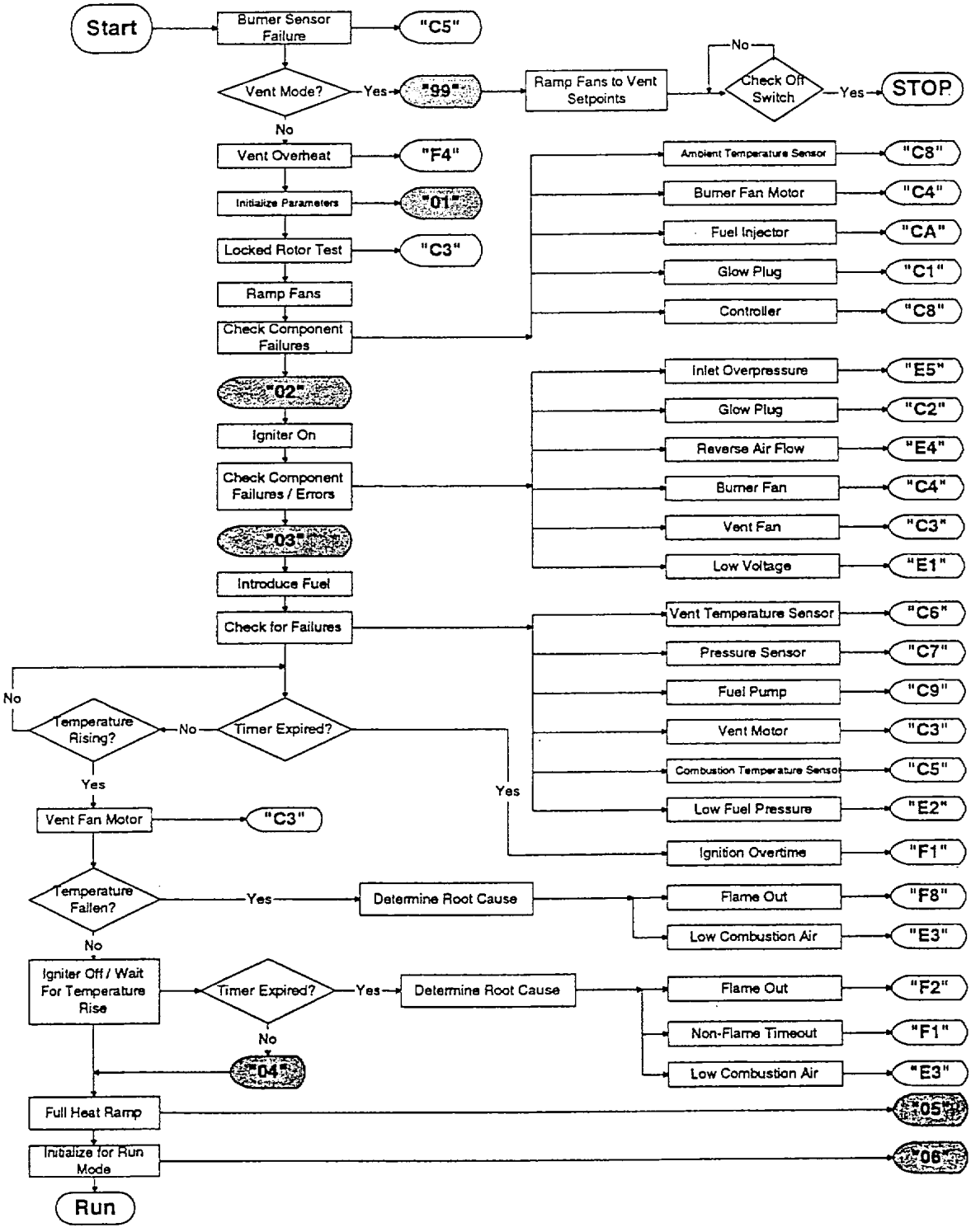


Figure E-1. Start Control Flow Chart

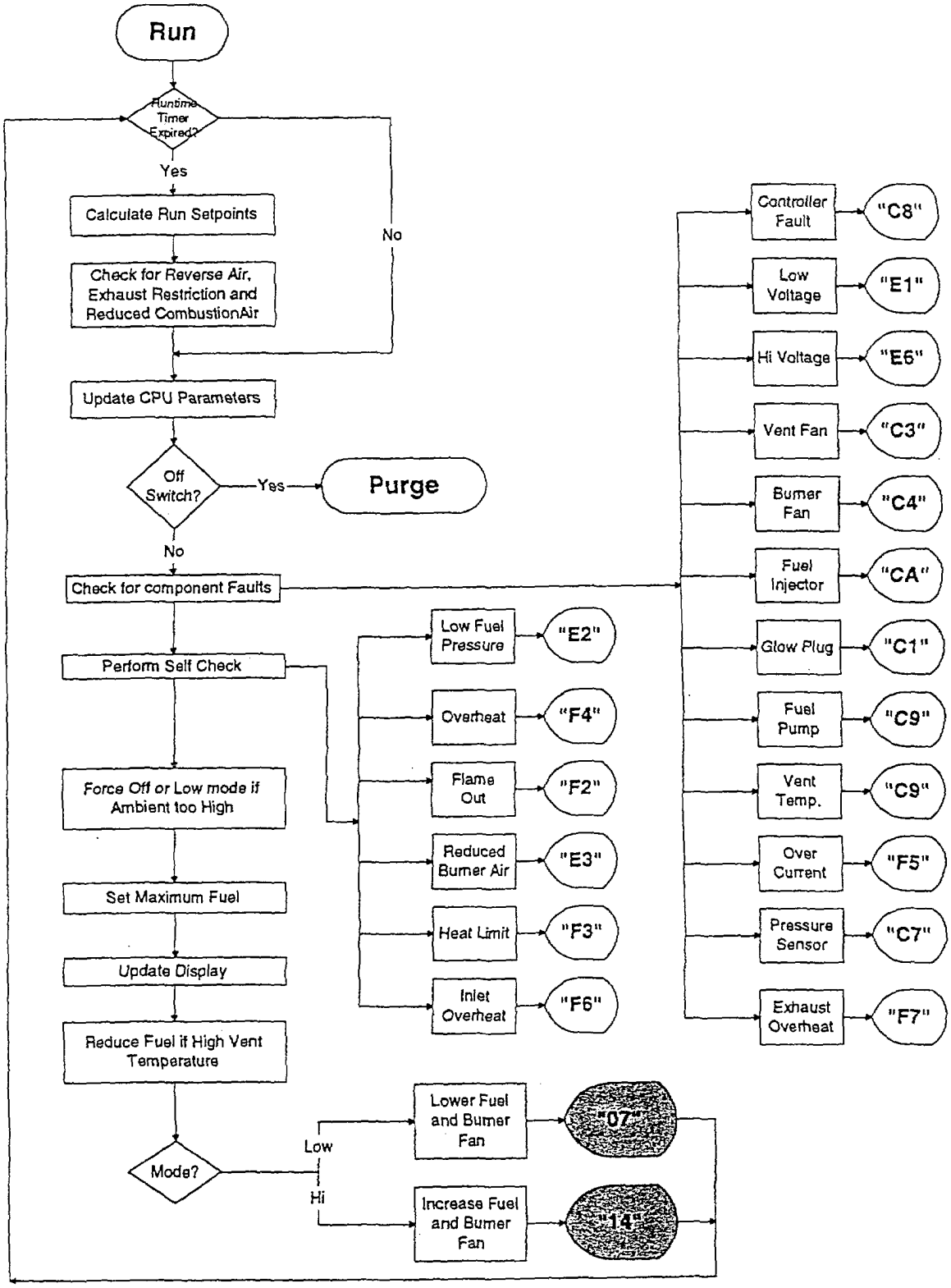


Figure E-2. Run Control Flow Chart

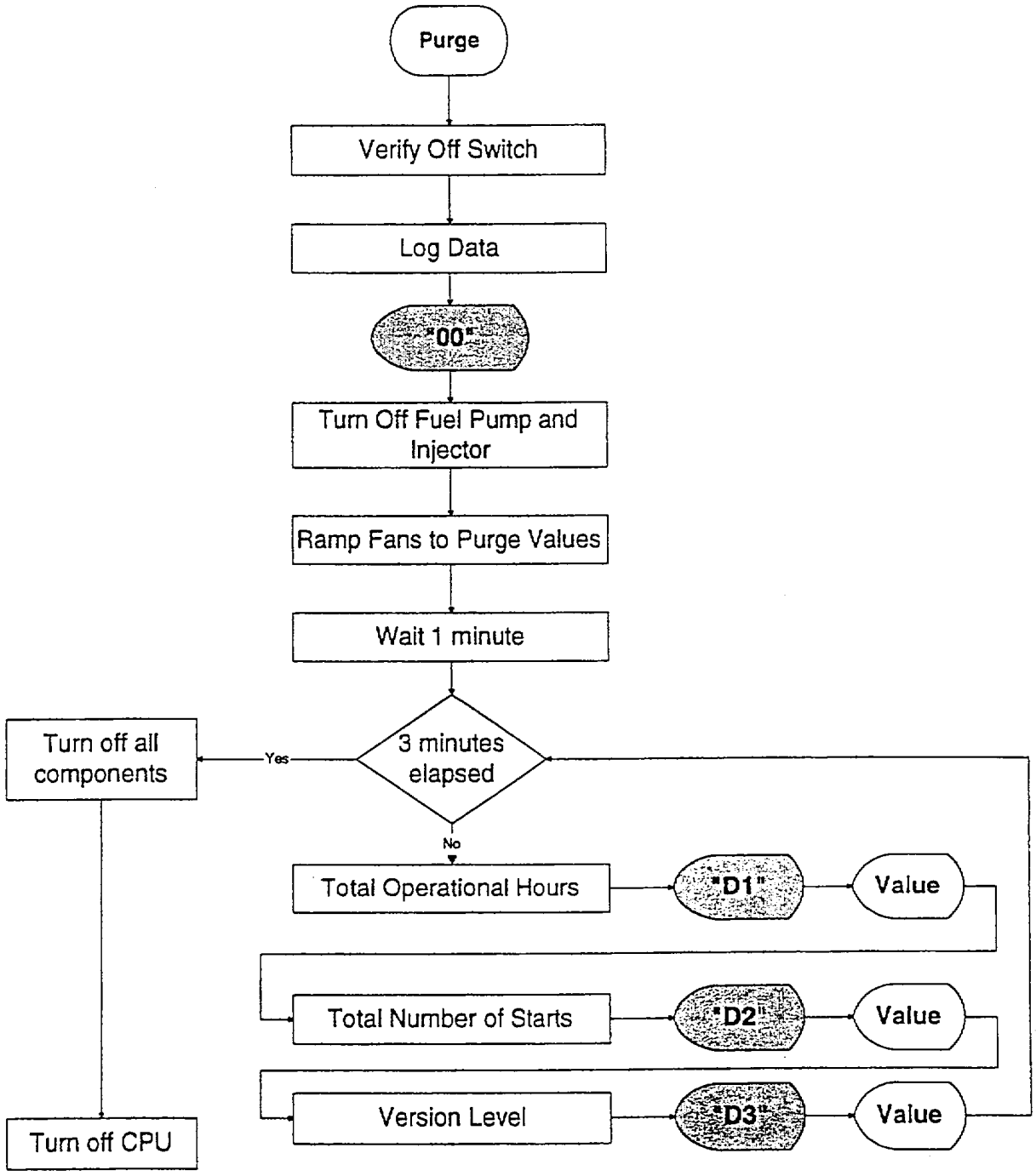


Figure E-3. Purge Control Flow Chart

APPENDIX F

HEATER LABELS

Model A-20 GLOBAL HEATER
Serial Number
NSN/NATO Stock Number: 2540-01-396-2826
Contract Number: *DAAE07-96-C-T250*
Cage Code: 38334
Mfg: Global Thermoelectric Inc.
Heater Assembly
Combustion Vehicle Compartment
Fuel Fired, 17.6 kW (60,000 Btu/hr)

Figure F-1. Heater Name Plate Label

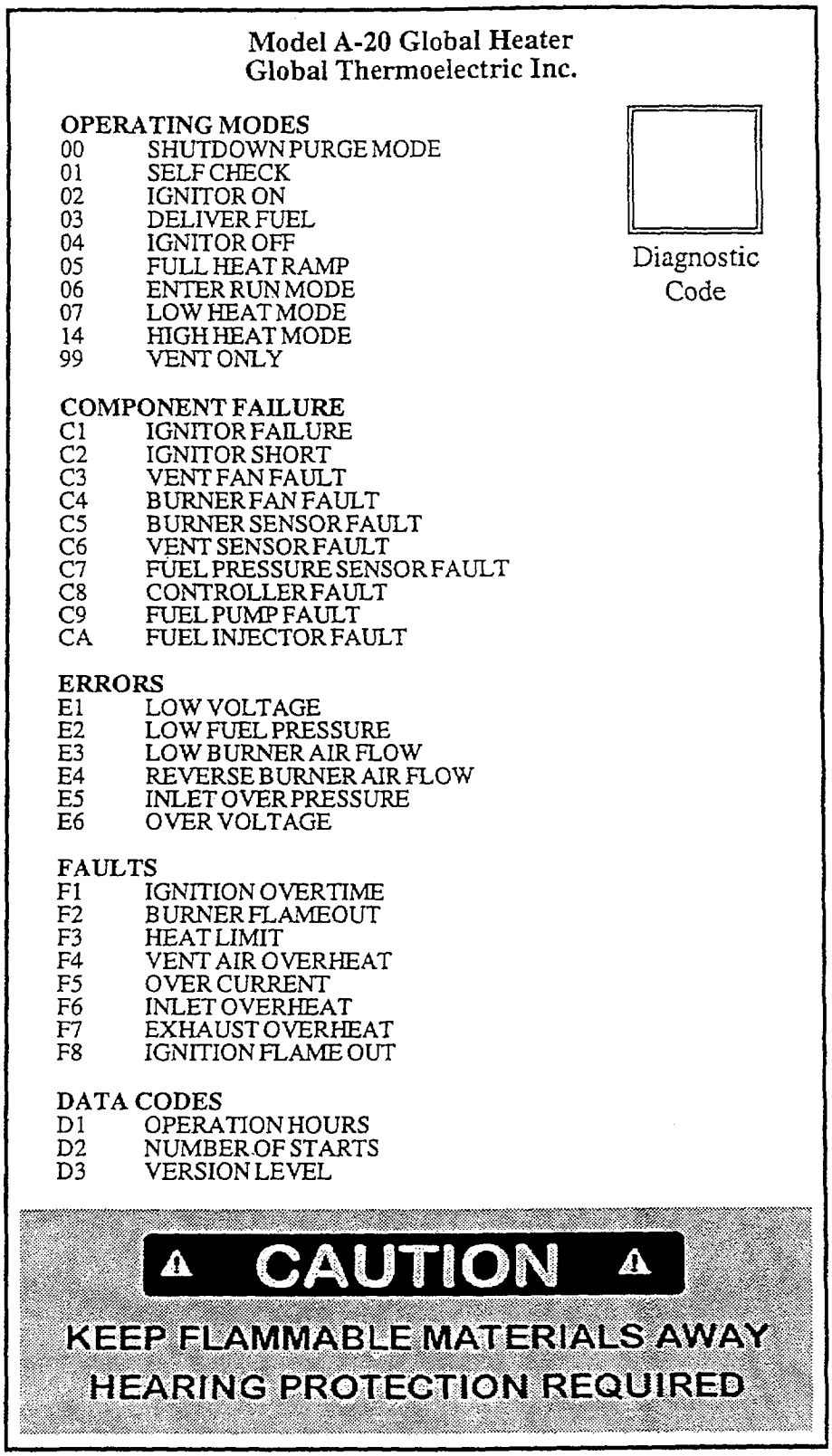
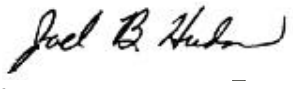


Figure F-2. Diagnostic Code Label

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

Official:



JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0020810

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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 Tool 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

ITEM	PAGE	PARA-	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

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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

CONVERSION TABLES

Temperature

°F	°C
95	35
115	46
125	52
160	71
210	99
250	121
325	163
340	171
345	174
350	177
500	260
1100	593
1400	760
-40	-40
-55	-48
-65	-54

Air Flow

SCFM	kL/min
225	6.35
205	5.81

Pressure

PSI	kPa
3	27.6
15	103

Heat Flow

BTU/Hr	kW
30,000	8.8
60,000	17.6

Dimensions

Inch	mm
1.50	38.1
3.50	88.9
5.55	140.97
5.90	149.86
6.75	171.45
7.38	187.452
7.87	199.898
8.00	203.2
8.38	212.852
10.42	264.668
11.15	283.21
11.50	292.1
12.96	329.184
18.17	461.518
24.38	619.252
26.92	683.768

PIN: 078344-000