



COMBUSTION HEATER I-SERIES OWNERS MANUAL P/N 99M90

HEATER MODELS

I-1500

I-2500

I-3500

I-5000



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Warning:

Owners and Operators that fly must recognize that there are inherent risks involved in this activity. Therefore every precaution in maintenance and training must be taken to minimize these risks as it is unlikely that they can be eliminated entirely. The cabin heaters listed herein are a critical component of the aircraft. Any failure of the combustion heater may result in a delay in departure, dangerous drop in cabin temperatures, smoke, fire or even more severe consequences that may result in injury or death.

Heaters are subject to wear based on conditions that may make the same unit life vary from airplane to airplane and condition to condition. The majority of our heaters are used in personal or business airplanes and rotorcraft that subject them to usage that ranges from every flight to seasonal flights with long periods of inactivity.

Each heater certified must demonstrate an adequate margin of safety before it is considered as safe to operate in an airplane or rotorcraft. Most heater installations are performed by the airframe manufacturer and many systems and components are added to the heater assembly. Even when every precaution is taken in the design and manufacture of a heater as well as the installation, malades have and will occur.

It is essential that the heater be properly operated per the airplane flight manual or pilots operating handbook and maintained according to recommended service procedures found herein and in the applicable aircraft service or maintenance manual. The heater must be observed closely in inspection and operation to detect any potential problems before they have a chance to become serious. Any abnormal or unusual operating reports should be investigated and repairs effected, as it may be a warning of impending failure.

The heater is relied on to provide a comfortable and safe environment for the pilot and passengers. It is critical due to the fact that heat is supplied via fuel combustion and air flow which, if uncontained, may result in smoke and fire aboard the aircraft. Without the continuous care and maintenance called for in this Manual, the heater will degrade and become unreliable and unsafe. Owners, operators and mechanics should read and understand this Manual. It contains the necessary information about your new heater to assure safe and long lasting operation. Please be certain to give it your undivided attention.

Thank you for choosing a Hartzell Engine Technologies LLC Combustion Heater. Maintained properly, it will give you safe and reliable service for many years to come.

Sincerely,

Hartzell Engine Technologies Product Support



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Record of Revisions

Revision Letter	Issue Date	Page Revised	Description	Inserted Date	By
New	5-09-12	All pages	Original Issue		



Record of Revisions

Revision Letter	Issue Date	Page Revised	Description	Inserted Date	By



Record of Temporary Revisions

Temporary Rev. Letter	Page Number	Issue Date	By	Date Removed	By



Record of Temporary Revisions

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Service Publication List

Pub. Number	Description	Heater Affected



Service Publication List

Pub. Number	Description	Heater Affected



List of Effective Pages

Content of Pages	Page	Date of Latest Revision
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AIRWORTHINESS LIMITATIONS

A.0 General Information

CAUTION:

THE AIRWORTHINESS LIMITATIONS HEREIN ARE THOSE MANDATED BY HARTZELL ENGINE TECHNOLOGIES LLC. THESE LIMITATIONS ARE THE MINIMUM REQUIRED TO MEET CONTINUED AIRWORTHINESS BUT MAY BE SUPERCEDED BY MORE STRINGENT REQUIREMENTS AS PUBLISHED BY THE FAA, AIRCRAFT, ROTORCRAFT OR OTHER MANUFACTURERS THAT USE THESE COMPONENTS IN THEIR APPLICATIONS. FAILURE TO OBSERVE THESE LIMITATIONS MAY COMPROMISE THE COMPONENT OR THE APPLICATION IT IS USED IN AND MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

**Airworthiness
Limitations**

A.1 Airworthiness Limitation Statement

1.0 The Airworthiness Limitations Chapter is FAA accepted and specifies maintenance required under Secs. 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

2.0 Not Applicable



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Chapter 1 INTRODUCTION

1.0 General Information

WARNING:

IMPROPER OR UNAUTHORIZED APPLICATIONS OF THE INFORMATION CONTAINED IN THE MANUAL MAY RENDER THE AIRCRAFT/ROTORCRAFT OR THE COMPONENT UNAIRWORTHY AND RESULT IN LOSSES, DAMAGES, OR INJURY TO THE USER.

DO NOT USE OBSOLETE OR OUTDATED INFORMATION. PERFORM BASIC MAINTENANCE AND INSPECTION PER THIS MANUAL OR OVERHAUL ACTIVITY IN ACCORDANCE WITH THE MOST RECENT REVISION OF HET P/N 99M91 OVERHAUL MANUAL. INFORMATION CONTAINED IN EITHER MANUAL MAY BE SIGNIFICANTLY CHANGED FROM EARLIER REVISIONS. USE OF OBSOLETE INFORMATION MAY CREATE AN UNSAFE CONDITION THAT MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE. REFER TO THE HET WEBSITE FOR THE MOST RECENT REVISION LEVEL.

This owners manual has been approved by Hartzell Engine Technologies LLC to provide the proper methods and procedures that A/P Mechanics, FAA approved repairmen, and/or other approved facilities should use for incidental maintenance of Hartzell Engine Technologies LLC I-Series heaters as may be indicated by the owner.

The owner/operator (pilot with a minimum of a private license) of an aircraft or rotorcraft is permitted by FAR 43 to perform certain preventative maintenance tasks. FAR Part 1, Section 1.1, defines preventive maintenance as "simple or minor preservation operations and the replacement of small standard parts not involving complex assembly operations." Under FAR Part 43, Appendix A, Paragraph C "Preventive Maintenance" there are no specific allowances for preventive maintenance to be performed on combustion heaters. All maintenance including preventative maintenance must be performed by licensed mechanics (A&P, A, IA, or international equivalents) or qualified repairman. For more detailed reference, see the latest revision of FAA AC 43.12a.

Because of the numerous modifications, Supplemental Type Certificates (STC), Parts Manufacturing Approvals (PMA), Form 337 Field Approvals, it is the responsibility of the repairman, mechanic or maintenance facility to determine proper heater to aircraft/rotorcraft application of the I-Series heater assemblies. All I-Series heaters are TSO C20(A-1) approved. Please refer to the appropriate aircraft Type Certificate (TC), Supplemental Type Certificate (STC), aircraft equipment list, maintenance manuals, and/or Log Book entries for determination.

When performing installation, maintenance, replacement, adjustment, inspection or overhaul of any HET assembly, component or part, it is imperative that the latest revision of the appropriate HET, manual or product support document be referenced. Reference the Hartzell Engine Technologies LLC website to be sure you have the latest revision before performing any work.



1.0 General Information (cont'd)

- A. All models of the I-Series Combustion Heaters are considered herein. These models are essentially the same. They have the same tube diameters but vary in length according to their BTU capacity.* These also vary with components for 12 or 24 volt operation. Both gasoline and kerosene burning models are available. The I-Series models use Inconel® combustion tubes which do not apply to the current B-Series heater AD.
** Model I-1500 is smaller in diameter.*
- B. The manual describes maintenance on heater or components as they may be installed on the aircraft/rotorcraft. Maintenance tasks must be accomplished by competent qualified personnel using appropriate equipment. There is no owner preventative maintenance permitted on combustion heaters.
- C. Maintenance tasks and subtasks may be included however, detailed maintenance and overhaul tasks are not. (Refer to the heater overhaul and maintenance manual.)
- D. The manual contains: Description, operation, troubleshooting, and other basic service information.
- E. If reference to aircraft/rotorcraft installation application is needed, refer to the HET website, <http://www.hartzellenginetech.com>. Aircraft/rotorcraft application data must be used for reference only as the installation of a combustion heater under TSO C20(A-1) is controlled by the applicable design holder (TC, STC, etc).
- F. Service Bulletins, Service Information Letters and other important publications may be critical to continued safe operation of the heater and should always be referenced along with this manual. Be advised that some service publications do not have a closing action but are re-occurring and will require continued action as required by HET, the FAA or other civil aviation authorities.

1.1 About the manual:

- A. This Owners Manual is provided with each new or rebuilt I-Series combustion heater manufactured or rebuilt by HET and is not specific for any I-Series heater model. This manual does not contain part numbers or overhaul data. For these activities, consult the I-Series Overhaul Manual with IPC part number 99M91.
- B. This Owners Manual is divided into 8 parts. Each part is designed to offer information to a specific area to educate or provide supplement instruction whenever operation or maintenance of the combustion heater is anticipated or desired.
- C. This Owners Manual does not replace or supercede any document or publication issued by a specific design holder as may be certified under a type certificate, supplemental type certificate or other restricted categories. This includes domestic and foreign aircraft, rotorcraft, or other manufacturers.
- D. When using this manual for operation or maintenance, always refer to the most current aircraft/rotorcraft AFM/POH, maintenance manual or service publications prior to beginning these activities.



1.2 How to use the manual:

- A. Refer to this Owner Manual in its entirety before operation or maintenance. Use Maintenance Chapter 8 for basic servicing of the Combustion Heater.
- B. Refer to "Troubleshooting" Chapter 3 prior to starting work to assure that the condition lies with the heater or heater component.
- C. If you need to identify a part or find a part number, refer to the Illustrated Parts Catalog (IPC), which has an Introduction Chapter describing the procedure. The IPC may be found in the Combustion Heater Overhaul & Maintenance manual HET P/N 99M91 as applicable to your heater. If your particular part number heater is not found in these manuals, it may be available in another HET or in aircraft manufacturers documents.
- D. Along with aircraft documents specific to the heater, it is imperative that you read, understand this manual and observe all the applicable **WARNINGS** and **CAUTIONS** before you perform any work or operations.
- E. Test the heater per the test procedures in the manual prior to running the aircraft. Utilize the aircraft manufacturers AFM, POH, and other service manuals and related publications before returning the aircraft to service.
- F. All inquiries concerning this or other HET manuals should be directed to Hartzell Engine Technologies LLC, 2900 Selma Highway, Montgomery, AL 36108. Tel: (334) 386-5400, Fax: (334) 386-5410 or by our website, <http://www.hartzellenginetech.com>, "contact".

1.3 Definitions

This paragraph defines the warnings and notifications used in this manual. **Warnings** place critical attention to use of tools, materials, procedures, or limitations, which must be followed without deviation to avoid injury to the technician or other persons. **Cautions** place immediate attention to use of tools and procedures which must be followed to avoid damage to equipment and facilities. **Notes** call attention to procedures which make the job easier.

The following are basic definitions of the terms used herein: (as related to this manual)

AMMETER: The device for measuring electrical current in variations of amperes.

BRUSH: Device for transmitting current through the commutator to the armature. It is a composite carbon block which includes a spring, lead and contact.

COMBUSTION AIR: The air forced into the combustion area via an electric motor and fan assembly or ram air for the purpose of enhancing and maintaining heater combustion.

COMBUSTION AIR DIFFERENTIAL: The differential pressure is the difference between pressure of combustion air coming into the heater and pressure at the exhaust outlet of the heater. This differential is used with the Combustion Air Pressure Switch.

COMBUSTION TUBE: The tubular device which contains the fuel/air combustion that provides a heat source via radiant heat to the ventilating air being forced past it and on to the cabin.



CONTINUITY: The continuous path for the flow of current in an electrical circuit.

DESIGN HOLDER: This may be defined as the company or entity responsible for design and certification of an aviation product. Type Certificate (TC), Supplemental Type Certificates (STC), and Form 337 Field Approvals (or foreign equivalents) are typical examples.

HEATER (COMBUSTION): The complete unit which transforms chemical energy (fuel) to heat energy by contained combustion via electrical ignition and forced air movement.

HEATER MOTOR: Device that supplies rotational force from the motor to a fan for the purpose of moving air for combustion or ventilation. (Combustion or Ventilating Air Blowers.)

JACKET: The external housing which covers the heater liner and combustion tube assemblies.

INSULATOR: Component that resists the flow of electricity. Typically used to isolate electrical wiring but may also be used in reference to heat insulation.

LEAKAGE: Dissipation of voltage or current from a component or connection. May also be used in terms of fuel, air pressure, heat, or exhaust.

OPEN: Electrical term for a complete disruption in electrical current. Infinite resistance.

RFI: Radio Frequency Interference. Electrical interference created from commutator/brush connection, the coil controller, or other poor connections.

SELF PILOTING FLAME: The whirling flame design is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process will continue until fuel is removed.

SHORTED: Common term for a connection which has zero or very little resistance as seen on an Ohmmeter in an electrical circuit.

SPRAY NOZZLE: The device provided to atomize fuel in a specific pattern to maximize efficient fuel burn in the combustion tube.

TERMINALS: Studs, screws or other connections provide access for electrical power.

VENTILATING AIR: The air forced through and around the combustion tube via electric motor and fan assembly for the purpose of supplying clean heated air to the aircraft or rotorcraft cabin.

VIBRATOR: Device which provides a specific frequency of electrical current to the spark plug through the ignition to maintain proper fuel burn in the combustion tube of the heater.

VOLT/OHM METER: Instrument used to measure voltage, current, or resistance. (DVM)

WHIRLING FLAME: Air entering the combustion chamber tangent to its surface imparts a whirling or spinning action to the air that when fuel is added provides a self sustaining flame.



1.4 Model Identification

Example: FR D 34D51 IS

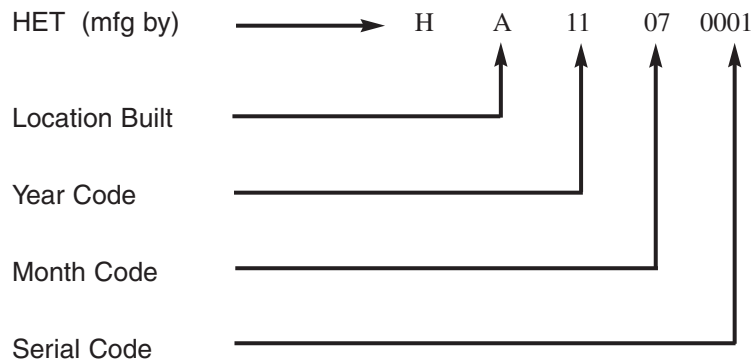
FR indicates Factory Rebuilt and will precede the part number if applicable.

D (if applicable) means a variation in the developed part number.

34D51 is the developed part number for the heater assembly.

IS indicates Inconel[®] Spec tube and will come after the part number.

1.5 Serial number Identification



Example above: S/N HA11070001* Built in Alabama in 2011, July, first unit of the month.

* Hartzell Engine Technologies (HET) Heater units.



1.6 Model number Identification

MODEL I-1500		
<u>Part No.</u>	<u>Part No.</u>	<u>Part No.</u>
96C60 (IS)		99C42 (IS)
MODEL I-2500		
<u>Part No.</u>	<u>Part No.</u>	<u>Part No.</u>
20D35-1(IS)	B37D88(IS)* 42D79-1(IS)	74D01-3(IS)^
MODEL I-3500		
<u>Part No.</u>	<u>Part No.</u>	<u>Part No.</u>
07E02-1(IS) ^	37D77-1(IS)	82D20-1(IS)^
10E21-4 (IS)* ^	C39D59 (IS)	88D81-2(IS)*
22D25-1(IS)	D39D59 (IS)	90D38-1(IS)
C34D51 (IS) ^	45D70-2 (IS)^	90D38-2 (IS)
D34D51 (IS) ^	47D65-3 (IS)^	91E88-1 (IS)
E34D51 (IS) * ^	62D95-1B (IS)	96C62-1 (IS)
MODEL I-5000		
<u>Part No.</u>	<u>Part No.</u>	<u>Part No.</u>
07E94-1(IS)	23E62-1(IS)*	90E00-1(IS)*
07E94-2 (IS)	23E62-2 (IS)	90E14-1 (IS)*
13E55-1 (IS) ^	39D90-1 (IS)*	91E18-1 (IS)*
13E55-2 (IS) ^	65D79-3 (IS)	99C80-2 (IS)
19E69-1 (IS)	81D94-3 (IS)	94E11-1 (IS)
	88D81-2 (IS)	

* indicates kerosene fuel burning heater assemblies
^ indicates pressurized heater

Table 1.1- Basic Model Numbers (Inconel®)



1.7 Warranties

Hartzell Engine Technologies LLC (HET) offers a Limited warranty with each new, overhauled, or rebuilt heater assembly or component (parts) it sells through its distribution system. **NO expressed or implied warranty exists** when repairing, overhauling, or rebuilding any assembly or component using this manual except as it may already apply to any new HET replacement part purchased. If you suspect that any warranty applies to the HET heater assembly, it must be returned through an authorized HET distributor in a manner prescribed by that specific distributor. The affected heater must be received by the factory fully assembled and not altered in any way for disposition by HET warranty department. ***(Warranty shall be denied for any heater received altered, modified, or disassembled.)***

The HET Limited warranty policy in effect for your heater was delivered with the unit at the time of purchase. *(As the Warranty policy is revised from time to time, you must check the policy delivered with your unit for specific terms and conditions should a warranty condition occur. If needed for reference, obtain the most current policy from the authorized HET distributor nearest you -or- visit our website at <http://www.hartzellenginetech.com>.)*



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Chapter 2 DESCRIPTION OF OPERATION

DESCRIPTION

2.0 General

- A. The cabin heater is designed to provide fresh, conditioned (heated) air from outside the aircraft to warm the crew and passenger areas during any phase of flight. In addition, the heater is designed to maintain a desired cabin temperature within the limitations of the given heater. A typical I-Series heater is shown in cutaway in Figure 2.1.
- B. Each heater system consists of a heater assembly, a ventilating air blower, a combustion air blower, nozzle holder, solenoid valve assembly, single piece spark plug, high voltage ignition system, combustion air pressure switch, overheat switch, cycling switch, and necessary radio noise suppressors. Optional equipment includes a duct switch, fuel pump, fuel regulator and shutoff valve, combustion air blower inlet adapter and a fanning strip (electrical connectors). All components except the combustion air blower, duct switch, fuel regulator and shutoff valve and fuel pump are combined into one assembly to facilitate installation and service operations. The optional equipment items are provided as separate components since they may be mounted at different locations in the aircraft. The basic heater assembly consists of the exhaust outlet, jacket, combustion head, and combustion tube. The combustion tube is made of Inconel[®] alloy steel with most other parts made of stainless steel alloy.



Fig. 2.1
Cutaway of Typical
I-Series Heater

DESCRIPTION

2.1 Component Operation

Spark Spray Ignition

The controlled atomized spray from a specially designed spray nozzle, coupled with high voltage spark plug ignition, ensures instant firing and continuous burning under all flight conditions. Spark spray ignition combined with the exclusive HET whirling flame combustion has been proved by millions of hours of heater operation in all types of aircraft throughout the world.

Heat is produced by burning a fuel air mixture in the combustion chamber of the heater. Aviation fuel is injected into the combustion chamber through the spray nozzle. The resulting cone shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Electric current for ignition is supplied by an ignition unit which converts 12 volts or 24 volts to high voltage, oscillating current, to provide a continuous spark across the spark gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self piloting. The burning gases travel the length of the combustion tube, flow around the outside of the inner tube, pass through cross over passages into an outer radiating area, then travel the length of this surface and out the exhaust. (See Figure 2.2)

Ventilating air passes through the heater between the jacket and combustion tube assembly outer surface and through an inner passage in the assembly. Consequently ventilating air comes into contact with two or more heated, cylindrical surfaces.

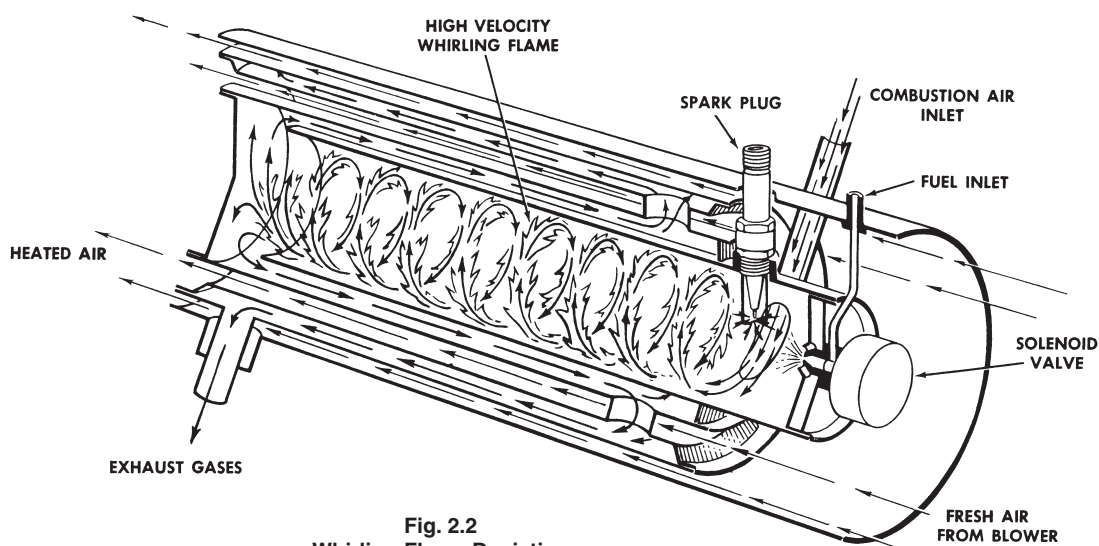


Fig. 2.2
Whirling Flame Depiction

DESCRIPTION

2.1 Component Operation (cont'd)

The Electric Fuel Pump

Aviation Gasoline Applications (See Figure 2.3)

For aviation gasoline applications, the electric fuel pump provides fuel pressure for ground operation and during flight. (The heater may be operated from the engine fuel pump, provided the fuel pressure output is controlled within the operating pressure range of the heater). Two (2) fuel pumps working in series can be used where a single pump is not able to provide sufficient fuel pressure.

Aviation Kerosene Fuel Applications (See Figure 2.4).

The electric fuel pump assembly is ideally suited for use, when needed, in aircraft heater fuel systems to provide proper pressures from the fuel source. This is accomplished through a fuel control system and on to the heater fuel nozzle. Pump supply is adequate for use with all kerosene burning heaters in the HET line and can be mounted in a horizontal position or vertically mounted provided the motor end of pump is at the top. Installation note: regardless of mounting position, an appropriate drain connection should be selected in the adapter section (between motor and pump) so as to drain fuel in the event of pump seal leakage. The drain normally extends through bottom of aircraft, clearing outer "skin" or other parts of the aircraft. It should be scarfed at an angle approximately 30° to the direction of flight so as to create a negative pressure on the end of the drain. A fuel pressure relief valve must be used whenever these pumps are part of the installation. In many cases, this fuel pump type and it's location are controlled by the aircraft or rotorcraft design holder.

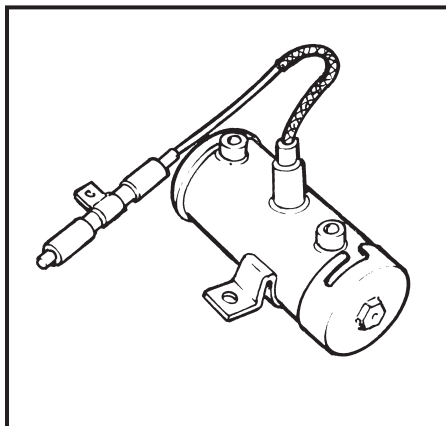


FIGURE 2.3 Electrical Fuel Pump
Aviation Gasoline

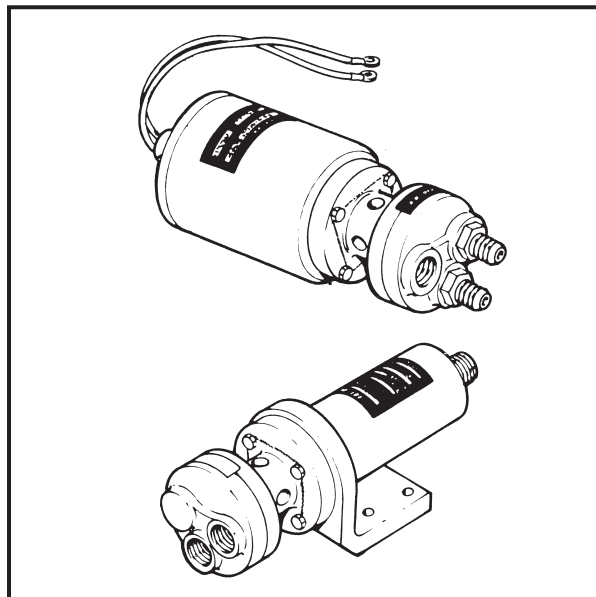


FIGURE 2.4 Electric Fuel Pumps used with Aviation
Kerosene Fuel Applications.



DESCRIPTION

2.1 Component Operation (cont'd)

There are several additional components required to allow the heater to function effectively. These components are used on most models but not all (will vary with heater application). The description below provides a better understanding of how typical heaters of various types function.

The Pressure Relief Valve

The relief valve is used, as its name implies, for relieving excessive pressure build up in the heater fuel system. It must be used whenever kerosene fuel is used but may also be used in gasoline applications in the heater installation.

Fuel Regulator and Shutoff Valve

This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater, regardless of fuel inlet pressure variations. It may be installed remote from the heater.

Fuel Feed, Nozzle Holder & Solenoid Valve

This assembly is mounted at the inlet end of the heater combustion chamber, and shuts off fuel to the heater when any one of the temperature control switches, or the master switch, is de-energized. The fuel nozzle is located near the fuel shutoff point, thus providing a "no drool" feature.

Combustion Air Pressure Switch

This switch is mounted on the combustion air inlet tube of the heater to sense combustion air differential pressure across the heater. (The differential pressure is the difference between pressure of combustion air coming into the heater and pressure at the exhaust outlet of the heater.) If combustion air flow drops below a predetermined setting, this switch prevents heater operation.

Cycling Switch

This switch is mounted on the heater in the ventilating air stream. Opening of the switch de-energizes the solenoid valve controlling fuel flow to the heater. The switch closes on temperature drop, causing the fuel valve to open, thus restarting the heater.

Over Temperature Switch

This may be a manual reset type switch or an automatic reset switch, either are mounted on the heater jacket to sense outlet temperature in the ventilating air stream.

Duct Switch

This switch is installed in the ventilating air duct downstream from the heater to sense the ventilating air outlet temperature. The duct switch temperature and location are normally controlled by the aircraft or rotorcraft design holder.

DESCRIPTION

2.1 Component Operation (cont'd)

Air Blower

This blower is attached to the inlet end of the heater assembly and provides a source of ventilating air through the heater. Ram air from the ventilating air intake scoop is normally used during flight. The blower can run continuously unless some provision is made to shut it off during flight and use ram air exclusively. The power line should be the circuit interrupted by a switch, not the line from blower to ground. (See Figure 2.5)

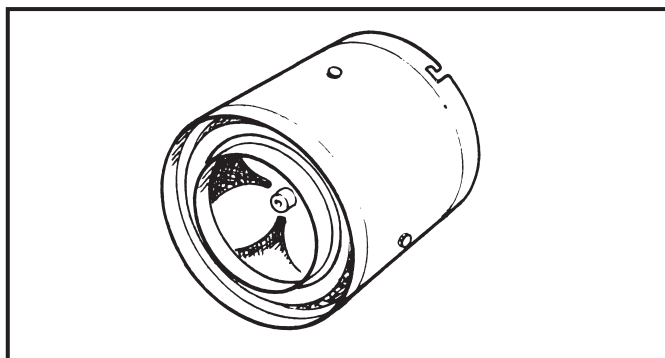


FIGURE 2.5 Typical Vent Air Blower Assembly

Combustion Air Blower

(See Figure 2.6 & 2.7)

This centrifugal type blower is normally mounted separately from the heater to permit more flexibility for installation. It supplies combustion air to the combustion chamber of the heater typically from outside air. (See Figure 2.7) Performance of the combustion air blower is assisted by the use of ram air during flight. The type of blower and mounting location are typically controlled by the aircraft/rotorcraft design holder.

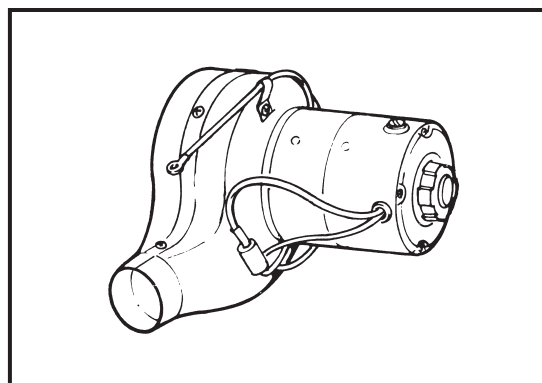


FIGURE 2.6 The Combustion Air Blower Ass'y

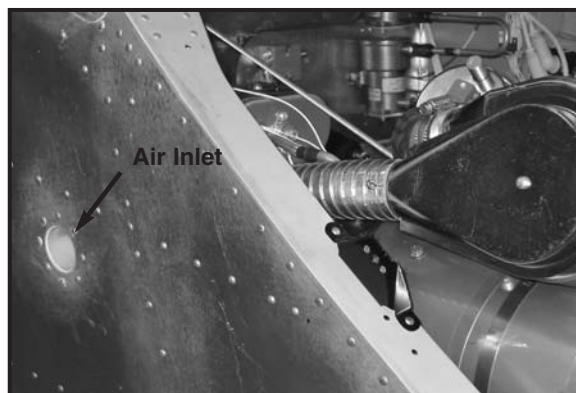


Figure 2.7 CA Blower Air Inlet (Typical)



OPERATION

2.2 Operating - Description

Operating Controls

The typical basic schematic diagram (Figure 2.8) shows in addition to the heater circuit, an aircraft/rotorcraft supplied control circuit. For the purpose of this manual, this circuit will be used to describe heater operation. However, the customer control circuit can and will vary in different installations and may have additions or changes added by the aircraft/rotorcraft design holder.

1. The "Master Switch" is connected in the line that supplies electrical power to all heater equipment and controls. When this switch is in the "OFF" position, the entire heater system is inoperative. This switch can have a (vent) position which permits use of the ventilating air blower to circulate cool air through the system for summer ground operation. With the switch in "VENT" position, the heater is inoperative, and only the ventilating air blower is energized.
2. The "HEATER START SWITCH" is a normally open, momentary "ON" switch that supplies power to (lock in) the safety relay through which power is supplied to the ignition and fuel circuits of the heater.
3. The "HEATER STOP SWITCH" is a normally closed, momentary "OFF" switch that de-energizes or breaks the (lock in) power to the safety relay to stop the heater fuel supply and ignition.

Operating Procedure

1. Place the "MASTER SWITCH" in the "ON" (or "HEAT") position. The ventilating air and combustion air blowers should operate and the red "HEATER FAILURE LIGHT" should be on.
2. Energize then release the HEATER START SWITCH. The red HEATER FAILURE LIGHT should de-energize (go out), and the green "HEATER RUNNING LIGHT" should energize (light). The heater will ignite and continue to operate. A short time lag may be required for the fuel pump to purge the fuel lines of air bubbles. This time lag should not be more than ten seconds except in cases where the fuel line has been drained due to maintenance overhaul being performed.
3. The "DUCT SWITCH" can be set to regulate the cabin temperature for desired comfort level. If this switch is set for ground operating comfort, it may be necessary to reposition it, since ram air will increase the ventilating air flow and the heater output.
4. To stop heater operation, push, then release the "HEATER STOP SWITCH." The heater will de-energize and the red "HEATER FAILURE LIGHT" will then energize. The green "HEATER RUNNING LIGHT" will be de-energized.
5. The blowers should be allowed to operate for several minutes to cool and purge the heater after operation. To stop blower operation, de-energize or turn "OFF" the "MASTER SWITCH."



Chapter 3 TROUBLESHOOTING

3.0 General

The purpose of this chapter is to provide a troubleshooting reference for the owner/operator to help diagnose conditions that may be found in the heater operation before placing the aircraft/rotorcraft into service repair. The owners responsibility in this chapter is to observe and record the fault.

The cabin combustion heater is virtually a self contained design, however there are many variations in the aircraft/rotorcraft design from manufacturer to manufacturer and model to model. Experience has demonstrated that many causes of heater maladies lie with faulty airframe designs such as air supply, electrical systems, or fuel routing. The overall objective of troubleshooting is to find the root cause of trouble and take corrective action to prevent a recurrence.

This chapter provides some basic troubleshooting procedures for the heater assembly, for unscheduled maintenance. It gives procedures to follow to determine the best course of action prior to maintenance or repair. Upon determination of fault(s), an appropriately licensed or approved mechanic may proceed with repairs and should refer to Chapter 6, testing or Chapter 8, Maintenance for the appropriate action(s) or requirement.

3.1 Procedure Prior to Repair

WARNING:

FOR APPROVED MECHANICS SERVICING OR REPAIRING THE HEATER, GREAT CARE AND CAUTION MUST BE TAKEN TO AVOID HAZARDOUS SITUATIONS. WHEN MOUNTED AND USED ON OR OFF AN AIRCRAFT OR ROTORCRAFT, THE HEATER WILL PRESENT A PHYSICAL HAZARD FROM THE USE OF AVIATION FUEL AND POTENTIAL UNCONTAINED FIRE IN THE SURROUNDING AREA. IN ADDITION, HEATER IGNITION SYSTEMS SUPPLY HIGH VOLTAGE ELECTRICAL CURRENT WHICH PRESENTS BOTH PHYSICAL SHOCK HAZARD, THAT CAN RESULT IN SERIOUS INJURY IF PROCEDURES IN THIS MANUAL OR IN THE AIRCRAFT/ROTORCRAFT SERVICE MANUALS ARE NOT FOLLOWED.

Note:

It is required to reference the aircraft or rotorcraft AFM or POH as well as the applicable service or maintenance manual to assure proper heater operation.

Prior to effecting any repair or using the heater troubleshooting tables herein, general aircraft/rotorcraft components should be checked to determine if fault lies in system or component other than the heater.

Check the aircraft/rotorcraft heater control or monitoring system. Most aircraft/rotorcraft will have controls to operate the heater beyond the original heater design. These controls can be very simple or can be a complex monitoring system with multiple duct sensors and switches. Complex systems are almost exclusively designed by the aircraft/rotorcraft design holder and while they work well with the original heater designs. If you experience temperature regulation problems, consult the aircraft/rotorcraft service or maintenance manuals to troubleshoot their systems.



3.1 Procedure Prior to Repair: (cont'd)

Check the aircraft/rotorcraft fuel supply and supply lines. Heater fuel pump and heater installations vary greatly from airframe to airframe. The distance and geometry of the supply lines can affect the ability to supply fuel to the heater. Twists and turns as well as corrosion, in the supply lines over time may cause restrictions. Contaminated or stagnant fuel may cause difficulty in starts. This is especially true of Jet fuels as inactivity may allow the growth of biologicals in the line, clogging them entirely. Some aircraft/rotorcraft incorporate pre-filters and scuppers which are also source of biological growths.

Check the aircraft air inlet system. Heater air inlets also vary greatly from airframe to airframe. Most inlets incorporate a scoop of some sort (flush or extended) to allow air into the heater and to provide a source of additional ram air for "altitude operations". In addition, many have a method to avoid icing over the inlet and may as well have an air shutoff system. Check all the connections from the inlet source to the heater for air leaks, restrictions, or debris.

Check the aircraft air supply to cabin. Conditioned or heated air can be lost on it's way to the cabin through leaks. Check all connections, ducts and tubes. Check for debris in the ducts.

Check the Combustion Heater exhaust. Heater exhaust is important in that a restricted exhaust will not allow proper combustion to occur or will stop it all together. Exhaust restriction may not be apparent as a restriction may form due to the positioning of the exhaust pipe or "scarf" in the wind stream. The aircraft or rotorcraft service or maintenance manual will indicate proper placement of the heater exhaust system and overboard requirements.

3.2 Troubleshooting

WARNING 1:

THERE ARE NO OWNER/OPERATOR MAINTENANCE ACTIVITIES PERMITTED ON HET COMBUSTION HEATERS. THE FOLLOWING TROUBLESHOOTING PROCEDURES MUST BE ACCOMPLISHED BY A QUALIFIED LICENSED MECHANIC OR REPAIRMAN FAMILIAR WITH AIRCRAFT HEATING SYSTEMS. FAILURE TO OBSERVE THIS WARNING MAY COMPROMISE THE COMPONENT OR THE APPLICATION IT IS USED IN. IMPROPER TROUBLESHOOTING MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

WARNING 2:

FOLLOWING THE REMEDIES LISTED IN THE TROUBLESHOOTING CHART, MAY CREATE HAZARDOUS CONDITIONS FROM THE USE OF GROUND POWER AND VARIOUS AIRCRAFT SYSTEMS. USE OF THE HEATER MAY RESULT IN AN UNCONTAINED FIRE OR CARBON-MONOXIDE POISONING IF OPERATED INDOORS. THESE ACTIONS MAY CAUSE SERIOUS INJURY OR DEATH IF FULL SAFETY PRECAUTIONS ARE NOT OBSERVED.

The following are some of the service troubles and suggested remedies provided to assist in locating and correcting malfunctions in the heating system. The following procedure is based upon the use of the heater assembly and optional components.

Table 3.1 on the following pages represent five main areas of trouble in the heater. Choose the applicable symptom and follow the appropriate recommendations.

1. Heater fails to light.
2. Heater air blowers fail to run.
3. Heater fires but runs unsteady.
4. Heater starts then goes out.
5. Heater fails to shut off.



3.2 Troubleshooting (cont'd)

TABLE 3.1 Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Heater fails to light.	Master switch or circuit breaker <i>OFF</i> .	Turn <i>ON</i> master switch or close circuit breaker. (See aircraft AFM or POH for operation.)
	Low voltage supply.	Apply external power supply. Attempt to start heater. (See aircraft service manual.)
	Fuel cut off from tank.	Turn <i>ON</i> manual shutoff valve (if used) or master solenoid. (See AFM or POH for operation.)
	Suction leak ahead of pump. Insufficient fuel pressure.	Secure all fittings. Low or no current to fuel pump. Check for operation of pump and remove for repairs if not operating.
	Regulator not operating properly.	Check for low pressure or replace regulator. When making fuel pressure check, be sure fuel is flowing through nozzle. Turn adjusting screw clockwise to increase fuel pressure and counterclockwise to decrease. (See 99M91 Overhaul & Maintenance manual)
	Fuel pump operating but not building up sufficient pressure.	Remove and repair or replace fuel pump,
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it. (See 99M91 Overhaul & Maintenance manual Testing chapter.)
	Fuel heater solenoid not working	Remove and check solenoid. Replace if faulty.
	Fuel lines clogged or broken.	Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located
	Fuel filter clogged.	Clean fuel filter element. Check for biologicals, corrosion, and ice in fuel system.
	Ignition vibrator inoperative.	Replace vibrator; check for defective radio noise filter.
	Manual reset limit (overheat) switch open.	Press reset button firmly and recheck to determine reason for switch opening.
	Combustion air pressure switch open. (Defective switch or low combustion air blower output.)	Check for low blower output due to low voltage and correct it. If switch is defective, replace it. (See 99M91 Overhaul & Maintenance manual)
Cycling switch open.	Replace if defective.	
Duct switch open.	Operate control to see if switch will come on. Replace switch if defective.	



3.2 Troubleshooting (cont'd)

TABLE 3.1 Troubleshooting (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Ventilating air blower fails to run.	"MASTER" switch "OFF". Broken or loose wiring to motor. Circuit breaker open. Worn motor brushes. Blower wheel jammed. Motor burned out.	Energize the "MASTER" switch. Check & repair wiring. (See aircraft AFM or POH for operation.) Close circuit breaker. Replace motor brushes. Remove and check the ventilating air blower wheel and realign if necessary. Remove blower assembly and replace motor.
Combustion air blower fails to run.	Defective radio-noise filter. Faulty wiring to motor. Poor ground connection. Worn motor brushes. Blower wheel jammed. (Usually indicated by hot motor housing.) Defective radio-noise filter. Faulty or burned-out motor.	Replace filter. Inspect and replace faulty wiring. Tighten ground screw. Be sure any metal preservation has been removed for good ground connection. Replace motor brushes. Overhaul the combustion air blower. Replace filter. Remove combustion air motor for overhaul or replacement of motor.
Heater fires but burns unsteadily.	Insufficient fuel supply. Ice or water in system fuel lines, Spark plug partially fouled. Loose primary connection at ignition assembly. Faulty vibrator. Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor.) High voltage leak in lead between ignition assembly and spark plug. Inoperative ignition assembly. Restriction in fuel nozzle orifice. Nozzle loose in retainer or improper spray angle.	Inspect fuel supply to heater including shutoff valve, solenoid valve, fuel filter, fuel pump and fuel lines. Make necessary repairs. Replace spark plug. CAUTION: Do not create spark gap by holding lead to heater jacket. This can result in damage to lead and ignition unit and operator may receive an electrical shock. Tighten the connection. Replace the vibrator. Remove and overhaul the combustion air blower assembly as required or correct low voltage condition. Replace ignition assembly. If vibrator is in good condition, replace ignition assembly only. Remove nozzle for cleaning or replacement. (See 99M91 Overhaul & Maintenance manual Testing chapter.) Tighten or replace the nozzle as required.



3.2 Troubleshooting (cont'd)

TABLE 3.1 Troubleshooting (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Heater starts then goes out.	Lack of fuel at heater.	Check fuel supply through all components from the tank to the heater. Make the necessary corrections. (See AFM or POH for operation or aircraft service manual.)
	Inoperative or chattering combustion air pressure switch.	Check, adjust, or replace switch.
	Inoperative overheat switch.	Check or replace switch.
	Inoperative cycling switch.	Adjust or replace the switch.
	Low voltage.	Attach external power. (See aircraft service manual.)
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly. (See 99M91 Overhaul & Maintenance manual)
	Inoperative duct and cycling switch.	Check and repair.
	Defective "MASTER" switch.	Replace the master switch. (See aircraft service manual.)



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Chapter 4 CLEANING

4.0 General

This chapter indicates the proper cleaning methods and materials for cleaning the heater for maintenance or repair. Except for cosmetic cleaning of the heater exhaust pipe on the exterior of the aircraft/rotorcraft, all cleaning activities must be performed by an appropriately licensed or approved mechanic.

WARNING 1:

THERE ARE NO OWNER/OPERATOR MAINTENANCE ACTIVITIES PERMITTED ON HET COMBUSTION HEATERS. THE FOLLOWING CLEANING PROCEDURES MUST BE ACCOMPLISHED BY A QUALIFIED LICENSED MECHANIC OR REPAIRMAN FAMILIAR WITH AIRCRAFT HEATING SYSTEMS. FAILURE TO OBSERVE THIS WARNING MAY COMPROMISE THE COMPONENT OR THE APPLICATION IT IS USED IN. IMPROPER CLEANING MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

WARNING 2:

PROLONGED EXPOSURE TO VOLATILE CLEANING AGENTS IS HAZARDOUS TO YOUR HEALTH. USE DEGREASERS AND SOLVENTS IN WELL VENTILATED AREAS. USE APPROPRIATE EYE PROTECTION, GLOVES, AND COTTON APRONS. *REVIEW ALL SAFETY INFORMATION FOR THE CHEMICAL BEING USED PRIOR TO USING IT!*

CAUTION:

AGGRESSIVE USE OF CHEMICAL DEGREASERS, CLEANING SOLVENTS, OR MECHANICAL CLEANING PROCESSES MAY RESULT IN NON-REPAIRABLE DAMAGE TO COMPONENTS AND PARTS OF THE HEATER. DO NOT LEAVE HEATER PARTS OR COMPONENTS UNATTENDED WHILE IMMERSSED OR SOAKING IN SOLVENTS. *DO NOT ATTEMPT TO CLEAN THE HEATER ELECTRICAL PARTS BY IMMERSION OR SOAKING.*

4.1 Required Safety Equipment

- Safety gloves
- Protective goggles or splash shield
- Protective apron
- Eye wash station

4.2 Recommended Materials

- Aviation Quality solvents
- Aviation Quality electrical contact cleaner
- Isopropyl alcohol
- Shop cloths
- Non-metallic bristle brush
- Crocus Cloth
- Oil free dry air source



NOTE:

Prior to cleaning the heater whether mounted on the aircraft or as removed, observe and note condition. Look for any signs of hot air or exhaust leaks, electrical arcing from wiring or ignition, and cracks or tears in the heater jacket or other heater parts.

4.3 Exterior Cleaning

CAUTION:

DISCONNECT ALL ELECTRICAL POWER OR OTHER SOURCE OF IGNITION AS CLEANING AGENTS MAY BE FLAMMABLE. FAILURE TO OBSERVE THIS CAUTION MAY LEAD TO AN UNCONTAINED FIRE WHICH MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

If mounted on an aircraft/rotorcraft, initial cleaning may be done using mineral spirits or isopropyl alcohol under pressure. Blow dry using clean shop air. Do not direct cleaning spray into the heater inlet or exhaust. Some heater installations are remote, do not allow cleaning fluids to accumulate and run into the airframe especially when using mineral spirits. Place shop towels below the heater to absorb any residue while cleaning.

If removed, initial cleaning should be done using a shop cloth and mineral spirits or isopropyl alcohol. Wipe dry using clean shop cloths.

4.4 General Component Cleaning

NOTE:

If components other than the air blowers or spark plug are removed and need cleaning, refer to the HET Combustion Heater Overhaul & Maintenance manual P/N 99M91 for more detailed cleaning and repair information.

Components separated during disassembly, may be cleaned in several ways.

- Aluminum components: Use of degreaser or solvents should be used by spray or wiping, however, dipping or immersion may be used if attended. Aluminum may degrade if left in degreasers or solvents for extended periods of time. Consult the directions for the agent being used.
- Metallic components: Most metallic components may be dipped or immersed for cleaning including combustion tube. Use a dry cleaning solvent such as Stoddard solvent (Federal Specification P S.661). Mechanical means such as bead blast may be used however, it is not advised on most of the heater parts as they may become misshapen. Sand blasting is not approved. Great care must be taken with the motor armature or armature housing cleaning. Aggressive cleaning may fracture the coating on wire or delicate connections. Use mineral spirits or isopropyl alcohol for cleaning. Blow drying must be done using low pressure air to avoid damage to wire insulation, air drying is preferred.

If hardware does not clean sufficiently with degreaser or solvents, replace the hardware with new. (Hardware is a required replacement part for overhaul.)

- Non-metallic components: Plastic or fiber components such as insulators, must be cleaned with isopropyl alcohol. Fiber components that have absorbed or "wicked" oil cannot be cleaned effectively and should be replaced. Electrical terminals or strips may be cleaned with electrical contact cleaner. Wipe or spray soak and air dry.

4.5 Spark Plug Cleaning

Type I Spark Plug (for I-1500 model only)

Cleaning is accomplished on a conventional aircraft type spark plug cleaner, except that it may be necessary to use several adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to provide an effective job. Plug the ceramic insert cavity at the terminal end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe this cavity out thoroughly with a cloth. If, after cleaning spark plug, porcelain is then white, and the electrodes are not eroded, re-gap the spark plug as described in Chapter 6. Refer to Chapter 8 for additional maintenance details.

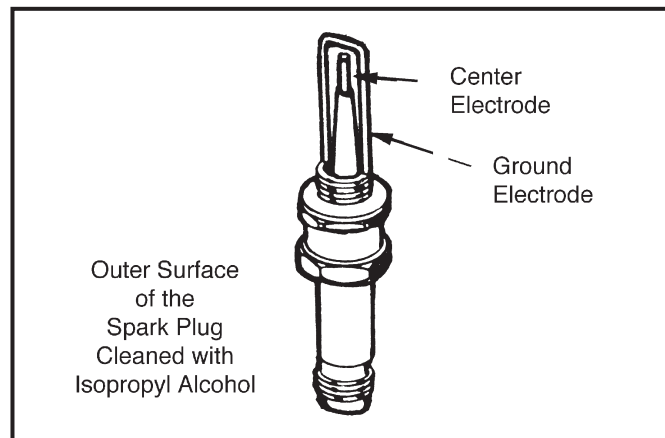


FIGURE 4.1 Type I Spark Plug

4.5 Spark Plug Cleaning (cont'd)

NOTE:

Previous heaters models that have been upgraded to I-Series combustion heaters may have used Type II spark plugs. These spark plugs do not have an anode so they will not function and the heater will not work. Type I spark plugs are used only in the I-1500 model heater. Type III spark plugs are used on on the remaining HET I-Series combustion heaters.

Type III Spark Plug

If the spark plug appears to be in good condition, the upper housing and the outer surface of the ground electrode sleeve may be wiped clean with a shop towel moistened with isopropyl alcohol, the internal porcelain may be blown clean using shop air directed through the vent holes or through the open end. No abrasive cleaning (sand or bead blast) permitted. After cleaning the spark gap, the spark plug may be checked as described in Chapter 6. Refer to Chapter 8 for additional maintenance details.

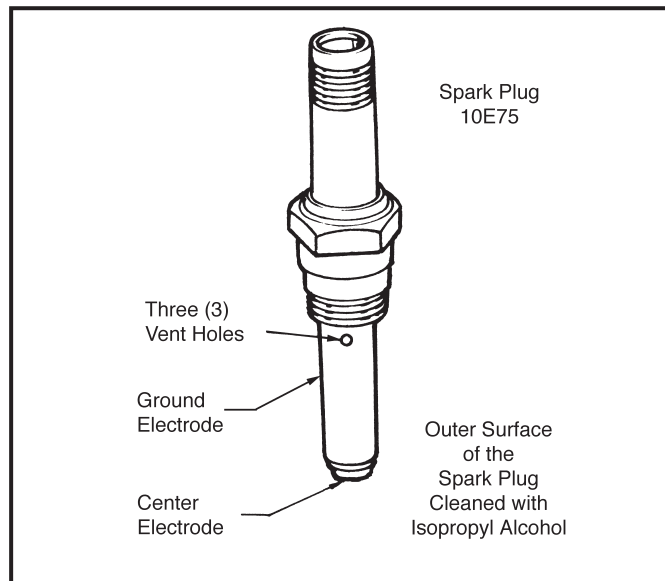


FIGURE 4.2 Type III Spark Plug Cleaning

Chapter 5 CHECK

5.0 General

This chapter calls out the various checks and inspections needed to assure reliable and safe operation of the combustion heater while in service. **It is the owners responsibility to observe and understand the task and the time it occurs.** These required checks are listed in hours time in service (TIS) or calendar time whichever is applicable. Some checks are one time initial and others are recurring. Refer to the appropriate chapter as required for the specific check in this manual or in the Overhaul & Maintenance manual P/N 99M91. Use only one method to determine TIS for inspection and maintenance (actual heater Hobbs meter time **or** calculation from flight time) **never use both.** These Checks must be accomplished by properly licensed mechanics or repairmen experienced in aircraft/rotorcraft heating systems. Owners performing an annual inspection should note "the first to occur" is the TIS requirement which may come prior to or after the annual inspection calendar time is reached.

5.1 Preflight and/or Daily Inspection Checks *(all heaters)*

1. Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to air scoop protrusions.
2. During preflight inspections look in the area of the combustion heater exhaust tube for large or unusual accumulations of soot on the skin of the aircraft. Soot accumulates are caused by the heater burning at a fuel "rich" condition.

5.2 Operational Check (Typical Heater)

An operational check should be performed prior to commencing any inspection interval or prior to any unscheduled maintenance to help determine the heater condition.

1. Place the "MASTER SWITCH" in the "ON" (or "HEAT") position. The ventilating air blower and combustion air blower should operate and the red "HEATER FAILURE LIGHT" should be energized. **Always refer to the aircraft AFM or POH to assure proper operation.**
2. Operate both the combustion air blower and ventilating air blower and check each for unusual current draw, noise or vibrations. Refer to Table 3.1 for troubleshooting and for recommended maintenance.
3. To proceed with the operational check, follow Chapter 2, para. 2.2 entitled "Operating Procedure". This procedure should be repeated several times or as needed.

5.3 Periodic Inspection Checks

Note:

As many B-Series combustion heaters have been upgraded to I-Series heaters, certain publications previously issued may still be relevant. If you heater has been upgraded to I-Series heater, you should reference the latest revisions of the following publications to assure compliance. SB A-101 Rev G, SB A-104 Rev. B, SB A-107A, SB A-108, and SB A-110B.)

10 Hours time in service (one time overhauled, rebuilt, or new).

Perform an initial check of the heater assembly. Gain access to the heater and check the security of electrical connectors and connections at the terminal strip, ignition leads and spark plug, all inlet and outlet air connections, and fuel line. Check the exhaust tube for condition and interference with structure. Check the drain line for obstructions.

5.3 Periodic Inspection Checks (cont'd)

Note:

It is recommended that a timing meter be used on the heater assembly to establish heater hours of operation. If a **timing meter is not used**, count one (1) heater hour for each two (2) flight hours for normal aircraft operation. If the heating system is used excessively in ground operations, the exact time of this operation must be used for inspection and overhaul purposes (calculation does not apply).

50 Hours time in service (one time overhauled, rebuilt, or new).

Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions and clear. Check that no damage has occurred to air scoop protrusions. Look in the area of the heater exhaust tube for a large or unusual accumulation of soot on the skin of the aircraft. This indicates a "rich" burning condition and requires troubleshooting. Perform operational check of the heater per para. 5.2.

100 Hours time in service and each 100 hours thereafter

(at annual inspection or each 12 months, the first of these to occur).

Inspection shall be conducted on all I-Series heaters (including new, rebuilt, upgraded, or overhauled). The 100 Hour Inspection consists of the items listed below. Refer to maintenance Chapter 8 of this manual, the applicable chapter of HET P/N 99M91 Overhaul & Maintenance manual, or the applicable aircraft/rotorcraft service manuals for appropriate details.

1. Inspect ventilating and combustion air inlets and exhaust outlet for restrictions and security at the aircraft skin line. Check any external scoop and make sure they are not distorted and are securely attached to the aircraft
2. Inspect the drain line to make sure it is free of obstructions. Run a wire of the appropriate length through it if necessary to clear any obstruction.
3. Check all fuel lines for security at joints and shrouds, making sure that no evidence of leaks exists. Also check for security of attachment of fuel lines at the various attaching points in the aircraft. Check any fuel filter or scupper if incorporated.
4. Inspect electrical wiring at the heater terminal block and components for loose connections, possible chaffing of insulation, and security of attachment points.
5. Inspect the high voltage cable connection at the spark plug to make sure it is right. Also, examine the cable sheath for any possible indications of arcing.
6. Inspect the combustion air blower assembly for security of mounting, tube connections and wiring. Tighten any loose electrical terminals and air tube connections.
7. Operate both the combustion air blower and ventilating air blower and check for unusual noise or vibrations. Refer to Table 3.1 "Troubleshooting" for diagnosis.
9. Following the 100 hour inspection, perform the preflight operating check as described in Chapter 5, paragraph 5.2.

* I-Series heaters use Inconel® steel combustion tubes which are marked **IS** at the end of the applicable part number for identification.

5.3 Periodic Inspection Checks (cont'd)

500 Hours time in service and each 500 hours thereafter (or 60 months, the first to occur).

Inspection shall be conducted on all I-Series heaters (including new, rebuilt, upgraded, or overhauled). The 500 Hour Inspection coincides with the requirements of the 100 hour inspection plus the following checks and inspections:

1. Perform the Pressure Decay Test per the instructions contained in P/N 99M91 Overhaul & Maintenance manual. Failure of the Pressure Decay Test requires heater overhaul prior to next use.
2. Replace the spark plug and fuel nozzle.
3. Replace brushes and bearings in the combustion air and ventilating air blower motors. If sealed motor, replace motor.

1000 Hours time in service (or each 60 months the first to occur).

(The 500 Hour Inspection coincides with the requirements of the 100 hour inspection.)

1. If installed, disconnect the external fuel shutoff valve, apply fuel pressure and check that the valve shuts off fuel completely. Internal fuel shutoff, check for fuel pressure drop with solenoid shutoff and accompanying fuel drip from heater drain. (Power on to flow fuel.) These components are replacement items only.
2. If installed, disconnect the fuel regulator and shutoff valve, apply fuel pressure and check that the valve shuts off fuel completely. Check regulation pressures per Chapter 9 of the P/N 99M91 Overhaul & Maintenance manual. If checked, note that no local overhaul or repair on these components are permitted. Some units may be returned to HET for overhaul or exchange. *It should be noted that these regulators contain age controlled components that are subject to the requirements of MIL STD 1523.*

2000 Hours time in service* (or if the pressure decay test fails, first to occur).

1. Overhaul or replace heater assembly.
 - * Upon the accumulation of 12 calendar years from new, rebuilt or from any overhaul, the combustion heater must be overhauled regardless of hours time in service.



5.4 Bi-Annual Maintenance Checks

The heating system should be inspected at regular intervals, the frequency of which should be determined by the type of service and the conditions under which the aircraft or rotorcraft is operated. It is recommended that in addition to the periodic inspection requirements, inspection/maintenance should be made at least twice a year, preferably to coincide with the onset of cold weather and warm weather. Include the following:

1. **Fuel System** - After any warm season or inactivity and prior to cool weather use, check the fuel system for contamination.
2. **Air System** - Check the inlet from outside air and the outlet into the aircraft cabin if the heater has been inactive. After active use, check the heater air inlets and cabin air outlets which may become clogged or damaged due to ground debris or icing.
3. **Ignition System** - Prior to or after active heater use, inspect and clean the spark plug lead end and spring.
4. **Exhaust System** - Examine the exhaust tube (and shroud if applicable) for security from the heater through the aircraft skin.
5. **Electrical System** - Check the wiring harness for evidence of deterioration of insulation, burns or overheat. Check for looseness at the terminal strip.
6. **Operation** - Perform an operational check of the heating system per Chapter 2 of this manual

For amplified description and procedures for the Bi-Annual Maintenance Check, refer to Chapter 8 section 8.1.

Chapter 6 TESTING

6.0 General

WARNING:

THERE ARE NO OWNER/OPERATOR MAINTENANCE ACTIVITIES PERMITTED ON HET COMBUSTION HEATERS. THE FOLLOWING TESTING PROCEDURES MUST BE ACCOMPLISHED BY A QUALIFIED LICENSED MECHANIC OR REPAIRMAN FAMILIAR WITH AIRCRAFT HEATING SYSTEMS. FAILURE TO OBSERVE THIS WARNING MAY COMPROMISE THE COMPONENT OR THE APPLICATION IT IS USED IN. IMPROPER TESTING MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

This chapter gives the tests and inspections required to help determine the condition of the heater removed for scheduled or unscheduled maintenance. Refer to the procedures given in the TROUBLESHOOTING Chapter 3 prior to applying any test for unscheduled maintenance. For any overhaul activity or maintenance not covered in this manual, consult the HET P/N 99M91 Overhaul and Maintenance manual. All testing activities must be accomplished by properly licensed mechanics or repairmen experienced in aircraft/rotorcraft heating systems

6.1 Testing

A. Equipment

1. Standard tools

- Standard mechanic's handtools.
- Torque wrench pound/inch (newton/centimeter)
- Torque wrench pound/foot (newton/meter)
- Air compressor (shop air)

2. Safety Equipment

- Safety gloves
- Protective goggles (eye protection).
- Ear Plugs (hearing protection)
- Safety shoes
- Protective cotton apron

3. Special tools

Special tools used in this chapter, are identified by description and as may be listed in SPECIAL TOOLS, EQUIPMENT, AND FIXTURES.

- Heater Pressure Decay Test kit (26E24-1)
(or Pressure Decay Tester, P/N PDT 285B or P/N PDT 286B).

4. Instruments

- A multimeter, (Simpson 260 or Triplett 630) or equivalent (accuracy 1%).
- An ammeter, (min. 250 amp rating).
- Zero to 30 volt power supply.
- Optical or Mechanical tachometer.

5. Test conditions

- Ambient temperature: 70 to 80 ° F (21 to 27 ° C).



6.1 Testing (cont'd)

B. Precautions

WARNING:

WHETHER THE HEATER IS INSTALLED OR REMOVED, MAKE SURE THAT THE AREA IN AND AROUND THE AIRCRAFT, ROTORCRAFT, OR SHOP IS SECURE AND THE TESTING AREA IS WELL VENTILATED. MAKE SURE THAT ALL STAFF AND PERSONNEL ARE WARNED THAT TESTING IS IN PROGRESS. ***CARBON MONOXIDE FROM THE HEATER EXHAUST AS WELL AS THE POTENTIAL OF UNCONTAINED FIRE MAY CAUSE INJURY OR DEATH.*** FAILURE TO OBSERVE THIS WARNING MAY COMPROMISE THE COMPONENT OR THE APPLICATION IT IS USED IN. IMPROPER TESTING MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

It is imperative that regular maintenance be accomplished per this manual or the HET P/N 99M91 Overhaul & Maintenance manual and per the requirements of the applicable aircraft/rotorcraft service manuals and publications. *Tests must be done by qualified and competent persons.* In addition, observe the following precautions:

1. Disconnect the battery or any ground power source before connecting or disconnecting test instruments (except voltmeter), or before removing or replacing any unit. Accidental grounding or shorting of power from the battery may cause severe damage to the test instruments, heater components, and/or heater or airframe wiring.
2. If the heater is tested on an aircraft/rotorcraft to observe heater performance, make sure that the area in and around the aircraft/rotorcraft is secure and the testing area is well ventilated. Make sure that all staff and personnel are warned that testing is in progress.
3. If the heater is being tested on the bench and combustion will occur, be sure that the heater is retained and secure before power and fuel are applied. Make sure that the air inlet is clear and the exhaust has been routed to outside air without leaks. Make sure the fuel source is well away from the heater or any ignition sources. The fuel source must come from an approved fuel container.

6.2 Pressure Decay Test

Evaluation of the condition of the combustion chamber is a vital task in maintaining the combustion heater until overhaul time is reached. It shall be made at the 500 hour inspection and each 500 hours thereafter (or 60 months, the first to occur). The latest revision of applicable heater related service publications must be reviewed and complied with if required in preparation for decay testing:

This test is intended to be accomplished while the heater is installed with a minimum of accessory disconnection. When necessary or desired for convenience, the heater assembly may be removed from the aircraft/rotorcraft to conduct the pressure decay test.

It is recommended but not required that the Pressure Decay Tester, P/N PDT 285B or P/N PDT 286B be used for this test.

6.3 Testing Combustion Air Blower After Brush Change

After installing new brushes, it is advisable to run in the brushes as follows:

Connect the motor to a controlled voltage supply (rheostat in a 28 volt DC line for 28 volt motor and a 12 volt line for 12 volt motor). Operate the motor at approximately 1/2 its normal speed for the first hour, then gradually increase the speed until it is rotating at approximately normal speed. Continue the run in operation for at least two hours to properly seat the brushes before installing the blower in the aircraft/rotorcraft.

6.4 Testing Spark Plug

WARNING:

DO NOT ARC IGNITION LEAD TO ANY GROUND EXCEPT THROUGH APPROVED SPARK PLUG GROUND ELECTRODES. GROUNDING LEAD TO JACKET IS DANGEROUS AND MAY CAUSE INJURY AND DAMAGE TO THE HEATER IGNITION UNIT.

FAILURE TO TEST THE SPARK PLUG AND/OR THE IGNITION ASSEMBLY BY THE PRESCRIBED SPARK PLUG METHOD WILL RESULT IN DAMAGE TO THE LEAD ASSEMBLY, COIL ASSEMBLY, SPARK PLUG, OR VIBRATOR. AND MAY SHORTEN THE USEFUL LIFE OF THESE ITEMS.

DO NOT TOUCH THE SPARK PLUG WHILE ENERGIZED. IT HAS DANGEROUSLY HIGH VOLTAGE AND MAY CAUSE INJURY OR EVEN DEATH. MAKE SURE TO PLUG THE SPARK PLUG HOLE IN THE HEATER TO PREVENT ANY POSSIBILITY OF RESIDUAL FUEL BLOWING OUT AND IGNITING.

Three types of spark plugs are used on HET Combustion Heaters. I-Series heater models use Type III Spark Plug exclusively except for the I-1500 which uses a Type I spark plug. The data shown for the Type II Spark Plug below is for identification purposes on I-Series heaters which have been upgraded. ***I-Series upgraded heaters, I-2500, I-3500, and I-5000 do not use Type I or Type II spark plugs, if found installed, the heater may not be an I-Series model.***

Type I Spark Plug has a center electrode and an attached ground electrode bail and is used in the I-Series model I-1500 only (see Fig. 6.1).

Type II Spark Plug (see Figure 6.2) has a center electrode but no attached ground electrode. The ground electrode is attached to the combustion head of the heater.

Type III Spark Plug is shown in Figure 6.3. This spark plug contains a center electrode. This spark plug is used mostly on B-Series high altitude kerosene burning heaters and all I-Series heaters.

6.4 Testing Spark Plug (cont'd)

CAUTION:

NEVER INSTALL TYPE I OR TYPE II SPARK PLUGS INTO AN I-SERIES MODEL I-2500, I-3500, OR I-5000 COMBUSTION HEATER. TYPE I IS USED IN I-1500 ONLY. DAMAGE MAY OCCUR TO THE HEATER IGNITION UNIT OR THE HEATER MAY NOT FUNCTION. OPERATION OF A HEATER WITH A DAMAGED IGNITION UNIT MAY RESULT IN EQUIPMENT DAMAGE, OR PHYSICAL INJURY.

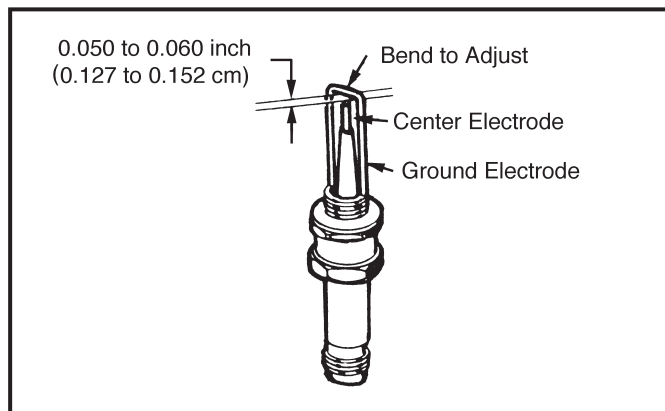


FIGURE 6.1 Type I Spark Plug
(Used in I-1500 model only.)

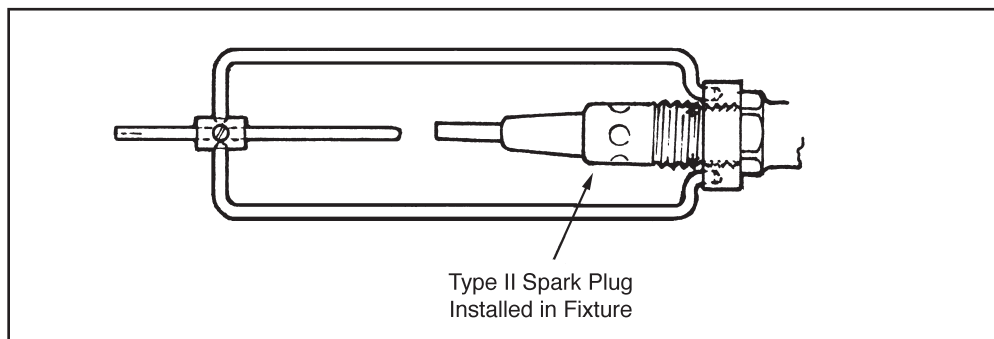


FIGURE 6.2 Type II Spark Plug
(For identification purpose only)

6.4 Testing Spark Plug (cont'd)

NOTE:

If the Type III spark plug fails to clean up properly and/or if electrodes are badly eroded, it should be replaced.

**NO RE-GAPPING OF TYPE III SPARK PLUG IS POSSIBLE
DO NOT BEND THE CENTER ELECTRODE OR THE DISK ON
TOP OF THE CENTER ELECTRODE.**

Testing Type I Spark Plug. Make sure that the spark plug is gapped properly by carefully bending the ground electrode until a 0.055 inch feeler gage can be inserted between the end of the center electrode and the ground electrode. The spark plug can be checked visually for sparking across the gap prior to installing the plug as follows:

Disconnect the wire from the No. 3 terminal on the heater wiring side of the terminal strip to de-energize the fuel solenoid valve. Connect the high voltage lead temporarily and lay the spark plug on the heater jacket. Energize heater system and check for spark between spark plug and ground electrode. (See Figure 2.8 Chapter 2.)

Testing Type III Spark Plug. The gap between the center electrode disk and ground electrode should be between 0.105 +/- 0.015 inch. (See Figure 6.3.)

Prior to installation, spark plugs can be checked visually for sparking across the gap prior to installing the plug as follows: Disconnect the wire from the No. 3 terminal on the heater wiring side of the terminal strip to de-energize the fuel solenoid valve. Connect the high voltage lead temporarily and lay the spark plug on the heater jacket. Energize heater system and observe spark between center electrode and ground electrode. (See Figure 2.8 Chapter 2.)

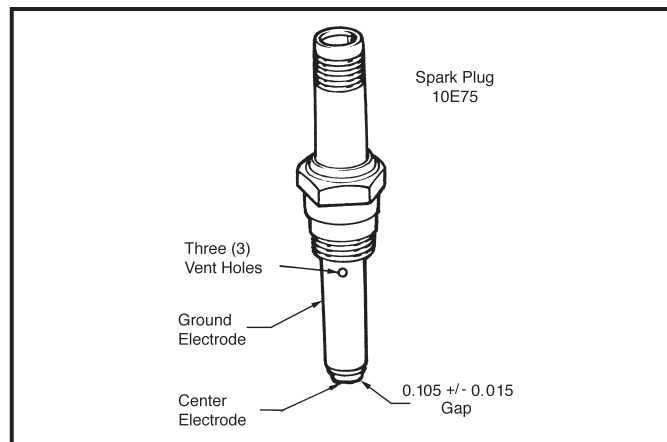


FIGURE 6.3 Type III Spark Plug Gap

6.5 Testing Miscellaneous and Optional Components

Except for 6.5(A), the miscellaneous and optional components should be tested as outlined in the Combustion Heater Overhaul & Maintenance manual HET P/N 99M91. Some items such as the fuel regulators, fuel pumps, ignition systems, cycling, over temperature, and duct switches are replaced with new or may be tested only by utilizing the completed heater assembly.

Miscellaneous and optional components vary widely from aircraft to aircraft and many tests are contained in the applicable aircraft or rotorcraft service / maintenance manuals. **These manuals should be checked for applicability prior to assembly of the heater.**



6.5 Testing Miscellaneous and Optional Components (cont'd)

A. Test ventilating air and combustion air motors for correct rpm and current draw:

1. Connect motor to correct voltage power supply (12 or 24 volts DC). Rotation should be counter clockwise when viewed from the shaft end.
2. Both motors should rotate at approximately 7500 rpm at rated voltage. Current draw for 12 volt motors is approximately five amps and for 24 volt motors is approximately 2.9 amps. This can be tested using a mechanical or optical tachometer.
3. If current draw is excessive, or if speed is too low, replace the brushes. Recheck both current draw and rpm after brushes are properly run in. (Refer to Para 6.3 for run in.)
4. If after replacing brushes, operation is still unsatisfactory, replace the motor.

The motor checks described above should be made without the blower housing attached, for both the ventilating air and combustion air motors.



Chapter 7 SPECIAL TOOLS

7.0 General

This chapter indicates the *Special* tools necessary to perform maintenance or repair. These tools are designed use by licensed mechanics or in shops specializing in aircraft combustion heaters. The tools in this chapter are those other than standard mechanics hand tools.

CAUTION:

THE SPECIAL TOOLS LISTED HEREIN ARE GENERALLY PURCHASED UNLESS AN EQUIVALENT IS INDICATED. USING AN IMPROPER TOOL CAN RESULT IN DAMAGE TO THE HEATER, AIRCRAFT, OR OTHER EQUIPMENT WHICH MAY ALSO LEAD TO PHYSICAL INJURY OR DEATH.

7.1 Required Safety Equipment

- Safety gloves.
- Safety glasses or Protective goggles.
- Protective apron.
- Eye wash station

7.2 Material Required:

Building materials are not required.

7.3 Special Tools Specifications:

The *Special* tools listed herein must be purchased. Common items are recommendations only and equivalents may be used.

Armature Growler Model 409 (110 volts A.C.)
 Model 509 (220 volts A.C.)

Common, may be purchased from:
King Electronics Company
7291 Swamp Street
P.O. Box 547
Hartsville, Ohio 44632-0547
USA

Phone: 330-935-2867
Fax: 330-935-2391
Toll Free: 877-772-5464
Email: info@4king.com



7.3 Special Tools Specifications: (cont'd)

Pressure Decay Test Kit 26E24-1 (Kit of required parts for decay test not using below tester.)

- or -

Pressure Decay Tester P/N PDT 285B -or- P/N PDT 286B

The above special tools, may be purchased from:

Hartzell Engine Technologies LLC	Phone:	(334) 386-5400
2900 Selma Highway	Fax:	(334) 386-5410
Montgomery, AL 36108, USA		

Website: <http://www.hartzellenginetech.com>

NOTE:

The HET P/N PDT 285B and P/N PDT 286B contain the Test Box, Instruction Manual 94E48, fuel pressure gauge, various lines and fittings, as well as a selection of expansion bulbs. They are intended for use in shops specializing in aircraft combustion heater inspection, overhaul, and repair.

The primary difference between the two kits is the PDT 286B has thermal reading capabilities and the air lines have quick connecting fittings.



Chapter 8 GENERAL MAINTENANCE

8.0 General

WARNING:

THERE ARE NO OWNER/OPERATOR MAINTENANCE ACTIVITIES PERMITTED ON HET COMBUSTION HEATERS. THE FOLLOWING MAINTENANCE PROCEDURES MUST BE ACCOMPLISHED BY A QUALIFIED LICENSED MECHANIC OR REPAIRMAN FAMILIAR WITH AIRCRAFT HEATING SYSTEMS. FAILURE TO OBSERVE THIS CAUTION MAY COMPROMISE THE COMPONENT OR THE APPLICATION IT IS USED IN. IMPROPER MAINTENANCE MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

This chapter provides information regarding the recommended maintenance including that called out in Chapter 5, "Checks". These requirements are needed to assure reliable and safe operation of the heater while in service. Maintenance times are listed in hours time in service (TIS) or calendar time, whichever is applicable. Heater time in service is calculated as one (1) heater hour for every two (2) flight hours or if an hour meter is used on the heater, the actual heater time, **never use both**. Some maintenance is one time initial and others are recurring. Maintenance activities in this chapter may require cleaning as called out in Chapter 4 or testing which is called out in Chapter 6.

These maintenance instructions apply to the basic heater and components while the heater is installed in the aircraft. Instructions for removal of some components are included provided the installation permits accessibility. With the exception of the pressure decay test, no special tools are required for normal periodic maintenance of HET aircraft combustion heaters. Maintenance indicated under the Periodic Inspection will require use of this manual and/or P/N 99M91 Overhaul & Maintenance manual accomplished by properly licensed mechanics or repairmen experienced in aircraft/rotorcraft heating systems. Part numbers are not given in this manual, for these, consult the IPC Chapter of P/N 99M91 Overhaul & Maintenance manual.

To perform the hourly or calendar time periodic check for detailed inspection, you must refer to Chapter 5, "Checks" in this manual. The start of any maintenance in this chapter (unless a specific anomaly has been diagnosed) should begin with a preflight and/or daily inspection at which general condition of the heater is recorded. This inspection is found in Chapter 5, "Checks". If performing an annual inspection, it should be noted that "the first to occur" is the TIS requirement which may come prior to or after annual inspection calendar time occurs.

NOTE:

Prior to any maintenance or testing activity, refer to Chapter 3 "Troubleshooting" in order to determine the condition and the best procedure to follow in correcting the anomaly.

Most of the maintenance activity items will require that the heater be operationally checked upon completion of the item. For this check, refer to the applicable aircraft POH or AFM to obtain detailed instructions.



8.1 Bi-annual Maintenance

The heating system should be inspected at regular intervals, the frequency of which should be determined by the type of service and the conditions under which the aircraft or rotorcraft is operated. It is recommended that in addition to the periodic inspection requirements, inspection/maintenance should be made at least twice a year, preferably to coincide with the onset of cold weather and warm weather. Include the following:

1. **Fuel System** - After any warm season or inactivity, the fuel system and prior to cool weather use, check the fuel system for contamination. Filters, scuppers, or lines will grow biologicals during warm temperatures and clog them (especially Jet Fuels). Water and other common contaminant's may clog or corrode lines. Flush and inspect the fuel system prior to active heater use.
2. **Air System** - The inlet from outside air and the outlet into the aircraft cabin may develop obstructions during heater inactivity. Animal or insect obstructions may develop in any part of the air system as well as general debris. In addition, after active use, the air inlets for heater or cabin air may become damaged due to ground debris or icing. Prior to running heater ventilation and combustion air blowers, inspect and clean the inlet and outlet air system. Run the blowers to push out any debris from the heater and inspect and clean again.
3. **Ignition System** - Prior to active heater use and again after the active heater use, inspect and clean the spark plug lead end and spring.
4. **Exhaust System** - Examine the exhaust tube (and shroud if applicable) for security from the heater through the aircraft skin. Make sure any extension is secure. If the exhaust shows evidence of excessive sooting further maintenance is required but at a minimum the spark plug should be cleaned and gapped.
5. **Electrical System** - Check the wiring harness for evidence of deterioration of insulation, overheat or burns. Move harness or wires and check for looseness at the terminal strip.
6. **Operation** - Perform an operational check of the heating system per Chapter 2 of this manual, however should any discrepancies between instructions from the aircraft or rotorcraft AFM or POH appear, the AFM or POH instructions shall take precedent.

8.2 Periodic Maintenance

For I-Series Combustion Heaters, the periodic inspection and overhaul requirements may be found in this manual in Chapter 5.

8.3 Overhaul & Maintenance Manual

For I-Series Combustion Heaters, the detailed instructions for overhaul and maintenance may be found in P/N 99M91 Overhaul & Maintenance which must be obtained separately.



8.4 Combustion Air Blower Maintenance: (Refer to Figure 8.1 & 8.2)

A. Removal:

1. Remove access panels if necessary to reach the combustion air blower assembly.
2. Disconnect the electrical cable connection at the most convenient location.
3. Disconnect the air tube between the blower and combustion air adapter on the heater. If the combustion air blower inlet adapter is used, disconnect it from the inlet tubing. This will depend upon the type of connecting tubing used and the method of attachment.
4. Disengage the clamp that secures the combustion air blower and remove the blower motor assembly. It will usually be possible to remove the assembly by loosening the clamp and sliding the motor out of the clamp. In some installations it is easier to remove blower and mounting bracket from the aircraft.

B. Brush removal & Installation:

1. Remove the brush cap at one of the brush locations. Note position of brush inside the guide and carefully lift the brush and brush spring out of the guide. Be sure to note the brush orientation in the guide so that it can be re-installed in the same position if inspection of the brush shows replacement is not required. On Motor Part No's. 27D39 and 34D30 it is necessary to remove motor case to replace brushes.
2. Inspect the brush for wear. If brushes are worn to a length of 3/16" or less they must be replaced. If this limit has not been reached, the brushes may be reinstalled in the orientation noted in step 1.
3. Looking through the brush guide, inspect the commutator, which should be smooth and medium brown to dark brown in color. Remove all dust from commutator with compressed air. If the commutator is grooved in, the brush track, gouged, scored or shows signs of having burned spots, replace the complete motor assembly. If the commutator is in good condition, install new motor brushes, and tighten brush caps into place. Make sure each brush is oriented so that the curved end fits the curvature of the commutator.
4. Install brushes in the reverse order of removal.
5. After installing new brushes, it is advisable to "run in" the brushes as follows:
Connect the motor to a controlled voltage supply (rheostat in a 28 volt DC line for 28 volt motor and a 12 volt line for 12 volt motor). Operate the motor at approximately 1/2 its normal speed for the first hour, then gradually increase the speed until it is rotating at approximately normal speed. Continue the "run in" operation for at least two hours to properly seat the brushes before installing the blower in the aircraft.

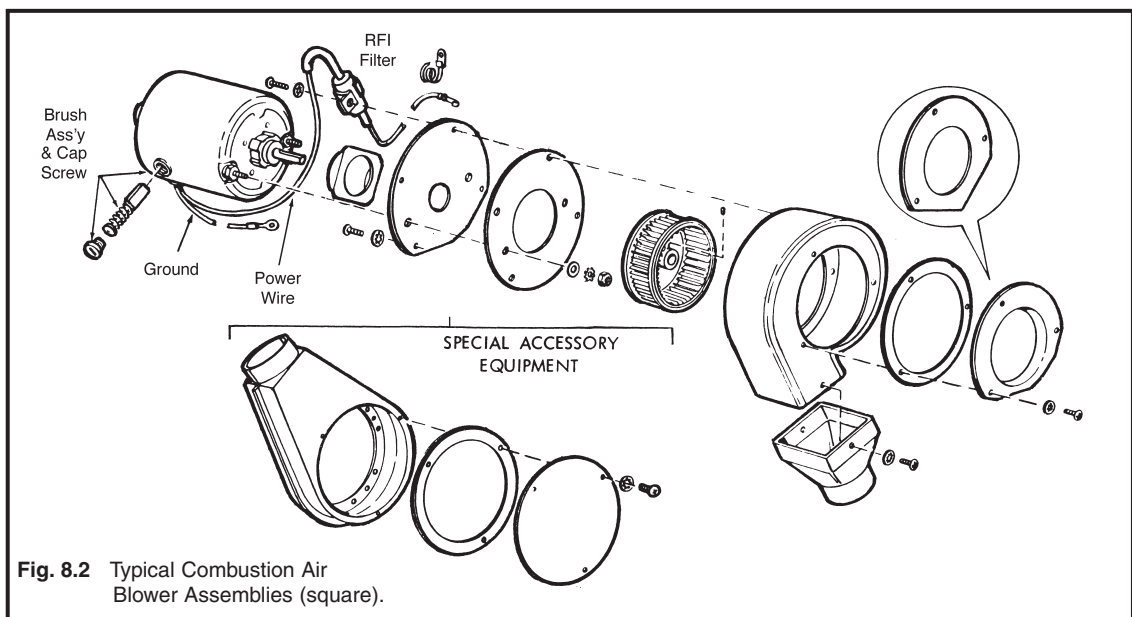
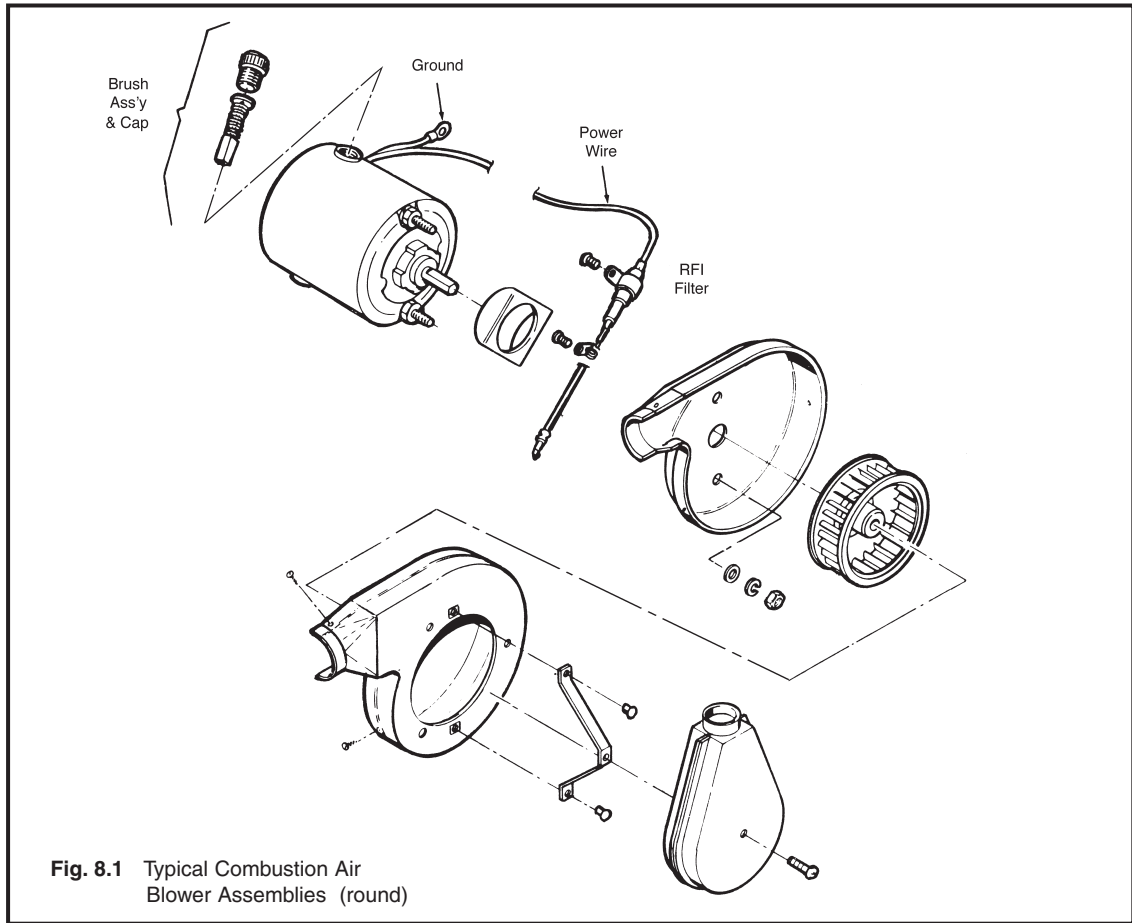


8.4 Combustion Air Blower Maintenance: (cont'd)

C. Installation: (Refer to Figure 8.1 & 8.2)

1. Prior to installing the combustion air blower, inspect all parts of the assembly for loose screws, loose nuts, and poor ground connection on the blower housing. Make sure the blower wheel is tight on the shaft and properly located in the housing. It should have just enough clearance to rotate at full speed without binding against the spill plate. Blower performance is based upon this close tolerance clearance. It is recommended that correct voltage be applied for this clearance check.
2. Install the blower inlet adapter in the same orientation as before removal (not used on all installations).
3. Place the combustion air blower assembly in position in the attaching clamp so the air tubing can be connected and slide the tubing into position at the point where it was disconnected during removal. Do not tighten until after tightening the motor in the attaching strap.
4. Tighten the blower motor mounting strap securely, making certain the air tubing is in proper alignment.
5. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.
6. Connect the wire lead at the quick disconnect terminal. Be sure to slide an insulating sleeve over the connection (or tape it) in order to prevent any possible short circuits. Tie the sleeve in place.
7. Connect the ground lead securely to the aircraft, under one of the motor mounting screws.
8. Check motor operation and re install access panels. By disconnecting the wire at the No. 3 terminal on heater terminal strip, blower can be operated without fuel flow to the heater. (Removing the wire from terminal No. 3 will shut off the fuel solenoid valve and allow the motor to run without fuel spray from the nozzle.)

8.4 Combustion Air Blower Maintenance: (cont'd)



8.5 Spark Plug Maintenance:

WARNING:

FAILURE TO TEST THE SPARK PLUG AND/OR THE IGNITION ASSEMBLY BY METHODS LISTED HEREIN, WILL RESULT IN DAMAGE TO THE LEAD ASSEMBLY, COIL ASSEMBLY, SPARK PLUG, OR VIBRATOR. IT CAN SHORTEN THE USEFUL LIFE OF THESE ITEMS AND MORE IMPORTANTLY, IT CAN CAUSE SERIOUS INJURY OR DEATH DUE TO ELECTRICAL SHOCK AND/OR BURNS.

Three types of spark plugs are used on HET combustion heaters. The I-Series Aircraft Combustion Heaters uses a Type III in all models except the I-1500 which uses a Type I. The Type I and Type III are described and pictured in Chapter 6, Figures 6.1 and 6.3, of this manual. All of the testing procedures for the spark plug are Chapter 6 as well.

WARNING:

DO NOT ARC IGNITION LEAD TO ANY GROUND EXCEPT THROUGH APPROVED SPARK PLUG GROUND ELECTRODES. GROUNDING LEAD TO JACKET IS DANGEROUS AND MAY CAUSE INJURY AND DAMAGE TO THE HEATER IGNITION UNIT.

FAILURE TO TEST THE SPARK PLUG AND/OR THE IGNITION ASSEMBLY BY THE PRESCRIBED TYPE III SPARK PLUG METHOD WILL RESULT IN DAMAGE TO THE LEAD ASSEMBLY, COIL ASSEMBLY, SPARK PLUG, OR VIBRATOR. AND MAY SHORTEN THE USEFUL LIFE OF THESE ITEMS.

DO NOT TOUCH THE SPARK PLUG WHILE ENERGIZED. IT HAS DANGEROUSLY HIGH VOLTAGE AND MAY CAUSE INJURY OR EVEN DEATH. MAKE SURE TO PLUG THE SPARK PLUG HOLE IN THE HEATER TO PREVENT ANY POSSIBILITY OF RESIDUAL FUEL BLOWING OUT AND IGNITING.

CAUTION:

NEVER INSTALL A TYPE II SPARK PLUG INTO AN I-SERIES HEATER. SEVERE DAMAGE TO THE HEATER AND HEATER IGNITION UNIT WILL OCCUR AND PHYSICAL INJURY MAY RESULT.

A. Removal: (Type I & Type III Spark Plug)

1. Remove the necessary access panels to expose the spark plug area of the heater.
2. Unscrew and remove the high voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the grommet.
4. Using a 7/8 inch deep hex socket, unscrew and remove the spark plug. Make sure the spark plug gasket is removed with the spark plug. It will normally stick on the spark plug threads; but if loose, it might drop into the ventilating air passages of the heater. Should this happen, remove the gasket with a wire hook.

B. Inspection and Servicing (Type I Spark Plug)

1. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrodes, it may be cleaned and reused. Refer to Chapter 4, cleaning information. If the electrodes are not eroded or damaged, re-gap the spark plug by carefully bending the ground electrode until a 0.055 inch feeler gage can be inserted between between the end of the center electrode and the ground electrode. (See Chapter 6.)

8.5 Spark Plug Maintenance: (cont'd)

C. Inspection and Servicing (Type III Spark Plug)

1. Inspect the Type III spark plug, if it fails to clean up properly and/or if electrodes are badly eroded, it should be replaced. No re-gapping of the Type III is possible. Do not bend the center electrode or the disk on the at the center electrode.

D. Installation (Type I & Type III Spark Plug)

NOTE:

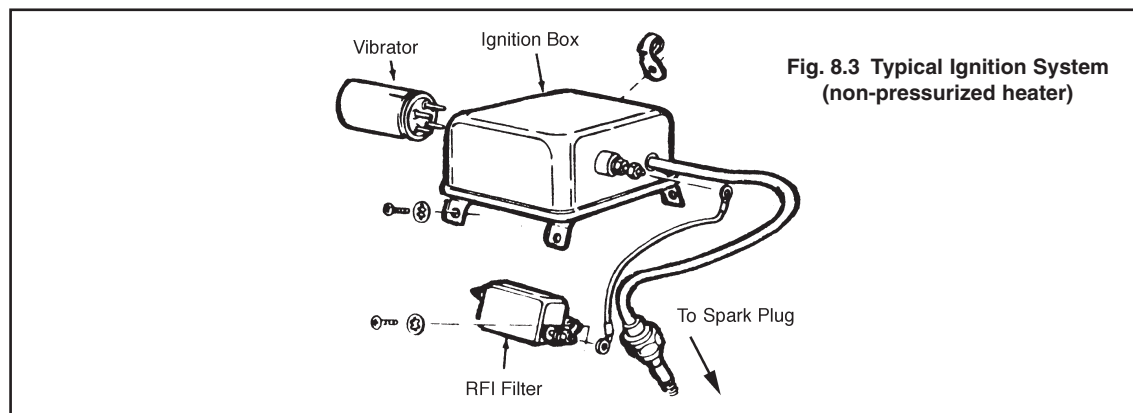
NO RE-GAPPING OF TYPE III SPARK PLUG IS POSSIBLE DO NOT BEND THE CENTER ELECTRODE OR THE DISK ON TOP OF THE CENTER ELECTRODE.

1. Perform a gap spark test per Chapter 6 applicable test.
2. After the spark plug gap is checked the spark plug and gasket may be installed and torqued.
3. Place a new spark plug gasket on the threads. If the gasket does not hold on the threads and would be likely to fall off during installation, place a small drop of Aviation Permatex, or similar material, on the gasket to stick it temporarily to the plug shell.
4. Screw the spark plug into the heater with a deep socket. Tighten to a torque of 28 ft. lbs.
5. Install the grommet in the heater jacket opening. Carefully insert the spring connector on the high voltage lead into the spark plug shell, press down gently and start the nut on the threads. Tighten the nut to 20 ft. lbs.

8.6 Vibrator Assembly Maintenance: (see Figure 8.3)

(if applicable to ignition unit)

1. Remove the necessary access panels to reach the ignition unit on the heater assembly.
2. Measure the distance the vibrator protrudes out of the ignition assembly to determine when the new unit is inserted properly. Grasp the vibrator and with a slight back and forth movement pull it straight out of the ignition unit. (For a friction grip, it may be necessary to use a piece of masking or friction tape around the exposed portion of vibrator.)
3. To install the new vibrator, carefully rotate the vibrator until the index marks are aligned and the connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket, then press the vibrator fully and firmly into position. *Replace the vibrator in the ignition unit at each overhaul or if it has failed.*
4. Check the heater for operation and close all access openings.



8.7 Ventilating Air Blower Maintenance

A. Removal: (See Figure 8.4)

1. If the heater is equipped with an adapter and screen assembly, remove it from the blower housing by removing the three screws and lockwashers.
2. Loosen the four screws and rotate the blower and motor housing to disengage the notched end from the four screws in the end of the heater jacket. Remove the grommet and separate the two electrical quick disconnects after sliding back the insulator sleeves on the wire ends.
3. To remove the motor from the housing, first loosen the Allen head set screw. Remove the fan. (May require penetrating oil to loosen the fan from the shaft.) Loosen the screw from the motor bracket in the housing.
4. Carefully remove the wiring through the motor bracket grommets, note positioning. Remove the motor.
5. Remove the screw, nut and flat washer, in the upper corner of the motor bracket assembly. Remove the two screws, flat washers, and new grommets at the two lower edges securing the motor bracket assembly. Remove bracket.

B. Inspection:

1. Inspect the housing and bracket for cracks, corrosion, and damage. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

C. Installation: (See Figure 8.4)

1. Insert the ventilating air motor into the motor bracket assembly slide the blower wheel on the end of motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.
2. Attach the capacitor and leads assembly to the motor bracket with the screw and lock washer. Make sure a good electrical ground connection is made at this point.
3. Insert this assembly into the blower housing and position it so the long screw is in alignment with the gap on the inner ring of the motor bracket assembly. This is the screw used to secure and align the motor in the bracket.
4. Slide the flat washer and rubber washer into position between the legs of the motor bracket and blower housing.
5. Make sure all four wires are routed and grommeted as they were prior to disassembly and install the two screws, flat washers and new grommets at the two lower edges securing the motor bracket assembly. Then install the grommet, flat washer, nut, and screw in the remaining upper corner of the motor bracket assembly.
6. Center the motor bracket in the housing and tighten the screw to secure it. The motor should be positioned in the bracket to locate the blower wheel properly in the blower housing. The blower wheel should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen head set screw, and spin the blower wheel by hand for a clearance check. Then apply appropriate voltage to run the motor as a final clearance check.
7. Attach the adapter and screen assembly (if used) to the end of blower housing with three screws and lockwashers.

8.7 Ventilating Air Blower Maintenance: (cont'd)

NOTE:

Due to the variation in motor availability, the motor installed in your particular installation may not have available brushes or replaceable brushes. In this case, the motor must be replaced.

D. Brush Removal: (internal brush) See Figure 8.5

1. Remove nuts and washers.
2. Remove back shell.
3. Remove secondary nuts and washers.
4. Carefully remove brush holder assembly.
5. Unsolder and remove brush and spring.
6. Remove brush and spring.
7. Remove foreign material from brush guides and commutator with a stream of filtered Compressed Air

E. Brush Removal: (External brush) See Figure 8.4

1. Remove brush screw cap.
2. Remove brush and spring assembly.

F. Brush Inspection: (all)

1. Remove the brushes one at a time from motors viewed in (Fig. 8.4 & 8.5) by removing the brush cap and carefully withdrawing the brush from its guide or holder (internal) noting the orientation of the brush for later reinstallation. Remove foreign material from the brush guide and commutator with a stream of filtered oil free compressed air. Check for brush wear. Inspect the commutator for grooved brush pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.
2. Inspect the brush for wear. If brushes are worn to a length of 3/16" or less they must be replaced. If this limit has not been reached, the brushes may be reinstalled in the orientation noted in step 1.
3. Inspect the commutator for grooved brush tracks, pitting or burning. The commutator should be smooth and medium brown in color. Replace motor if the commutator or other parts show damage. Reverse above procedure for re-assembly.

G. Brush Installation: (Internal brush)

1. Carefully install brush holder assembly.
2. Install brush and spring.
3. Solder brush lead and spring or install assembly.
4. Install secondary nuts and washers.
5. Install back shell.
6. Install nuts and washers.
7. Brushes must be "run in" the same manner as in 8.4.B, step 5.

8.7 Ventilating Air Blower Maintenance: (cont'd)

NOTE:

Due to the variation in motor application, the motor installed in your particular installation may not have available or replaceable bearings. In this case, the motor must be replaced. Check the IPC Chapter of the P/N 99M91 Overhaul & Maintenance manual.

H. Brush Installation: (External brush)

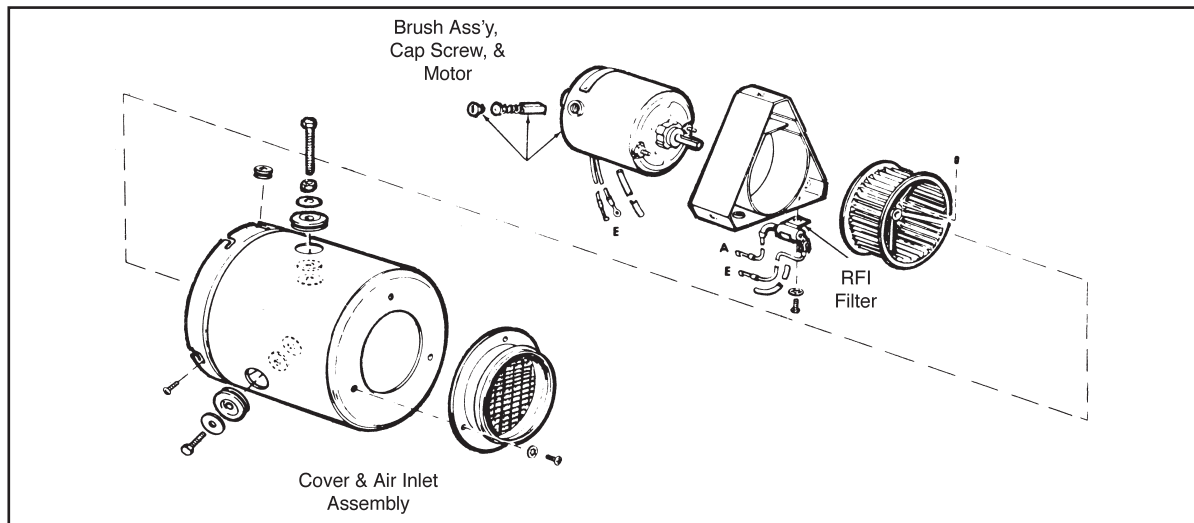
1. Install brush and spring assembly.
2. Install brush screw cap.
3. Brushes must be "run in" the same manner as in 8.4.B, step 5.

I. Bearing Removal: (motor removed from housing)

1. If not already accomplished, remove fan by loosening the allen screw.
2. Remove the nut and lockwasher. Remove the thru bolt.
3. Remove the housing assembly.
4. Carefully remove brushes and holder assembly.
5. Remove armature very carefully, taking care not to damage the commutator or stator.
6. Before replacing the bearings, it is advisable to inspect the components of the motor for condition, check the stator wires/insulation, and check the armature with a "growler" for performance. If armature fails this test or any discrepancies are noted it is more economical to replace the motor.
7. Using a common bearing puller of the correct size, remove the bearing

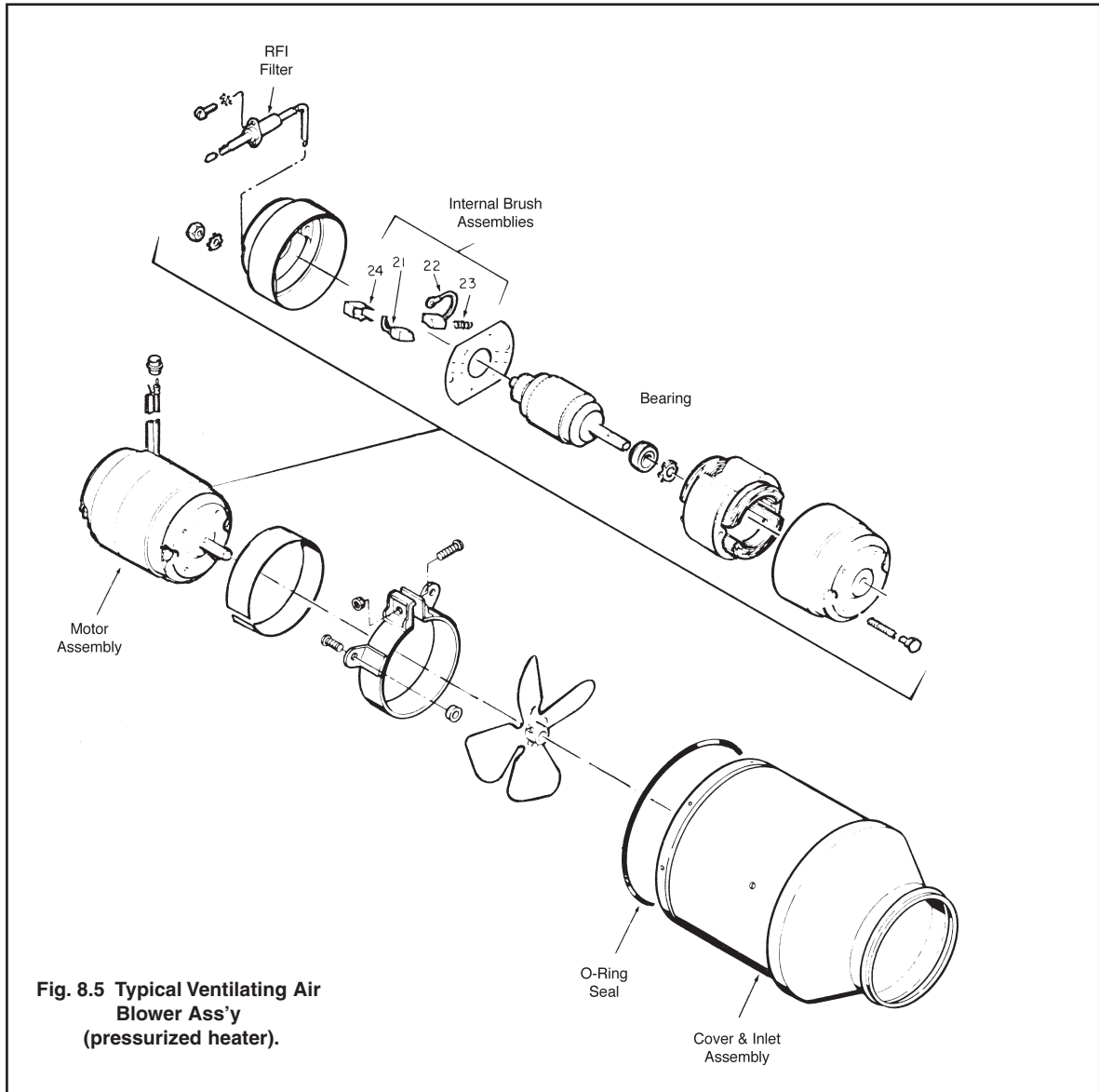
J. Bearing Installation

1. Inspect the bearing cavity for condition. Ball bearings are press fit and should not easily fit. If bearing easily slips into the cavity, replace the motor assembly.
2. Press the bearing using an arbor press and appropriately sized tool.



**Fig. 8.4 Typical Ventilating Air Blower Ass'y
(non-pressurized heater).**

8.7 Ventilating Air Blower Maintenance: (cont'd)



8.8 Fuel Nozzle Maintenance:

No periodic maintenance is required on the fuel nozzle. If it is suspect that the fuel nozzle is clogged or not spraying the proper pattern as may be found in Chapter 3, Troubleshooting, it may be removed and cleaned or replaced in lieu of overhauling the heater. However, the nozzle is difficult to remove and replace so the P/N 99M91 Overhaul & Maintenance manual steps in “disassembly” and “assembly” must be followed to remove and reinstall or replace the nozzle. Cleaning and testing may be done in accordance with the appropriate chapters in the overhaul manual.

8.9 Combustion Tube Maintenance:

No periodic maintenance is required on the combustion tube. However, if an I-Series combustion tube fails a pressure decay test at any time, it will need to be replaced. Specific inspection times are outlined in Chapter 5, please note specific requirements. ***No Weld Repairs are Permitted!***

Make a general combustion tube inspection if you suspect that the heater has suffered an over temperature or if the heater has been inactive for extended periods. The combustion tube cannot be seen without disassembly, however evidence may be seen in accessible areas inside the heater. Inspection may be accomplished using flexible optics passed into the exhaust or air inlet. If evidence of damage is found, perform a pressure decay test prior to further operation.

8.10 Miscellaneous Components Maintenance:

Inspection and Servicing:

NOTE:

All discrepant parts must be replaced with approved new HET parts and components. Destroy and discard removed parts. Refer to the applicable portion of the P/N 99M91 Overhaul & Maintenance manual IPC for specific part numbers for the heater being worked on.

1. Discard all rubber parts, such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket.
2. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chaffed or cracked insulation. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals, rather than solder for all heater wiring connections. If extensive wiring harness damage is visible, the entire harness assembly should be replaced. Individual damaged wires may be replaced but be sure that all cable ties and clamps are restored. If heater controls were operating properly at the time of removal, reinstall them.
3. Inspect accessible hardware parts, consisting of bolts screws, nuts, washers, and lockwashers. Replace broken or damaged parts as needed.
4. Inspect the heater electrical terminal strip for distortion and cracks and replace it if either condition exists.
5. Inspect all radio noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open circuit reading should be obtained. Radio noise filters may degrade over time, if RFI is related to heater operation, it is advisable to replace them.

8.11 Fuel Pump Maintenance: (See applicable aircraft service manual)

The heater fuel pump or pumps are largely dependent on the design of the particular installation on a specific aircraft or rotorcraft. Some installations require low pressure or high pressure pumps and others require two pumps placed in series to obtain the pressure and flow required for supplying fuel from a tank to the heater. The information is typical and is an example of many heater installations. (See Figure 8.7 & 8.8)

A. Removal: (Typical)

1. Remove access panels required to reach the fuel pump assembly. Many aircraft will have heater fuel pumps located away from the heater assembly or in isolated locations. Refer to the aircraft or rotorcraft maintenance manuals as necessary to locate and remove them.
2. Remove all electrical power. Shut off the fuel supply to the pump; disconnect electrical lead and fuel lines. Provide a method to catch residual or spilled fuel. Exercise care to avoid losing the insulator in the electrical connector. Unless the fuel lines are rigid enough to remain in their original locations, be sure to cap and tag them for proper connection during reinstallation.
3. Remove the attaching bolts from the fuel pump bracket and remove the fuel pump from the aircraft.
4. The HET P/N 99M91 Overhaul & Maintenance manual steps in "disassembly" must be followed to remove fuel pump components.

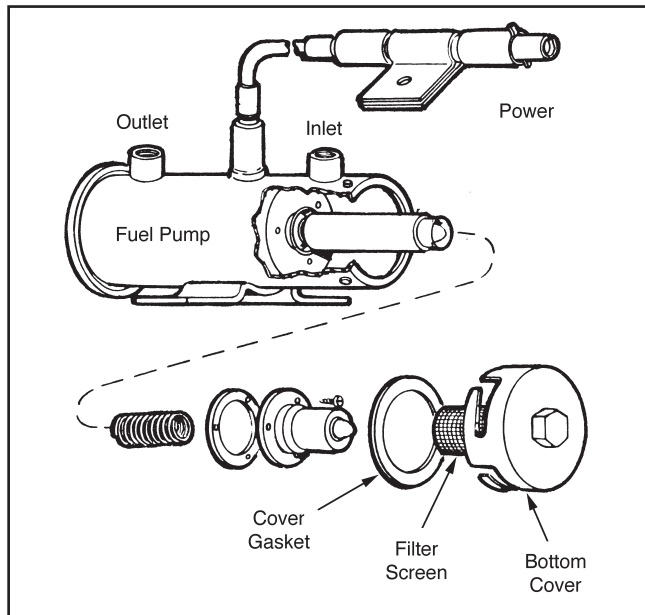
B. Inspection and test: (Typical)

1. Inspect all parts visually for damage.
2. Inspect the fuel pump electrical resistance by connecting an ohmmeter between the connector terminal and ground on the pump housing. Resistance should be between 19.0 and 30.0 ohms for 24 volt models, and 4.8 to 12.0 ohms for 12 volt models. If resistance is not within limits, replace the pump assembly.
3. Low pressure pump as shown in Figure 8.7 have a filter screen which may be accessed by removal of the bottom cover.
4. Complete cleaning and testing may be done in accordance with the appropriate chapter in the overhaul manual.

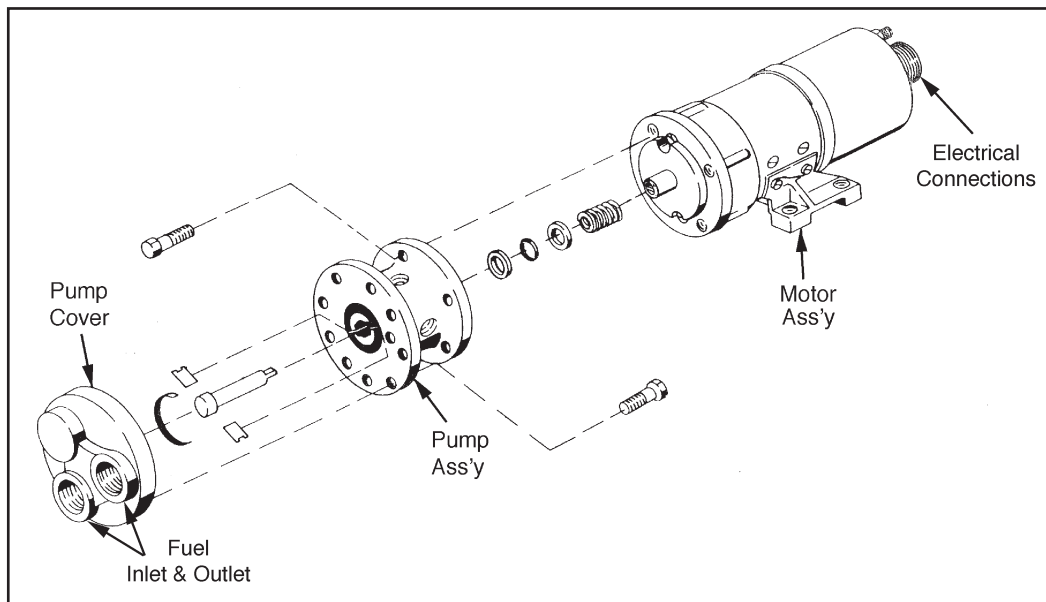
C. Installation: (Typical)

1. The HET P/N 99M91 Overhaul & Maintenance manual steps in "assembly" must be followed to reinstall fuel pump components prior to aircraft installation.
2. Attach the fuel pump to the aircraft structure member with the two attaching bolts. The radio noise filter bracket must be attached with one of these bolts. Make sure a good electrical ground is present and proper polarity connection made.
3. Remove tags and caps. Connect the inlet and outlet fuel lines and tighten them securely.
4. Connect the electrical lead at the radio noise filter connection. Be sure the insulator is in place and the connector is locked securely.
5. Run the pump for a few minutes to check for fuel leaks.
6. Install access panels. Refer to the latest revision of the aircraft or rotorcraft service or maintenance manuals as required.

8.11 Fuel Pump Maintenance: (cont'd)



**Fig. 8.6 Typical Fuel Pump Components
(low pressure pump)**



**Fig. 8.7 Typical Fuel Pump Components
(high pressure pump)**