



Model:
P/N
S/N

Maintenance Manual

for Hartzell Engine Technologies LLC. Aircraft Combustion Heater
Models CD15K, CD25K, CD35K, CD45K CD50K, CD55K and CD70K
with P/N's ending in -1 (dash one series) (Includes Airworthiness Limitations)



MM10001

January 1, 2008

REV. L dated May 21, 2015

FAA Approval has been obtained on technical data in this publication
that affects product type design

NOTE:

Instructions for Continued Airworthiness" as outlined on page 8 are required.
The Airworthiness Limitations Section (Section 7.2.) is MANDATORY.

Before performing service consult www.hartzell.aero for latest revision to this manual.

Changes to the Instructions for Continued Airworthiness will be distributed by way of service bulletins and service letters. The Airworthiness Limitations section is FAA approved and specifies maintenance required under section 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

Congratulations!

You have purchased the world's highest quality heating system.

Hartzell Engine Technologies LLC (HET) has been servicing heating systems for many years. Using the latest modern technology, Hartzell Engine Technologies has received FAA approval to manufacture new TSO-C20 heaters for general aviation aircraft. Installations are available for most twins and some single engine aircraft. Complete heating systems for aircraft with no prior combustion heater, are also available.

These units are designed with pilots, passengers, and maintenance personnel in mind. We are confident upon installation and operation of this heater that you will agree on its excellent quality. If properly serviced (in accordance with the "Instructions for Continued Airworthiness" contained in this manual) overall safety and reliability of the system will increase.



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TABLE OF REVISION

REVISION LETTER	REVISION DATE	INSERTION DATE	SECTION	DESCRIPTION
A	3/25/09	3/25/09	Warranty VII. 4. IX. A. 11. IX. H. 1, 3. IX. H. 1, 3.	Added Teflon notes & purging delivery line notes.
			XIV.	Changed amber light to green on rotary heat control.
B	9/15/09	9/15/09	Pg 3, 4	Removed model # ref.
			VII.E.1 IX.A1	Added recommend tube replacement note.
			XIV.	Changed blue light to amber to indicate failure.
C	7/27/10	7/27/10	Pg 1	Airworthiness Limitations sect. corrected from IV.B to VI.B.
D	3/8/11	3/22/11	XV	Removed plug and changed elbow p/n, added 21794 nozzle holder option.
E1	7/14/11	7/14/11	Pg 17	Add motor overhaul information.
E2	10/3/11	10/3/11	Pg 1, 3, 7	Added models CD50K & CD70K
E3	10/3/11	10/3/11	Pg 12 Pg 13	Add note about pdt test. Changed pdt test time from 250hr/2 yr to 250hr/4 yr.
F	2/3/12	2/3/12	Pg 37	Added 4-10 pressurized wiring schematic.
G	7/24/12	7/24/12	Pg 11	II. iv. O/H temp from 350 deg to 300-450 deg.
			Pg 15	VIII.A. Corrected overhaul yr from 5 to 4.
H	9/10/13	9/10/13	Pg 25 XI. B.1.	Corrected "0 to 20" psi for Jet fuel to "0 to 200"
I	8/1/14	8/1/14	Cover Page	Added models CD50K & CD70K
J	3/26/15	3/26/15	Pg 12, 23, 29, 30, 35	Added torque notes
K	4/16/15	4/16/15	Pg 23	Added "not" to allow lead wire to twist.....
L	5/21/15	5/21/15	ALL	Reformatted, added more specific info, clarified procedures, added warranty page, removed section ref from ICA's AL section.



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1. WARRANTY – *Must read before proceeding with heater installation, modification or servicing*

- 1.1. New HET heaters come with 4-yr or 2,000-hr, whichever comes first, full warranties. After 1000-hrs of heater operation or 4 years (whichever comes first) the pressure decay test and inspection described in the “Instructions for Continued Airworthiness” becomes mandatory.
- 1.2. Any warranty work must be pre-authorized in writing by Hartzell Engine Technologies LLC.
- 1.3. Warranty shipments must be accompanied by proper paperwork reflecting a Warranty Authorization Number obtained directly from Hartzell Engine Technologies LLC (HET). Return shipments cannot be accepted without this authorization, HET reserves the right to repair or replace warranted items. HET is not responsible for aircraft down-time, lost revenues, customs or duties. Factory covers ground freight only in the USA if warranty is authorized.
- 1.4. IN NO EVENT SHALL HARTZELL ENGINE TECHNOLOGIES LLC (HET) BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGE: however arising, whether in warranty, strict liability, contract, tort, negligence or otherwise, including but not limited to loss of profits, revenue, loss of total or partial use of the products, facilities, services, downtime costs, or claims of purchaser for such or other damages whether on account of products furnished hereunder or delays in delivery thereof, HET liability of any claim shall in no case exceed the purchase price allowable to the product or part thereof which give rise to the claim. Notice of claims against Hartzell Engine Technologies LLC must be made in writing within forty-eight (48) hours of discovery affording HET an opportunity to make a prompt investigation of surrounding facts and mitigate any damage which might ensue. Should the responsibility be determined to be Hartzell Engine Technologies LLC a waiver by the purchaser of any right later to assert such a claim will be required. Any cause of action against Hartzell Engine Technologies LLC arising out of or relating to the contract or the performance hereof shall expire unless brought within one year of the time of accrual thereof. The forgoing limited warranty is exclusive and in lieu of all other warranties expressed or implied, including but not limited to any warranty of merchantability or fitness for particular purpose.

1.5. NOTICE:

1.5.1. WARRANTY DEPENDANT ON THE FOLLOWING:

- 1.5.1.1. Balance between combustion air inlet and exhaust is critical. Any modifications to the heater, combustion air inlet or the exhaust could cause the heater not to run properly and voids warranty.
 - 1.5.1.2. ANY modification to any HET component without documented permission from the PAH voids warranty and excludes Hartzell Engine Technologies LLC (company and/or personnel from any and all liability.
 - 1.5.1.3. **Breaking any tamper-proof seal, or introducing Teflon products (Teflon tape, dope etc.) for use as a fuel sealant voids warranty.**
- 1.6. **TO ACTIVATE WARRANTY AND RECEIVE CORE REIMBURSEMENT, you must fill out and return warranty activation card included with your heater or go online to www.hartzell.aero/warranty/**





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2. INTRODUCTION:

Aircraft combustion heaters manufactured by Hartzell Engine Technologies LLC are designed primarily to provide heat to the passengers and crew during ground and/or flight. Additional uses are de-icing and engine preheating. Heat output generally is from 15,000 to 70,000 BTU.

Heaters are FAA TSO-C20 approved and are designed to use the aircraft fuel (aviation gas or jet) in both pressurized and non-pressurized aircraft. Both 12 and 24 volt applications are available. Designated models are CD15K, CD25K, CD35K, CD45K, CD50K, CD55K & CD70K, with a p/n ending in "-1".

3. SCOPE:

This manual provides maintenance information for aircraft combustion heaters manufactured by Hartzell Engine Technologies LLC, 2900 Selma Highway, Montgomery, AL 36108 USA. www.hartzell.aero.

The purpose of this manual is to guide its reader to a thorough understanding and working knowledge of the Hartzell Engine Technologies “-1” series combustion heater and subsequent components.

While general concepts in operation mentioned herein apply to all aircraft combustion heater makes, the design and operation of a “-1” combustion heating unit is completely unique to itself. Models vary, pictures and information are generic and information provided within this manual may not apply to all models. Please contact Hartzell Engine Technologies for more specific information regarding your model. In order to achieve continued efficiency and longer Time Before Overhaul (TBO) the envelope of operation as outlined in this manual must be met.

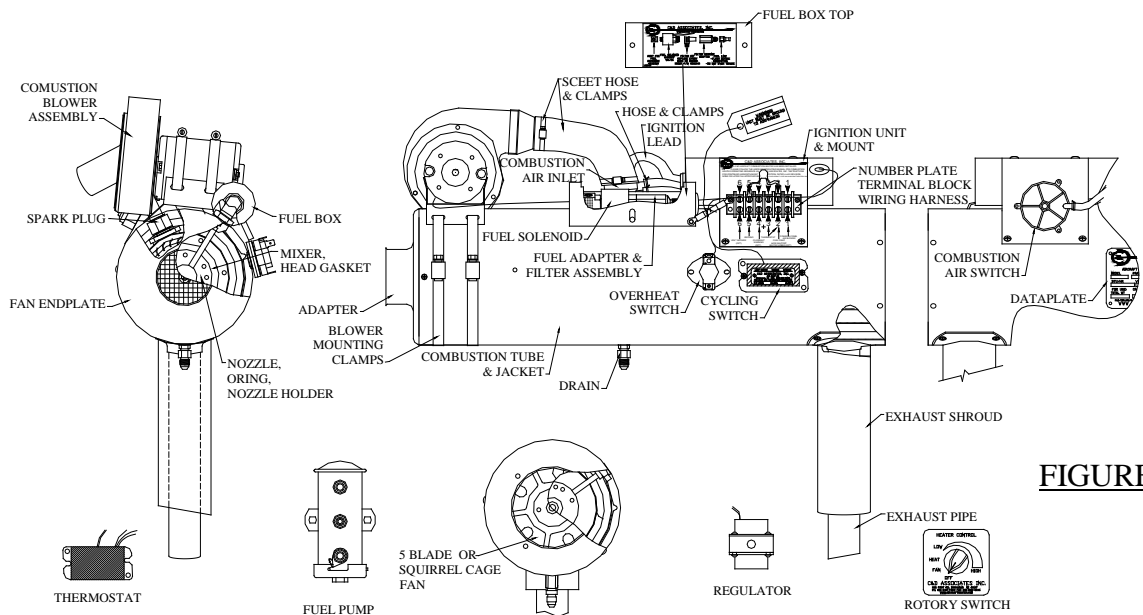


FIGURE 1

-Heater configurations may differ- (For reference only)

BTU'S	LENGTH	DIAMETER	VDC/AMP	WEIGHT	FUEL PRESS AV/JET	MAX. FUEL GAL/HR
15-25,000	9-17"	5.50	12VDC/3-18 AMPS 24 VDC/3-14 AMPS	10-25 lbs	7/100	.25 GPH
25-35,000	17-20"	6.00	12VDC/14-20AMPS 24VDC/7-12AMPS	20-30 lbs	7/100	.5 GPH
35-45,000	20-23"	6.00		20-30 lbs	7/100	.65 GPH
45-55,000	21-24"	6.00		20-30 lbs	7/100	.75 GPH
55-75,000	21-24"	6.00		20-30 lbs	7/100	.85 GPH



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LISTING OF P/N'S PER SERIES
* INDICATES JET A APPLICATIONS

CD11000 SERIES

CD11000-1	CD11004-1	CD11008-1	CD11049-1
CD11001-1	CD11005-1	CD11010-1	CD11050-1
CD11002-1	CD11006-1	CD11014-1	CD11214-1
CD11003-1	CD11007-1	CD11047-1	CD11215-1

CD12000 SERIES

CD12003-1	CD12013-1	CD12036-1	CD12066-1
CD12004-1*	CD12015-1	CD12039-1	CD12067-1
CD12006-1	CD12016-1	CD12043-1	CD12089-1
CD12007-1	CD12017-1	CD12044-1	CD12090-1
CD12008-1	CD12018-1	CD12059-1	CD12091-1
CD12009-1	CD12022-1*	CD12060-1	CD12099-1
CD12010-1	CD12030-1	CD12061-1	CD12188-1
CD12011-1	CD12031-1	CD12064-1	CD12189-1
CD12012-1	CD12032-1	CD12065-1	

CD14000 SERIES

CD14010-1	CD14048-1	CD14075-1	CD14152-1
CD14019-1	CD14050-1	CD14076-1	CD14186-1
CD14020-1	CD14055-1	CD14077-1	CD14187-1
CD14025-1	CD14060-1	CD14078-1	CD14188-1
CD14026-1	CD14066-1	CD14079-1	CD14190-1
CD14027-1	CD14067-1	CD14080-1	CD14192-1
CD14028-1	CD14070-1	CD14090-1	CD14193-1
CD14041-1	CD14071-1	CD14125-1	
CD14045-1	CD14072-1	CD14126-1	
CD14046-1*	CD14073-1	CD14127-1	

CD15000 SERIES

CD15010-1	CD15020-1	CD15030-1
CD15011-1	CD15025-1	

CD50000 SERIES

CD50000-1	CD52000-1	CD52001-1
CD52002-1		



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4. DESCRIPTION

Each heater system generally consists of a combustion chamber assembly, a ventilation air blower, a combustion air blower, nozzle holder, solenoid valve assembly, spark plug, high-voltage ignition system, combustion air pressure switch, overheat switch and cycling switch. These components are combined in a complete assembly. Optional equipment includes thermostat, fuel pump, fuel regulator and remote shut off valve, heater circuit breaker, controls, and operation indicator lights. The optional equipment items are provided as separate components since they may be mounted remotely in the aircraft and subject to customer preferences.

Aviation Gasoline Applications may use an electric fuel pump that provides fuel at 7.0 to 9 PSI for operation. 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 and does not adversely affect engine operation.

Jet Fuel Applications use an electric fuel pump assembly that fuels through a fuel control system providing fuel pressure at 105 +5.-0 PSI.

5. CONSTRUCTION:

The majority of the heater is manufactured using corrosion resistant stainless steel. The combustion tube is a welded, gas tight container consisting of the combustion chamber/ radiator assembly with HET's exclusive Durakoat coating applied to high wear areas for longer life. The combustion tube is encased in a stainless steel shroud or 'jacket' assembly. Space between the tube and shroud provides an area for heat transfer. The ventilation fan, combustion air inlet and fuel feed assembly are located at one end while the air outlet and exhaust are generally located at the other. On the inlet end of the combustion tube is the 'head assembly' where the fuel feed and nozzle assembly that houses the spray nozzle are attached. Externally mounted is the ignition assembly, fuel solenoid, & wire mounting terminal board. A combination of mechanical and solid state switches are used to regulate heat and airflow. These switches also provide safety control for shut down of unit in the event of malfunction.





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6. OPERATION:

In order for the heater to operate properly, it must have (1) an external power source, (2) ignition, (3) combustion air, (4) ventilation air and (5) a fuel source. Heat in the combustion chamber or tube is achieved by burning a fuel to air mixture of proper proportions. Any deviation of this ratio will cause reduced heat output, poor operation, and shortened TBO. For the following, assume that these are provided as required.

Properly atomized spray from a specially designed fuel nozzle, a balanced combustion air inlet and exhaust, coupled with a continuous spark ignition, ensures instant firing and continuous burning under all flight conditions. Heat is provided by burning this fuel-air mixture in the combustion chamber of the heater. Jet or aviation fuel is injected into the combustion chamber through the spray nozzle. A 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 spark plug to the ignition assembly. 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.

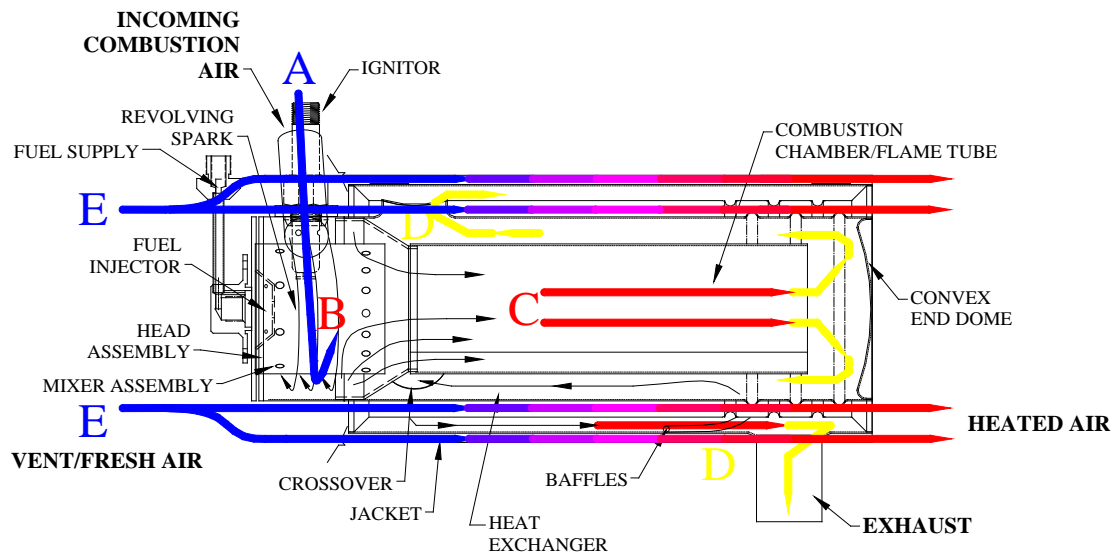


FIGURE 2

- A. Combustion Air Supply. This is provided by way of an external ram air scoop and or a blower assembly independent of the vent/fresh air supply. Combustion air enters the head assembly, and then is metered into the mixer chamber.
- B. Ignition is supplied via high-voltage oscillating current, this coupled with the igniter design, create a revolving continuous spark located in the head assembly. This igniter is positioned in the path of an internal fuel injector designed to atomize the fuel at a pre-determined pressure.
- C. This ignited fuel/air mix is then dragged from mixer assembly as additional combustion air channels through the head assembly into the combustion chamber portion of the liner. The majority of combustion is created at this point in the combustion chamber or flame tube area.
- D. The flame travels full length of the flame tube hitting the end dome, it then doubles back along the inside wall and on into the outer layer of the heat exchanger. The spent gasses again travel the length of the tube around a series of baffles then exiting out the exhaust.
- E. Air for the ventilation system is picked up via an external ram air scoop and/or a blower assembly typically mounted on the inlet end of the jacket. Air is forced through the heated external passages of the combustion chamber. Ventilating air thus comes in contact with the heated cylindrical surfaces subsequently pushing heated air into the cabin.



7. ICA (INSTRUCTIONS FOR CONTINUED AIRWORTHINESS)

Second Edition: Rev E dated 5-21-15

When Hartzell Engine Technologies LLC (HET) heater is installed in an aircraft, the following action is required. A description of its operational principals, controls, servicing, maintenance, troubleshooting and testing can be found in the attached MM10001 maintenance manual in the "Table of Contents."

APPLICATION

Applies to HET Model #CD15K, CD25K, CD35K, CD45K, CD50K, CD55K and CD70K with part number ending in "-1". Combustion heaters marked as meeting the standards of FAA TSO-C20, installed in aircraft certified in any category.

7.1. PREFLIGHT/OPERATIONAL CHECK AND SHUTDOWN PROCEDURE

NOTE: Pilots operating under FAR91 may perform the checks required

- 7.1.1. Ensure that combustion and ventilation air inlets are free of any obstructions or constrictions and are not damaged.
- 7.1.2. Check that the fuel drain line is free of obstructions, constrictions and damage.
- 7.1.3. Check that the area of the aircraft external skin surface behind the exhaust pipe does not have indications of excess exhaust slip stream build up.
- 7.1.4. Perform operational check
- 7.1.5. Adjust the thermostat or duct limit switch to the minimum setting.
- 7.1.6. After heater has begun to burn, allow it to cycle a minimum of two minutes to ensure proper operation in low. Verify medium and high positions also function.
- 7.1.7. Verify during operation that the exhaust from the heater does not indicate excess smoke.
- 7.1.8. Prior to shut down, set thermostat to low (cold) and/or fan position. Allow heater to run at this setting two minutes so as to purge the combustion chamber.

Note: Many "-1" series heaters are equipped with auto-reset overheat switches. If overheat condition occurs, continue cool down process until automatic reset occurs. (around 100 °F)

7.2. AIRWORTHINESS LIMITATION SECTION (MANDATORY)

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

AIRWORTHINESS LIMITATION SECTION IS MANDATORY PER FAR 23
PERFORM FOLLOWING CHECKS AS OUTLINED IN THE CIRCUMFERENCE OF THIS
MM10001 MAINTENANCE MANUAL

1. 100 HOUR/ANNUAL OPERATIONAL CHECK (see MM10001 (latest revision) 'Heater Maintenance and Servicing' Section.)
2. 250-HOUR/2 YEAR SERVICE AND INSPECTION (see MM10001 (latest revision) 'Heater Maintenance and Servicing' Section.)
3. 1000-HOUR/4 YEAR HEATER INSPECTION AND SUBSEQUENT 250-HOUR/PDT TEST INTERNAL INSPECTION (see MM10001 (latest revision) 'Heater Maintenance and Servicing' Section.)
4. 2000-HOUR/10 YEAR OVERHAUL [to be accomplished in accord with MM10001 (latest revision)]



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7.3. FLIGHT MANUAL SUPPLEMENT SAMPLE



C&D Associates, Inc.
302 Post Rd., Buchanan, MI 49107
FMS()

FAA-APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT	
For	
Aircraft Make: _____	Aircraft Models: _____
Registration No. _____	Aircraft S/N: _____
C&D Associates Inc. Combustion Heater Kit P/N: _____	

This supplement must be attached to the FAA Approved Aircraft or Rotorcraft Flight Manual dated _____ when the C&D Associates TSO-C20 Combustion Heater has been installed in accordance with STC # _____ and/or C&D P/N _____. The information contained in this document supplements or supersedes the basic manual only in those areas listed. For limitations, procedures, performance, and loading information not contained in this supplement, consult the basic Airplane Flight Manual.

SAMPLE

FAA-Approved _____ Manager, Aircraft Certification Office Federal Aviation Administration Chicago, IL Date: _____

www.CDaircraftheaters.com
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C&D Associates, Inc.
302 Post Rd., Buchanan, MI 49107
FMS()

FAA-APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT For	
Aircraft Make:	Aircraft Models:
Registration No. _____	Aircraft S/N: _____
C&D Associates Inc. Combustion Heater Kit P/N:	

LOG OF REVISIONS

<u>Rev. No.</u>	<u>Description</u>	<u>Pages Revised</u>	<u>Approved By</u>	<u>Date</u>
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SAMPLE

FAA-Approved _____ Manager, Aircraft Certification Office Federal Aviation Administration Chicago, IL Date: _____

www.CDaircraftheaters.com
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C&D Associates, Inc.
302 Post Rd., Buchanan, MI 49107
FMS()

FAA-APPROVED	
AIRPLANE FLIGHT MANUAL SUPPLEMENT	
For	
Aircraft Make:	Aircraft Models:
Registration No. _____	Aircraft S/N: _____
C&D Associates Inc. Combustion Heater Kit P/N:	

SAMPLE

1. OPERATING LIMITATIONS:

CAUTION: Heater must be off during engine starts to reduce the possibility of electronic device damage.
The heater is generally controlled by the same methods as the replaced heater.

2. PROCEDURES:

2.1. NORMAL OPERATING PROCEDURES:

2.1.1. Heater start up: Open heat ducts as needed to allow heat distribution. Follow the original equipment methods of control. Place the heater control switch from off to desired heat position. Heater shut down: Place heater control to fan positions for two (2) minutes prior to shut down.

2.1.2. A C&D TS0-C20 combustion heating system has been installed in this aircraft. The new C&D heater has a 2000 hr TBO with a 4 yr 2000 hr full warranty. C&D Associates, Inc. combustion heater uses the aircraft fuel to provide heat as needed.

2.1.3. General Information: C&D Associates, Inc. combustion heater uses the aircraft fuel to provide heat as needed. Heater construction is of stainless steel. Combustion takes place in a welded gas tight chamber called the combustion tube which has been specially coated with Durakoat to minimize the corrosive effect of the fuel air burn. Combustion inlet air and carbon monoxide gases created from the burn remains separate from the heated cabin ventilation air. The burnt gases are ducted outside of the aircraft through the exhaust pipe, which extends out of the aircraft skin. Fresh air taken from the ventilation air inlet is forced over the exterior of the welded combustion tube allowing heat transfer (thermo conductivity) to the forced air. This heated forced air then flows through the aircraft heat ducts into the cabin area. Due to the fact that the ventilation is supplied by a blower and or ram air, the outside of this sealed chamber is of higher pressure than the inside of the combustion tube. This assures that CO carbon monoxide levels are non-existent in the heated air distributed in the cabin.

2.1.4. SAFETY FEATURES: In the unlikely event the fuel solenoid sticks open allowing fuel to continue flowing, a mechanical overheat switch is located on the heater. This overheat switch will deactivate electrical power, if the temperature exceeds 350 deg. F, shutting of the ignition, fuel solenoid, fuel pump and remote fuel shut-off located at the fuel source. This will stop all fuel flow and electric to the heating system and shut off the ignition. A combustion air switch, in series with the overheat switch, also performs the same function in the event combustion air drops below .5 inches of water.

2.2. EMERGENCY PROCEDURES: In the event of heater malfunction such as overheating, smoke or fumes, disable heater by turning heater off and disengage the heater circuit breaker. Notify qualified service technician for servicing. If equipped with an auto reset overheat switch, should the heater overheat 2 times consecutively (indicated by overheat warning light and/or large swings in temperature) disable the heater as described above and have heater serviced/inspected prior to further use.

I. PERFORMANCE: This device will not change aircraft performance.

II. LOADING INFORMATION: Check weight and balance.

FAA-Approved _____ Manager, Aircraft Certification Office Federal Aviation Administration Chicago, IL Date: _____



8 HEATER MAINTENANCE AND SERVICING

NOTE: Prior to servicing, verify you are using the latest revision of the HET MM10001 Maintenance Manual. Please consult www.hartzell.aero for latest revisions.

Many hours have been spent to provide the most comprehensive instructions as reasonably possible. It is strongly recommended that installation and servicing be done by skilled, licensed aircraft mechanics with a working knowledge of the following:

- ❑ Fuel lines installed in accordance with AC43.13-1B Chapter 8 section 2 paragraph 8-31.
- ❑ Electrical installation completed in accordance with AC43.13-1B Chapter 11.
- ❑ Riveting and metal work in accordance with AC 43.13-1B Chapter 4 Section 4 paragraph 4-57.

The following instructions are outlined and worded with this assumption.

8.1 REMOVAL AND INSTALLATION PROCEDURES

NOTE: Use of Teflon products as a fitting sealer anywhere in a combustion heater fuel system could contaminate heater fuel nozzle and voids warranty.

NOTE: It is also highly recommended that the fuel system and delivery lines be purged prior to being connected to heater. This applies to new installations as well as during maintenance involving any fuel system component. This will greatly reduce the risk of nozzle contamination.

- 8.1.1 Follow the aircraft manufacturers (OEM) recommendations in the OEM's maintenance manual. In most cases the heater operating controls remain the same. If not, operation will be clarified in the FAA-Approved "Airplane Flight Manual Supplement" provided for the specific aircraft.
- 8.1.2 Where deviation from the original heater controls are required the installation instructions provided with the Hartzell Engine Technologies LLC (HET) heater will address these changes. Refer to appropriate installation instructions.
- 8.1.3 For new HET TSO-C20 Supplemental Type Certificate (STC'd) heater kits, the installation instructions from HET will contain complete procedures for operation and integrating in the aircraft.
- 8.1.4 To achieve optimal performance and reliability some new HET FAA-PMA heater installations require change to the combustion air inlet. Please follow all instructions specific to your installation closely.



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8.2 100 HOUR/ANNUAL HEATER INSPECTION AND OPERATIONAL CHECK

NOTE: This inspection must be recorded in accordance with FAR43.9 and maintained as required by FAR 91.417.

- 8.2.1 Perform the following checks at the end of 100 hours of heater operation or annual inspection:
- Check that the combustion air and ventilating air inlets are free of any obstructions or damage of any kind.
 - Check that the exhaust outlet is free of obstructions or constrictions, is secure, is free of excessive carbon formations, abnormal stains and/or discoloration, which would indicate poor heater operation.
 - Check that the fuel drain lines are free of obstructions, constrictions and damage.
 - Check the entire length of all fuel lines for security and any visible signs of leakage. Be sure all joints and shrouds are secure and in good condition.
 - Check that the heater wiring has no loose connections, cracked or broken wires, or frayed insulation and is secure at the attachment points.
 - Check the ignition system for security at the spark plug, making sure there is no evidence of burning or discoloration of the lead.
 - Perform the Preflight/operational check to assure correct heater performance.

8.3 250 HOUR/ 2 YEAR HEATER INSPECTION

NOTE: Once the combustion heater has reached 1000 hrs. time in service, pressure decay tests are required every 250 hours or four years (whichever comes first).

- Replace the heater fuel filter by installing filter kit CD21346
- Verify the torque of the ignition lead both at the igniter plug (15-20 ft. lbs.) and ignition unit (12-15 ft. lbs.).
- Complete 100hr/Annual inspection and operational check.



8.4 1000-HOUR OR 4 YEAR HEATER SERVICE, INSPECTION AND SUBSEQUENT 250-HOUR INTERNAL SERVICE AND INSPECTION (as contained in the Instructions for Continued Airworthiness, MM10001 Maintenance Manual)

NOTE: This inspection must be recorded in accordance with FAR43.9 and maintained as required by FAR 91.417.

At the end of 1000 hours or 4 year heater operation time* and thereafter at intervals not to exceed 250-hours* (or four years whichever comes first) perform the following checks:

- Complete Pressure Decay Test as outlined in MM10001 Section 8.6.
- Complete the 250hr/2yr service inspection

IMPORTANT: IF LEAK IS DETECTED DURING PDT, THE COMBUSTION TUBE ASSEMBLY HAS FAILED. PRIOR TO FURTHER FLIGHT, OVERHAUL ANY HEATER THAT DOES NOT PASS THE COMBUSTION TUBE PRESSURE DECAY TEST REQUIRED BY THIS INSPECTION. IT IS RECOMMENDED THAT THE OVERHAUL BE PERFORMED BY THE HARTZELL ENGINE TECHNOLOGIES LLC SERVICE CENTER.

8.5 2000-HOUR OR 10 YEAR OVERHAUL (to be accomplished in accord with MM10001 sections 8-11.)

NOTE: This procedure must be recorded in accordance with FAR43.9 and maintained as required by FAR 91.417.

NOTE: IT IS RECOMMENDED THAT THE OVERHAUL BE PERFORMED BY THE HARTZELL ENGINE TECHNOLOGIES LLC SERVICE CENTER.

NOTE: *If an hour meter is not used, count one (1) heater hour for every two (2) flight hours of normal aircraft operation. Consideration should be given for any excessive ground operation or geographical operation of the heating system.

- Overhaul of the combustion heater and all accessories are recommended at 2000-hours or 10 years. If wear is evident, it is recommended to replace the combustion chamber. If a new combustion tube is installed at overhaul, the heater may operate to the 1000-hour inspection interval at which time the pressure decay test is required. Thereafter the pressure decay test is not to exceed each 250-hours or four years (whichever occurs first). **If the combustion tube is found to be serviceable and is reused at the overhaul time, the 250-hour/4 year repetitive pressure decay test is still required.**



8.6 HEATER PRESSURE DECAY (PDT) AND COMBUSTION AIR SWITCH TEST

Purpose: Condition evaluation of the combustion chamber and combustion air switch. Inspection shall be made at the 1,000hr/4yr inspection and thereafter each 250 hours or four years, whichever comes first. This test can be accomplished while the heater is installed with a minimum of accessory disconnection. For convenience, the heater assembly could be removed from the aircraft to conduct the pressure decay test. It should be kept in mind that some leakage is expected due to gasket or screw seal. However “NO COMBUSTION TUBE LEAKAGE IS PERMISSIBLE!” If during inspection the integrity of the welded combustion tube itself is in question, the heater should be removed and further inspected.

NOTE: Be sure test kit calibration is up to date.

8.6.1 Equipment Required to conduct the pressure decay inspection test:

- “Pressure Decay Test Kit” P/N 70100,
- “Pressure Tester” P/N 70200
- Other FAA approved equipment.

8.6.2 Combustion Tube Pressure Decay Test (Read entire instructions before beginning PDT.)

- ❑ To conduct the pressure decay test, the heater must be sealed at all openings into the combustion chamber assembly. The openings into the combustion chamber include the combustion air inlet tube, fuel drains (one or two), and the exhaust tube. To obtain access to the heater exhaust tube in some aircraft, you may have to loosen and remove aircraft heater mounted exhaust tube and exhaust tube shroud from the heater assembly before inserting exhaust seal bulb.
- ❑ Install pressure seals on combustion chamber using the parts supplied in the combustion pressure decay test kit. Remove the combustion air inlet adapter (Figure 26A), having two hoses attached from the combustion air switch.
- ❑ Loosen the overboard drain line from the heater and install a cap or plug.
- ❑ Visually inspect exhaust tube of heater for obstructions. (See Figure 28) Check exhaust inner surface for sharp projections that could damage the rubber bulb of the exhaust tube seal during inflation.
- ❑ Attach the correct size exhaust seal expansion bulb to the pressure supply system as shown in Figure 26. Use the largest size expansion bulb that will fit the exhaust inside diameter.
- ❑ NOTE: After the seal is properly inserted into the exhaust tube (see figure 28), and while holding it in place, slowly inflate the seal to 70 ± 5 psig pressure using the regulated supply air as shown in Figure 26. When properly installed and inflated, the seal will hold itself in place.
- ❑ Install and tighten in place (Figure 26) the combustion air pressure supply assembly using the hose clamp. Attach air supply line as shown. Attach a supply line to the combustion air pressure supply assembly fitting (see figure 26) Slowly apply 3 psi of air pressure from the regulator as shown in test set-up diagram. If leakage is suspected at PDT seals, check with a mixture of soapy water sprayed on seals and look for bubbles. Pressure in the exhaust seal expansion bulb may be increased to 95 psi to achieve a leak proof seal.



- ❑ Apply $6.0 \pm .5$ psi to the combustion chamber through the combustion air pressure supply assembly as shown on the test set-up diagram, Figure 26. After the pressure reaches $6.0 \pm .5$ psi and stabilizes, close off the shutoff valve removing air to the supply line. This can be accomplished by turning the air pressure regulator all the way off relieving all pressure to the shutoff valve. (This shut off valve should be checked for leaks prior to the start of testing as should all connections.) Start the timer. After 45 seconds, the pressure in the combustion chamber must exceed 1.0 psi. If the pressure decays to less than 1.0 psig before the 45 seconds, a leak is present either in the combustion chamber or the seals. Re-check all the seals installed on the combustion chamber for leaks and rerun the pressure decay test.
- ❑ If the heater continues to show rapid pressure decay of the combustion chamber, the heater must be removed from the aircraft, and a more complete inspection be made to determine the location of the leak.
- ❑ After the heater is removed from the aircraft, conduct the pressure decay test again to check for leaks at the spark plug seat, the fuel feed inlet gasket, screw heads and weld seams. High temperature PERMATEX®137W or equivalent may be applied to screw threads to stop leaking, if required. If leakage is from the stainless chamber and not gaskets, seals, spark plug or screws, the combustion tube must be replaced. **NO REPAIRS ARE ALLOWED TO THE COMBUSTION CHAMBER!**

8.6.3 Combustion Air Pressure Switch Testing (See Figure 27)

NOTE: Testing of the combustion air pressure switch is recommended each time the PDT is accomplished: Use an air pressure source that can be controlled in a range of zero to maximum 5" of water or damage to the switch will occur.

- ❑ With the combustion air inlet adapter removed from the heater, attach the inlet adapter pressure port (3/16" air tube on the larger end of adapter) to the regulated air of the test kit (Fig. 26 A&B, 27 A&B). Airflow into this switch should build slowly from zero to 0.5 ± 0.1 " of water indicated on a water manometer. Leave the vacuum port tube (extending out of the small end of combustion air inlet adapter) open to atmosphere during the test.
- ❑ Using an ohmmeter across the switch terminals or across terminals #1 and #2 of the heater terminal strip (#6 & #7 for terminal strips numbered 4, 5, 6, 7, 8, 10) to determine the exact instant of switch closing. This reading should be $0.5 \pm .01$ " of water. If an adjustment is required, using a .100 inch square drive tool, rotate (1/8 turn at a time) the set screw in the center of the switch, clockwise to increase and counter-clockwise to decrease setting. Several trials should be made to assure accuracy and consistency.
- ❑ Increase and decrease air pressure slowly in order to produce accurate indications. Replace switch if not adjustable. Apply tamper/vibration seal after satisfactory adjustment.
- ❑ Following the successful completion of the pressure decay test (PDT), and the combustion air pressure switch test. Remove all test fittings, plugs, supply lines, etc., and re-install combustion air supply lines and drain lines which make up the aircraft heater installation.



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Dated 1/1/08
Rev L dated 5/21/15

8.7 HEATER DISABLING

In the event the heater is determined to be unsafe for use it must be disabled until repairs can be made. To properly disable the heater complete the following:

- Disengage the heater circuit breaker. Disable the heater by disconnecting the electrical wires at the heater and ensure that the electrical connections are properly insulated/secured to eliminate the possibility of electrical spark or structural damage.
- Disconnect and cap/plug off fuel to the heater as close to fuel source as possible
- Inspect and test to ensure that the cabin heater is disabled and that there are no fuel leaks or other aircraft systems affected by this action.
- Placard with date near heater control "HEATER DISABLED XX/XX/XX"



9 HEATER OVERHAUL

NOTE: Assemble per breakdown included with installation instructions for particular unit as this manual is only typical. Components and configuration may vary.

NOTE: It is strongly recommended that overhaul of any combustion heater be performed by an approved repair station. To ensure continued safe and reliable operation of the HET dash 1 series heater, return the complete system including supporting components (fuel pump, regulator, thermostats, etc.) to the PAH for the 2000hr/10 year overhaul.

Purpose: The heater assembly should be overhauled after 2,000 hours of operation, after 10 years or whenever it fails to pass the pressure decay test. Whenever the heater requires overhaul, all accessories should be removed and overhauled. Re-use of a sound combustion tube at the 2,000-hour overhaul will require the repetitive 250-hour or 4-year inspection, including the pressure decay test. If a new combustion tube is installed and a “0” time overhaul is completed per the most current revision of the MM10001 Manual, the heater may once again to operate for a 1,000 hours before the 250-hour inspection intervals are re-instated.

9.1 CLEANING

- ❑ Clean individual parts (metal) with a cleaning solvent such as Stoddard Solvent® (Fed.Spec. P-D-680) or any other suitable solvent. (Do not clean electrical switches with this solvent.) Use a soft bristle brush if necessary to remove dirt. Dry thoroughly with compressed air.
- ❑ Clean electrical components with electrical contact cleaner and wipe with a cloth.
- ❑ Wipe dust off of switches.

9.2 CLEANING COMBUSTION TUBE AND JACKET ASSEMBLY

- ❑ The inside of the combustion can and shroud assembly can be cleaned by submerging in a solvent.

CAUTION: If a wire brush is to be used for cleaning (not recommended), make certain it is a stainless steel brush. Ordinary steel may cause corrosion.

- ❑ Wipe the jacket with a cloth dampened in dry-cleaning solvent and follow up with a clean, dry cloth.

9.3 HEATER ASSEMBLY INSPECTION AND TESTING

9.3.1 INSPECT THE COMBUSTION TUBE FOR THE FOLLOWING CONDITIONS:

NOTE: Cracks or holes in the combustion tube will be detected in the pressure decay test as described under ‘Pressure Decay Test’. A damaged heater caused by an overheating condition is the result of a faulty component such as cycling switch, improper fuel pressure, bad spray pattern, etc.

NOTE: Generally soft and spongy metal can be detected by tapping lightly with the end of a screwdriver on the downstream end of the combustion tube. A dull sound will indicate a soft spot as opposed to the solid ring of good metal. If a soft spot is found, the combustion tube assembly must be replaced.

NOTE: Deformation as a result of backfiring or high altitude over heating will distort the wall of the radiator near the end dome. This will be accompanied by evidence of extreme oxidation and is cause for replacement of the combustion tube assembly. If detected, replace the combustion tube.



- Visible wear of the Durakoat coating that is visible on the lower half of the flame tube. (If wear is evident, it is recommended that the tube be replaced)
- Soft and spongy areas due to overheating.
- Deformation due to overheating or backfiring, fatigue cracks and pin holes.
- Perform a pressure decay test as described under 'Pressure Decay Test and Combustion Air Switch Test'.

9.3.2 INSPECTION OF FUEL SUPPLY

NOTE: Any evidence of distortion or damage is reason for replacement of the nozzle assembly.

CAUTION: FUEL NOZZLE CLEANING: Do not scrape or buff deposits off the nozzle face. Do not press or tap on the nozzle face. Cleaning the nozzle is not recommended.

CAUTION: Do not use Teflon products as sealer for fuel fittings.

9.3.2.1 Replace fuel nozzle at 2000hr/10yr overhaul.

9.3.2.2 Inspect threads, etc., on the fuel feed and fuel nozzle holder assembly. Check for cracks or a distorted holder. Replace if any are evident.

9.3.2.3 Check fuel spray pattern using appropriate line pressure as outlined in section 9.3.3.

9.3.2.4 Check the solenoid by reading the resistance across the two leads with an ohm meter. A reading of 40-45 ohms for 24-volt, 10-14 ohms for 12-volt at room temperature is normal. Replace if out of limits.

9.3.2.5 NOZZLE HOLDER ASSEMBLY INTEGRITY TEST

- ❑ After removing the nozzle, apply 100 PSI of filtered compressed air to drain port which is located on the surface of the fuel feed and nozzle holder assembly near the threaded nozzle cavity. (See Figure 18)
- ❑ Submerge in water, with the fuel inlet and nozzle cavity left open.
- ❑ Check for bubbles, which would indicate leakage. If bubbles appear at either the nozzle cavity or the fuel inlet, there is a leak in the fuel tube. If bubbles appear externally at either end of the shroud tube, the shroud tube is leaking. Replace the whole assembly.
- ❑ If no leaks are detected, dry the assembly carefully with compressed air.

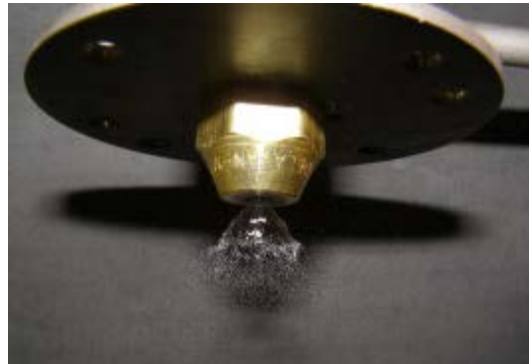
9.3.3 NOZZLE SPRAY TEST

NOTE: At 2000hr/10yr overhaul, nozzle must be replaced.

WARNING: Keep atomized fuel away from a spark, etc., or a fire will result.

- ❑ Screw the spray nozzle into the nozzle holder and tighten to 75-100 inch-pounds. This torque is very important as incorrect tightening could cause an improper spray pattern or could cause nozzle core to become loose. No thread sealant is necessary between nozzle and nozzle holder.
- ❑ Connect the fuel feed and nozzle holder assembly tube to a source of fuel; $7\pm.5$ PSI minimum for AV gas, 100 PSI for jet fuel. No thread sealant is necessary between nozzle and nozzle holder.
- ❑ Observe the spray patterns of the nozzle. It should be conical in shape with an even, fine mist pattern in all directions. NO 'ONION' SHAPE.
- ❑ With the fuel pressure being shut off several times, there should only be one or two droplets at the nozzle tip.
- ❑ If the spray pattern is distorted, replace the nozzle.

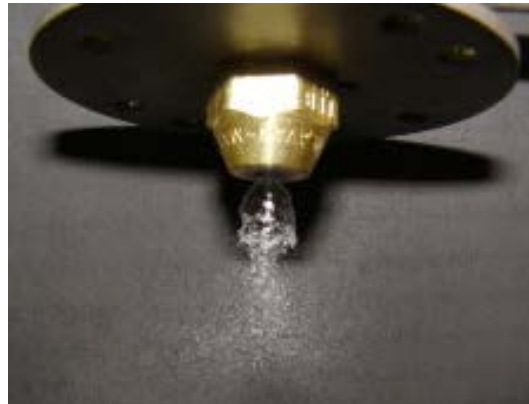
Proper spray pattern is as shown in figure 15 with approximately $\frac{1}{4}$ " of even sheet, or funneling of the fuel. At this point atomization will occur producing a fine mist.



Nozzle & Holder

FIGURE 15

Improper spray pattern is as shown in figure 16. Typically the sheet or funneling action would be distorted or "onioning", i.e. closing in on itself or atomizing prematurely.



Nozzle & Holder

FIGURE 16

9.3.4 INSPECTION OF MOTOR ASSEMBLIES

9.3.4.1 Inspect the fan for tip or blade damage. Fan nicks may be straightened as long as blades are not bent out of shape or balance is affected.

9.3.4.2 Typically, unless the motor condition is in question, tear down and overhaul of the HET long-life motor even at overhaul (2000 hr.) is not necessary, unless one or more of the following is noticed the motor may continue in service.

- End caps shift or are loose from housing.
- Excessive amounts of carbon are noticed.
- When commutator is slowly rotated, bearing squeak is present
- Commutator is loose or has lateral movement
- Cracked or damaged wiring.

9.3.4.3 Motor disassembly and inspection may be accomplished by scribing a line on motor housing and end caps prior to bolt removal. This will ensure proper permanent magnet positioning when reassembled. The motor performance will be affected if correct alignment is not achieved when re-assembled. Inspect the commutator on the armature. It should be smooth and medium brown to dark brown in color. Use compressed air to remove all dust. If the commutator is grooved in the brush track, gouged, scored, or shows signs of having burn spots, replace the complete motor assembly. If the commutator is in good condition, new brushes and bearings may be installed. Motor overhaul kits are available. Always provide heater P/N and S/N when ordering motor overhaul kit. Inspect motor brushes for wear. Replace if worn more than 50% (5/16"). If brushes are in good condition, reinstall in the same position they were before removal to ensure the curved ends fit the curvature of the armature.

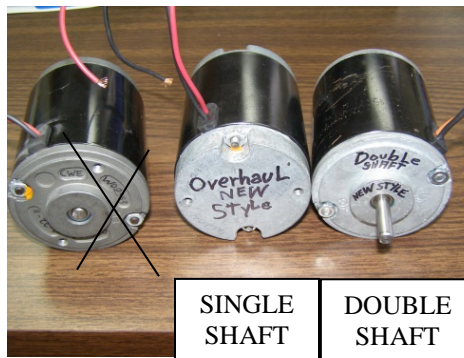


FIGURE 3

NOTE:

- Motor style on far left cannot be overhauled
- Two styles on right can be overhauled with bearing and brush service kit P/N 29910
- An overhauled motor will not have as long of a service life as a new motor.

CAUTION – Do not touch armature with bare hands – oils will cause premature wear.

9.3.5 **INSPECTION OF IGNITION ASSEMBLY**

9.3.5.1 The ceramic tip and spring and rubber insulator should be intact.

9.3.5.2 Lead material should be soft and free of carbon tracks or splits.



Ignition Lead

FIGURE 4

9.3.5.3 Examples of common problems.

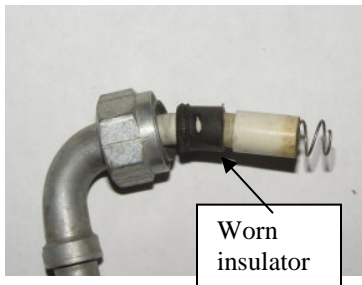


FIGURE 5

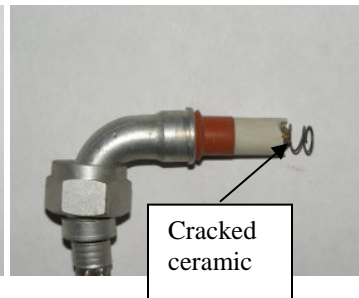


FIGURE 6

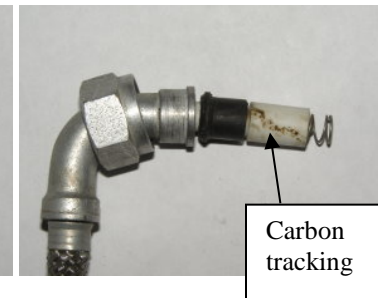


FIGURE 7

9.3.5.4 Inspect inside of ignition unit well area where lead attaches. Any evidence of arcing or deterioration of insulator is cause for replacement.



Ignition Unit and
Lead Assembly

FIGURE 8

9.3.6 TESTING THE IGNITION UNIT

CAUTION – Less than rated voltage may cause early failure

9.3.6.1 Testing equipment needed:

- Power source
- Voltmeter, 0-30 VDC
- Ampere gauge, 0-3 A
- Grounded electrode fixture

NOTE: Use di-electric lubricant at both ends of lead.



Ignition Unit and
Lead Assembly

FIGURE 9

9.3.6.2 Apply power. Ampere gauge should read $1.00 \pm .25$ Amperes. 24VT, 12VT.

NOTE: Spark should be a steady blue color. If it varies, replace the ignition.

9.3.6.3 Test ignition by holding lead ¼” away from ground as shown looking for strong blue spark able to jump at least 3/8” to ½” gap.



Ignition Lead and
Spark Plug

FIGURE 10

9.3.7 **INSPECTION AND SERVICE OF SPARK PLUG (See figures 12-14)**

9.3.7.1 With spark plug in lead, verify strong blue rotating spark. Gap of .080 to .100.
Do not attempt to bend or adjust the ground disc portion of the plug.



Spark Plug

FIGURE 11

9.3.7.2 Clean spark plug using scotch bright pad and wiping with cleaning solution.

Spark Plug

FIGURE 12

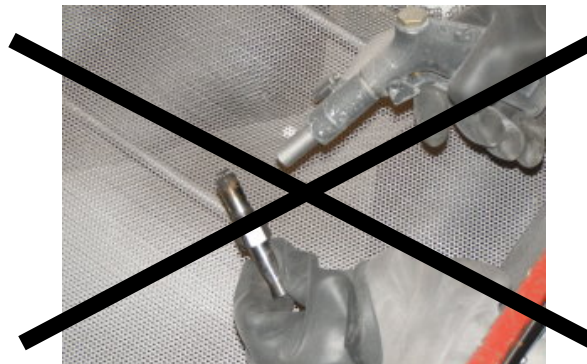


Spark Plug

FIGURE 13



"DO NOT SAND OR BEAD-BLAST."



Spark Plug

FIGURE 14

9.3.7.3 After cleaning, air-blast the component.

9.3.7.4 Carefully inspect the porcelain for cracks, erosion or carbon trail. Reject any spark plug if its appearance is questionable.

9.3.7.5 Check the electrode disc for erosion. If found, replace.



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9.3.8 INSPECTION OF REMAINING COMPONENTS

9.3.8.1 Always replace all grommets, gaskets, O-rings and rubber parts at overhaul.

9.3.8.2 Inspect all wiring for chafed, cracked or damaged insulation. Replace if necessary with MIL-W-22759/18 AWG wire, cut to length and crimping on terminal ends.

NOTE: If cracks or distortions are evident on the terminal strip, it must be replaced.

NOTE: Do not use solder for heater wiring connections.

9.3.8.3 Reinstall heater controls if they were operating correctly before overhaul.

9.3.8.4 Replace all damaged hardware.

9.4 REASSEMBLY

Except for parts that have already been reassembled and tested as subassemblies, generally follow the reverse order of the index number in the 'illustrated parts breakdown' when reassembling the heater. Use all new gaskets, filters, seals and O-rings.

CAUTION: Fasteners securing components to heater must be as specified in the illustrated parts breakdown.

NOTE: Use caution in protecting nozzle face. Any deviation of the original contour will alter the spray pattern. The nozzle must be replaced if this occurs.

NOTE: Do not use Teflon products as a fitting sealer anywhere in the fuel system.

9.4.1 Mixer

- Before installing combustion head mixer assembly in combustion tube, coat gasket with Permatex® 1372W High Temperature Form-A-Gasket or equivalent. Also apply a small amount to the threads of the mounting screws.

9.4.2 Assemble jacket to combustion tube.

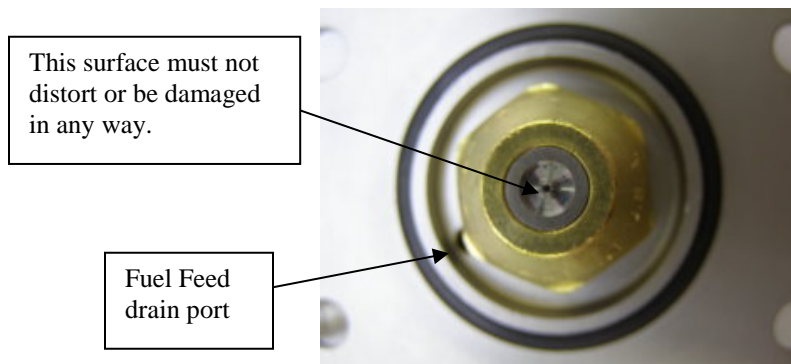
9.4.3 Nozzle Holder

- Insert O-ring 20692 into groove on nozzle side of holder.



Nozzle & Holder

FIGURE 17



Nozzle & Holder

FIGURE 18

- ❑ Slip nozzle holder and assembly fitting through hole in shroud. Be very careful verifying O-ring stayed in place. Apply sealer to screws and tighten nozzle to combustion head.



Nozzle & Holder

FIGURE 19

9.4.4 Spark/Igniter Plug and Ignition

- ❑ Screw the spark plug into the heater first applying small amount of metallic anti-seize to threads.
- ❑ Tighten to a torque of 28 foot-pounds.



Spark Plug

FIGURE 20

- ❑ Torque the lead assembly to the igniter plug at 15-20 ft. lbs. and the lead to the ignition unit at 12-15 ft. lbs., being careful not to allow the lead wire to twist or spin while tightening.

9.4.5 Complete the assembly per illustrated parts breakdown.

9.4.6 Verify and install wiring as specified by P.A.H. (typically same location and connected to the same terminals as before disassembly.)



10 TESTING AFTER INSTALLATION OR OVERHAUL

10.1 GENERAL

A test of all components should be made after overhaul to ensure proper operations. If facilities for measuring airflow, pressure drops, etc., are not available, the heater may be installed in the aircraft. Provide a power source to maintain rated voltage during tests. Test should be run on the ground and in the air to determine if operation is normal.

10.2 BENCH TESTING (SEE FIGURE 30.)

Required Equipment

- A test stand suitable for holding the heater is utilized. Choose a location where the exhaust can exit freely from the heater.
- 7-10 psig fuel pressure source. $100 \pm .5$ for jet burners.
- Volt and Amp Meter
- A 12/24 VDC supply.
- Two water manometers (0-10.00 inches H²O) for measuring combustion and ventilation air stream pressure.
- A piece of ducting, 24 inch minimum length, to be attached to the downstream end of the heater. Install a 2-1/2 inch diameter opening at the outlet end. Provide openings for a thermometer, thermostat duct switch and static tap 6 to 18 inches from the end of the test duct.
- A 500°F thermometer. If testing in the aircraft, install temperature sensor into the outlet plenum just aft of the heater. A small hole may be made in the plenum or duct for insertion of sensor. After the test has been completed, close hole with high temp silicone.
- A 0-15 psig fuel pressure gauge for AV gas, or 0-200 psig for Jet fuel.
- A source of controls outlined in Figure 30. This simulates outside wiring of the heater installation sufficiently to perform an operational test of the heater.

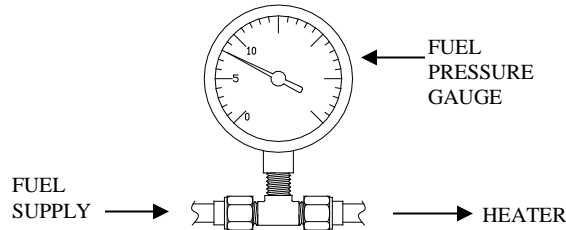
10.3 OPERATIONAL TEST

NOTE: Exhaust smoke during initial ground operation or testing is normal. The small amount of smoke is expected due to limited combustion airflow on the ground. In flight, combustion air is assisted by ram air and should burn clean.

NOTE: To reduce the risk of nozzle contamination, purge heater fuel delivery components and lines prior to connecting to and operating heater.

- Install heater in test set up or aircraft, making sure all connections are tight and secure.
- Turn on master switch. Individually check the operation of the ventilating air blower, combustion air blower and fuel pump.
- Verify that the combustion air pressure switch is activated by checking for rated voltage at terminal #2 for strips numbers 1-6 and terminal #7 for strips numbered 4-10. If not, the combustion air blower is not providing sufficient air to actuate the combustion air switch or the switch is improperly adjusted.
- Check the ventilating air pressure water manometer. It should have a minimum reading of 1.0 inches H²O minimum at rated voltage. (Optional)
- The combustion air water manometer should indicate approximately 1-7 inches H²O at rated voltage. (Optional)

- Adjust fuel pump pressure to 8psi. (6.5psi min, 10psi max) (100 psig +5 for jet fuel). Close heater switch. The heater should ignite within five seconds.



- The duct switch or thermostat should control the outlet temperature from around 50° to 225°F.

NOTE: This is dependent on air flow and ambient temperature.

10.4 DETERMINING AND SETTING HEAT OUTPUT

- 10.4.1 Install a temperature probe (min 0-500° F) in the outlet plenum 6-8" aft of the heater. A good location would be approx. 6" aft of the heater or near the thermostat sensor. Usually you can find a small access point somewhere in the ducting aft of the heater

CAUTION: Verify thermal couple is not touching plenum internal wall.

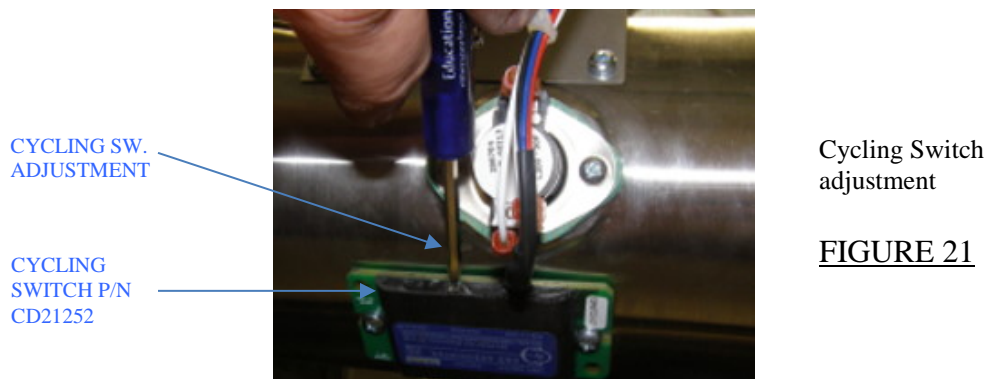
- 10.4.2 Setting upper limit temperature upper limit switch

10.4.2.1 If your heater is equipped with a CD21252.....

- Place a 6" 20G jumper wire with 2 small alligator clips (or the like) across the heater terminal strip numbers 2 and 3 for terminal strips numbered 1-6 or 7 and 8 for terminal strips numbered 4-10, which will bypass the aircraft thermostat.

NOTE: Be sure not to short any other terminals.

- With the heater running, verify that the outlet plenum temp. is set properly. Adjust the temperature of the heat duct outlet distribution plenum as follows:
 - For non-pressurized aircraft set switch to a low of 215° and a high of 255°.
 - For pressurized aircraft set switch to a low of 190° and a high of 225°.



Cycling Switch adjustment

FIGURE 21

NOTE: Adjustment is made by rotating a small 1/16" screw located next to the wires on the side of the switch. It may have a dab of inspectors lacquer over the screw. Rotation clockwise one turn will increase temperature approx. 20° F. Decrease temperature by turning counterclockwise.



- ❑ After sensor is adjusted, place small drop of tamper proof seal on adjustment screw (this locks in settings so as to not change due to vibration. Use a product that can be easily removed for readjustment if necessary).
- ❑ Remove the jumper wire and verify that the temperature is controlled by the aircraft thermostat from low (approx. 75° F) to medium to high (approx. 250° F) as determined by the upper limit switch.
- ❑ Remove the temperature probe and seal all holes with high temperature silicone.

10.4.2.2 If your heater is **not** equipped with CD21252...

Upper limit adjustments should be made in accordance with aircraft manufacturer's instructions.

10.4.3 Thermostat Control

The thermostat should control the heat output from approximately 65° F in the low position, up to the maximum setting of 225° F, ambient, or when the cycling switch limits heat output. Monitoring thermostat operation can be accomplished by:

- ❑ Placing voltmeter red probe on terminal #3 with heater terminal strips numbered 1-6 or terminal #7 for terminal strips numbered 4-10 and black probe to ground.
- ❑ Each time switch calls for heat; Verify rated voltage indicated.

10.4.4 Overheat Switch Testing

In the event of heater malfunction such as overheating, smoke or fumes, disable heater by turning heater off and disengage the heater circuit breaker. Notify qualified service technician for servicing. If equipped with an auto reset overheat switch, should the heater overheat 2 times consecutively (indicated by overheat warning light and or large swings in temperature) disable the heater as described above and have heater serviced/inspected prior to further use.

NOTE: In aircraft testing of the overheat switch is not recommended. Test switch in an oven or on a test stand. Activation temperature is stamped on the switch mounting flange.

- ❑ To check the overheat limit switch, remove the cycling switch from its mount on the heater so that it does not read the heater temperature and jumper the thermostat switch terminals #2 and #3 or #7 and #8.
- ❑ Restrict completely the ventilating air flow and observe that the overheat switch shuts down the heater. It should open between 300° and 450°F. This shut off temperature is also dependent upon ambient temperature and if any air flow.

NOTE: The overheat switch is not adjustable and must be replaced if defective.

- ❑ After the overheat switch shuts off the heater, remove the jumper wire from the heater terminal strip and the restriction blocking the ventilation air, and reinstall the cycling switch. The heater should ignite and function normally within 5 minutes after sufficient cooling has taken place.
- ❑ Allow sufficient time for cool down to prevent residual heat from actuating overhead switch.
- ❑ Shut down heater and recheck all components.



11 TROUBLESHOOTING

The following lists service troubles and suggested remedies. It will assist in locating and correcting the cause of faulty operation. Some of the information is based upon the use of optional and separately provided components.

11.1 TROUBLESHOOTING - HEAT QUICK CHECK

Introduction: Every heating system requires 3 key components to achieve proper operation. They must have combustion air, ignition, and fuel. If your heater is not working, one or more of these elements is deficient. By finding out which of these three elements is lacking, the problem can be determined in just a few minutes. In order to complete a thorough analysis of heaters operation, three pieces of test equipment will be needed. A volt meter or light for checking rated voltage, a quality fuel pressure gauge and a 0-500° temperature gauge.

Preparation: Remove access panels to heater area. With assistance in the cockpit, perform the following initial three-step inspection.

- **Combustion air:** Generally 1/2" to 8" inches of water is sufficient. This does not need to be measured with a water manometer; simply wave your hand a couple inches under the exhaust. Airflow from the exhaust should be steady, and the pressure output should feel similar to a standard hair dryer. Keep in mind that in flight, ram air supplements the blower to provide additional combustion air. Unfortunately ram air also prematurely will wear out older heater motors as the blowers continue to pin-wheel even with the heater off.
- **Ignition:** All Janitrol B-series and S-series igniter plugs should be replaced and have their gap set every two years. This should fix most of your problems. If not, remove the lead from the spark plug and using rubber handled pliers (very important if you like your mechanic) and hold the lead end approx. 1/4" from a ground. Have someone turn the heater on and verify that the spark jumps at least 1/4", is consistent, blue in color and strong. Another simple way to check for ignition, move close to the exhaust; see if you notice the sound of a constant, strong spark. It should sound kind of like a wet hornet trying to get out. Use caution with this method though as the heater could suddenly light off. You can usually identify the mechanic who has done this procedure incorrectly by the resultant lack of facial hair.
- **Fuel:** Fuel pressure is the neglected step child of the combustion heater. Annually ensuring proper fuel pressure to your heater can add years to its life (and many times your marriage) because overall reliability will definitely improve. Most Janitrol B series and Hartzell Engine Technologies LLC heaters require 6.5-8 PSI (turbine aircraft 100+5-0 PSI). South Wind 8240-8472 series must have 22 PSI or above. It's relatively simple to "T" in a quality fuel pressure gauge just upstream from the heaters fuel solenoid, and take a reading while the heater is running.



MM10001
 Dated 1/1/08
 Rev L dated 5/21/15

PROBLEM	REMEDY
Low/Intermittent Heat Output	Spark plug – Do not sand blast!
	Ignition unit trouble (See 11.4.4 or 11.4.5).
	Air flow switch erratic (See 11.4.2)
	Fuel pressure (See 11.4.8) or nozzle contamination
Low Heat at High Altitude	Ignition or spark plug needs replacing (See 11.4.3).
	Irregular fuel pressure
Low Heat In Flight	See Heater Accessories Section 11.4.4, 11.4.5, 11.4.8 and Heat output section of this table.
Heater Operates On Ground, Not In Flight (Goes Out When Speed Increases)	Spark plug – Wipe down with Methyl Ethyl Ketone (M.E.K.) or cleaning solvent. Look for carbon trekking along amber colored insulation inside lead end of plug. Do not sandblast
	Ignition (See 11.4.3.).
	Fuel pressure, nozzle contamination (See 11.4.8)
Heater Operates In Flight But Not On Ground	Combustion air blower weak or out (See 11.4.9).
Heater Continues To Heat – Fails To Shut Off.	Fuel solenoid on heater stuck open (See 11.4.6).

11.2 TROUBLESHOOTING - COMBUSTION HEATER SYSTEM

NOTE: Full system voltage (12 and/or 24-volt DC) must be present at the heater for trouble-shooting sequence. **CAUTION** – Low Voltage will cause premature failure of ignition unit, electronic switches, etc., or may cause low or no fuel pressure. Verify voltage at heater with voltmeter prior to going any further in the outlined trouble shooting sequence.

Tools needed - Volt/OHM meter, 0-500° temperature monitor, #2 Phillips & 3/32 square tip screw driver, 3/ 4" open-end wrench, a 7/8" deep well spark plug socket with ratchet (0-15 PSI f or AV Gas, 0-200 PSI for Jet fuel), fuel pressure gauge with jumper wire (min 3") and auxiliary power to aircraft to supply rated system voltage.

Basic information - Three basic factors are needed for proper heater operation: Combustion air, fuel and ignition. When one or more of these are missing, the heater will not function. Follow missing item to its malfunction and correct it.

Terminal strips on heaters are numbered with four different configurations.

- Terminal strips numbered 1, 2, 3, 4, 5, 6 or 6, 5, 4, 3, 2, 1 have power present on terminals numbered 1, 2, 3 and 6 when heat is called for. Terminal number 4 is generally for an overheat light connection and terminal number 5 is always ground. In a very few heaters, a ventilation blower is not incorporated in the heater and terminal number 6 has no wires. In some installations the ventilation blower may receive power from terminal 6 through a landing gear squat switch. Heat control is maintained by interrupting power to terminal number 3 generally by a thermostat wired between terminals 2 and 3.
- Terminal strips numbered 4, 5, 6, 7, 8, 10 or 10, 8, 7, 6, 5, 4 have power present at 4, 6, 7, 8 and 10 when heat is called for. Heat control is maintained by interrupting power to terminal number 8 and 10. Heat control is generally controlled by a thermostat wired from terminal 7 to 8.



FIGURE 22



11.3 TROUBLESHOOTING - INSPECTION RESULTS with heater on. Heat full on.
Numbers in () are for terminal strips numbered “4, 5, 6, 7, 8, 10.

STEP	INSPECT FOR	VOLTAGE CHECK	PROBABLE CAUSE
1	Combustion Air: NO air flow from exhaust	Terminal 1 (#7) NO voltage	Circuit breaker tripped. Combustion air blower shorted out. Replace combustion air blower.
	Fuel smell: NO fuel smell from exhaust	Terminal 3 (#8) NO voltage	
2	Combustion air: YES air flow	Terminal 2 (#7) NO voltage	See 11.4.1: Overheat switch activated. If voltage at pin 2, overheat condition exists. These switches are auto-reset. Overheat switches require a cool down of 3-5 minutes once activated. If voltage to pin 1 of the switch but none to pin 3, even after cool down period, replace switch.
	Fuel smell: NO fuel smell	Terminal 3 (#8) NO voltage	
3	Combustion air: YES air flow out exhaust	Terminal 2 (#6) YES voltage	See 11.4.4: Adjustable duct switch (thermostat).
	Fuel smell: NO fuel smell	Terminal 3 (#8) NO voltage	
4	Combustion air: YES air flow	Terminal 2 (#6) YES voltage	See 11.4.5: Cycling switch. See 11.4.6: Fuel solenoid.
	Fuel smell: NO fuel smell	Terminal 3 (#8) YES voltage	
5	Combustion air: YES air flow	Terminal 2 (#7) YES voltage	See 11.4.3: Ignition.
	Fuel smell: YES fuel smell	Terminal 3 (#8) YES voltage	



11.4 TROUBLESHOOTING - HEATER ACCESSORIES

11.4.1 Overheat switch

These switches are mechanical and typically have automatic reset after cool-down of approximately 3-5 min. Switch terminals are numbered 1, 2 & 3. Terminals 1 & 3 are normally closed.

- ❑ If no voltage is coming out of auto-reset switch, but has power to it, replace switch.

11.4.2 Combustion air pressure switch

With combustion air blower running, check both sides of combustion air pressure switch to see if voltage is present.

- ❑ If voltage is to switch, but not out, yet airflow is constant out of exhaust, check switch setting or replace.

11.4.3 Ignition

- If rated voltage present at ignition power at terminal 2(10), remove power from heater.
 - ❑ Remove lead from spark plug and, using rubber-handled pliers, hold lead approximately 1/4" from shroud of heater.
 - ❑ Turn heater on and observe spark. It should be strong, blue and constant.
- Weak or no spark (1) check ignition lead under ceramic tip at plug end and coil end. Replace if arcing is evident. If arcing is found on lead, also check spark plug insulator where ceramic end of lead is housed.
- Spark plug has a fixed gap setting and should only be cleaned using M.E.K. or cleaning solvent. NEVER sandblast.
- Verify lead is secured properly to both the ignition unit and igniter plug. Torque at igniter plug is 15-20 ft. lbs. and ignition unit, 12-15 ft. lbs.

11.4.4 Adjustable duct (thermostat) (See Figure 31A & B)

Red wire - power in, blue wire - power out, black wire - ground, yellow wires – to thermostat control. (0 to 10 OHMS resistance)

- ❑ Voltage to (red wire), but is less coming out (blue wire), or erratic in operation, replace switch.

11.4.5 Cycling/Limit switch (See Figure 31A & B & C & diagnostic chart)

NOTE: See heater and or CD21252 installation instructions

11.4.5.1 General description

The CD21252 operates as an upper limit cycle switch, adjusted to cycle the heater off at 250°F regardless of how high the duct switch is turned up in the cockpit. The upper limit of the heater is adjusted and set at the time of assembly and testing is done at the factory. However, final adjustment can be made upon final installation of the heater.

11.4.5.2 Description of operation

- 11.4.5.2.1 The switch is equipped with three wires, a red power supply wire, a black ground wire and a blue power out wire to activate the fuel solenoid.



- 11.4.5.2.2 The switch is also equipped with two LED lights located next to the adjustment screw, one red and one green.

- The green lamp indicates the CD21252 has power being supplied on the red wire. This can be a 12 VDC or 24VDC. **NOTE:** Make certain a good ground is obtained.
- The red lamp indicates the switch is calling for heat and thus supplying line voltage to the blue wire of the switch, which is attached to the fuel solenoid of the heater.



- 11.4.5.2.3 The red light also helps to diagnose a system fault. If the blue wire has shorted internally the red light will blink repeatedly. Once a ground fault has been recognized by the switch, its internal circuitry shuts off power to the blue wire until the ground fault is repaired.



DIAGNOSTIC CHART	
Red lamp on Green lamp on	System is on and calling for heat
Red lamp off Green lamp on	System is on but not calling for heat
Red lamp blinking Green lamp on	System is on but ground fault has occurred between switch and solenoid.
Red lamp on Green lamp on, But no heat output	-no fuel to solenoid -no ignition to spark plug -solenoid stuck in closed position (replace solenoid) -break in wire between switch and solenoid (repair break)
Red lamp off Green lamp on, But heater still running	-switch has failed and is supplying voltage to blue wire (replace switch) -solenoid is stuck in open position (replace solenoid)
Red lamp off Green lamp off But main power is on	-duct switch not supplying voltage to limit switch red wire -power to duct switch has been interrupted -combustion air switch not activated due to low or no airflow or failed combustion air switch or break in wiring in combustion air circuit

11.4.6 Fuel solenoid

To check the fuel solenoid for proper operation, complete the following:

- Separate the fuel solenoid valve, located under fuel line connection cover, from the blue wire coming out of the cycling switch.
- Verify proper operation by applying rated voltage to the solenoid wire in a quiet environment (no noise). Momentarily make contact 2 or 3 times. By listening to the solenoid you should hear a positive click as it activates and de-activates.
- If no action on the part of the solenoid is noted, consider the solenoid bad.
- The solenoid should activate near 1 amp for 12 VDC or .5-1 amp at 24 VDC.

11.4.7 Fresh Air Fan

In most applications power can be obtained by removing the ventilation motor power wire from terminal #6 for terminal strips numbered 1-6 or terminal #5 for heaters with terminal strips numbered 4-10. This wire will then become hot when the switch is turned to Fan Only position.

11.4.8 Fuel Shutoff Valve

Check fuel shut-off valve (remote solenoid), located near fuel source and before the fuel pump if equipped, for proper operation.

11.4.9 Fuel pump

Always 'T' in for fuel pressure checks. Read pressure with heater running. Av-gas 7psi ± .5 PSI, jet fuel 100 PSI + 5-0 PSI.

11.4.10 Motors

If no power to vent motor, yet power to its supply terminal, check for landing gear squat switch and/or connections. It is not recommended that HET permanent magnet motors be repaired. Replacement is recommended in the event of failure. Normal operation of a 12 VDC motor will draw 6-8 amps and 3-5 amps for 24 VDC. Life expectancy is 2000 hrs. minimum under normal operating conditions.



11.5 TABLE A TROUBLESHOOTING GUIDE

PROBLEM OCCURS = ■ GROUND OPERATION ■ AIR OPERATION ■ BOTH

TROUBLE		PROBABLE CAUSE	REMEDY
Heater fails to start	■	1. No power to heater system circuit breaker	Turn off all switches; reset circuit breakers, check fuses.
	■	2. Overheat Switch on heater activated.	Auto switch. After 3-5 min. delay should auto reset.
	■	3. Faulty spark plug.	Inspect and repair or replace as indicated for the separately provided components.
	■	4. Improperly secured lead.	Torque lead nut at igniter plug 15-20 ft. lbs. and nut at ignition unit 12-15 ft. lbs.
	■	5. Faulty ignition unit.	Replace ignition unit.
	■	6. Defective shielded lead.	Replace lead.
	■	7. Weak ignition	Replace ignition unit.
	■	8. External fuel system not energized or operating improperly.	Check operation of components and condition of all fuel lines and wiring connections.
	■	9. Low fuel supply pressure.	Replace fuel filter/fuel pump.
	■	10. Fuel filter clogged at heater. (Air should pass thru with little restriction)	Replace element P/N CD21346. (Recommend replacement every 500 hrs.)
	■	11. Dirty or clogged spray nozzle.	Replace spray nozzle.
	■	12. Insufficient combustion air/	Remove cause of clogging/replace motor.
	■	13. Combustion air pressure switch will not close.	Check blower operation.
	■	14. Faulty combustion air pressure switch.	Adjust or replace pressure switch.
Heater is cycled off and on by overheat switch, indicated by heater cycle spread of 3-5 minutes.	■	1. Cycling switch set too high.	Adjust duct temperature 220° to 250° F.
	■	2. Cycling switch is faulty.	Replace.
	■	3. Vent blower damaged or defective.	Repair or replace blower assembly.
	■	4. Obstruction in ventilating air system.	Remove obstruction.
	■	5. Overheat switch faulty.	Replace. Not adjustable.



PROBLEM OCCURS = ■ GROUND OPERATION ■ AIR OPERATION ■ BOTH

TROUBLE	PROBABLE CAUSE	REMEDY
Heater backfires, burns with pulsating combustion or shows smoky exhaust.	■ 1. Low Voltage.	Check power supply.
	■ 2. Spark plug arcing at lead.	Inspect and or replace as indicated for the separately provided components.
	■ 3. Faulty ignition system.	Replace.
	■ 4. Improperly secured lead.	Torque lead nut at igniter plug 15-20 ft. lbs. and nut at ignition unit 12-15 ft. lbs.
	■ 5. Ignition lead arcing.	Replace.
	■ 6. Spray nozzle loose.	Tighten nozzle to 75 to 100 inch pounds.
	■ 7. Oversize spray nozzle.	Check markings on nozzle. Replace with nozzle of proper size.
	■ 8. Damaged or contaminated nozzle.	Replace nozzle.
	■ 9. Faulty fuel pump.	Repair or replace as indicated.
	■ 10. Faulty fuel pressure regulator.	Reset or replace.
	■ 11. Insufficient combustion air.	Inspect and repair combustion air system as indicated.
Heater starts, and then goes out	■ 1. Low voltage.	Attach external power.
	■ 2. System does not requires heat.	Reset cabin control above ambient temperature to check heater operation.
	■ 3. Malfunction in control system.	Check components as needed, according to wire diagram for heater installation.
	■ 4. Weak ignition.	Check ignition system.
	■ 5. Lack of fuel at theater.	Check fuel system: Check thermostat or cycling switch for operation.
	■ 6. Improper air balance between exhaust and combustion air.	Verify installation instructions unique to unit.
Low Heat Output	■ 1. Thermostat setting or cycling switch.	Adjust or replace (See Heater Accessories Sections 11.4.4, 11.4.5 and Determining Temperatures Section 10.4.4 & 10.4.5.)
	■ 2. Low fuel pressure.	Check fuel pressure
	■ 3. Collapsed or blocked ducting.	Check ducting aft of heater
Heater fails to shut off.	■ 1. Heater fuel solenoid stuck open; dirt under valve seat.	Remove and replace solenoid assembly as required to restore correct operation.
	■ 2. Defective control components in external control circuits.	Adjust or replace defective controls.

12. FIGURES FOR REFERENCE

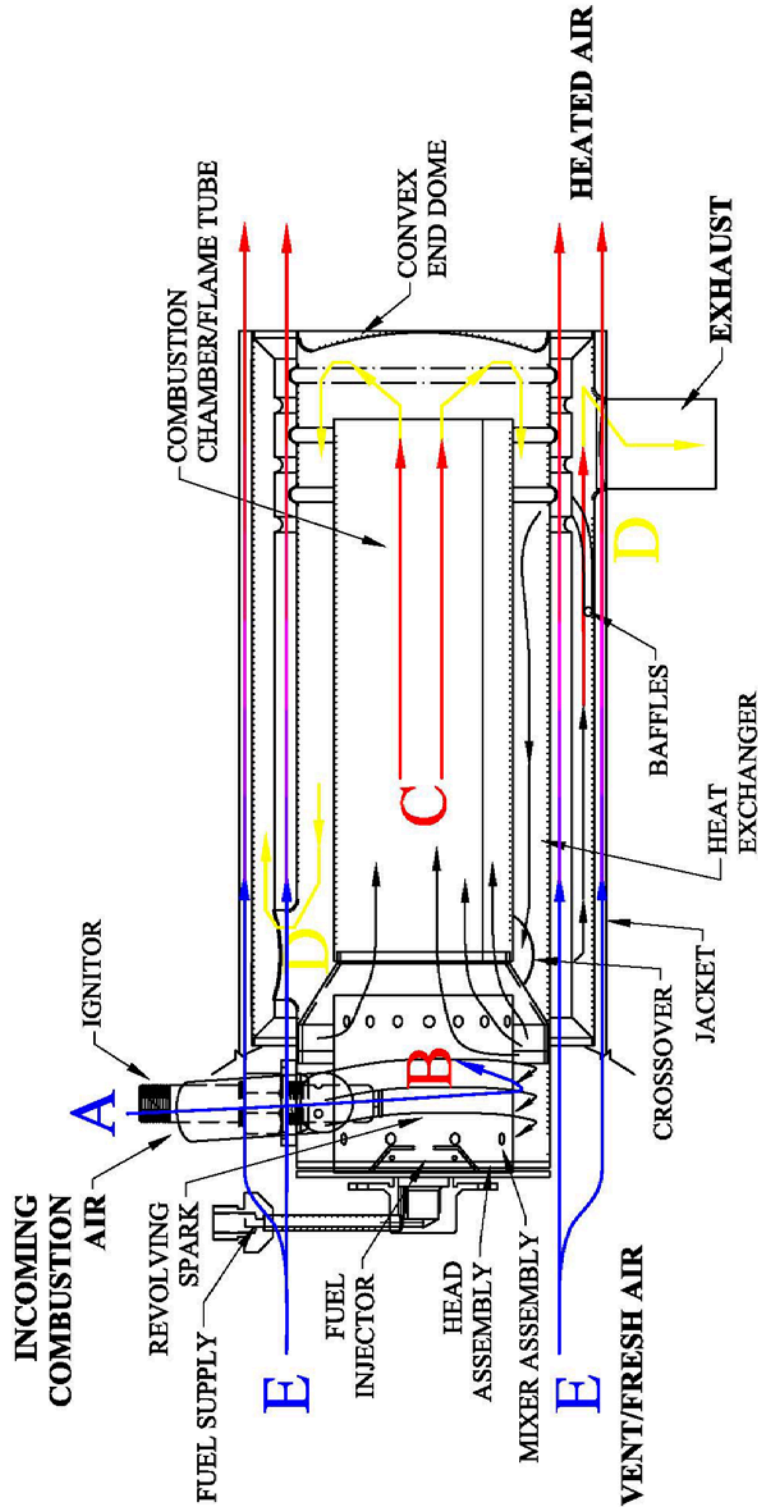


FIGURE 25: CUT-AWAY VIEW OF A TYPICAL "1" COMBUSTION HEATER

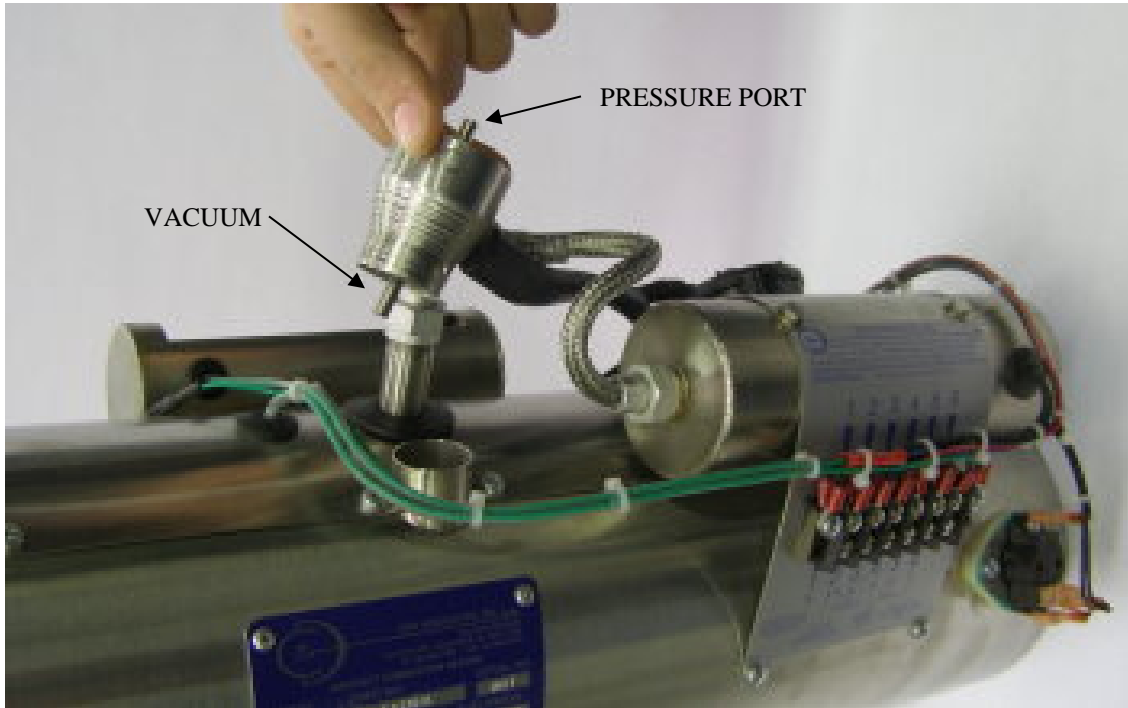


FIGURE 26A: REMOVING COMBUSTION AIR ADAPTER

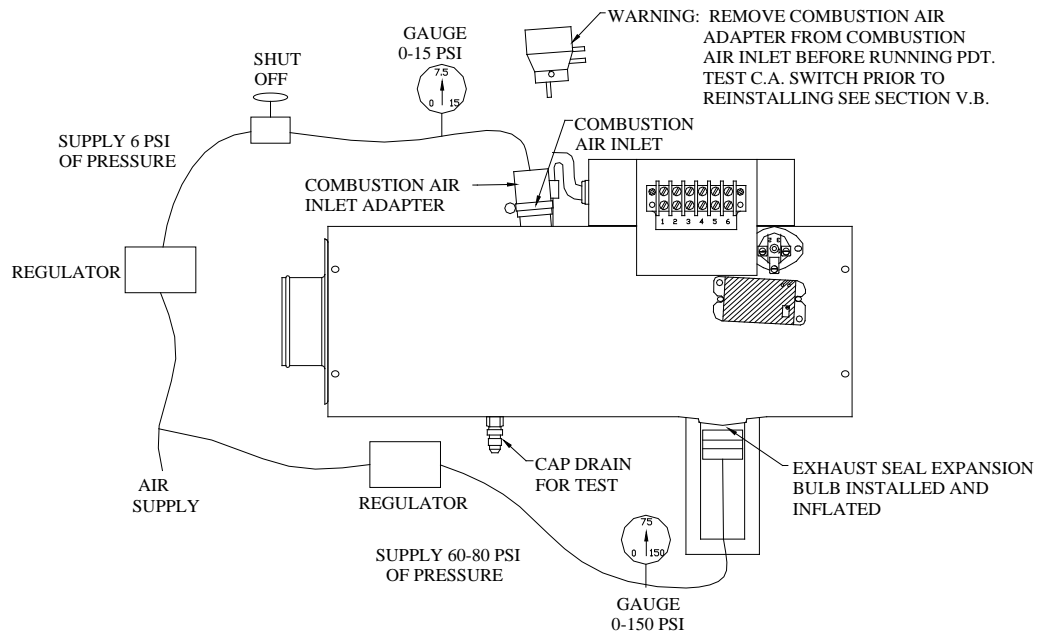


FIGURE 26B: TYPICAL TEST SET-UP PRESSURE DECAY TEST

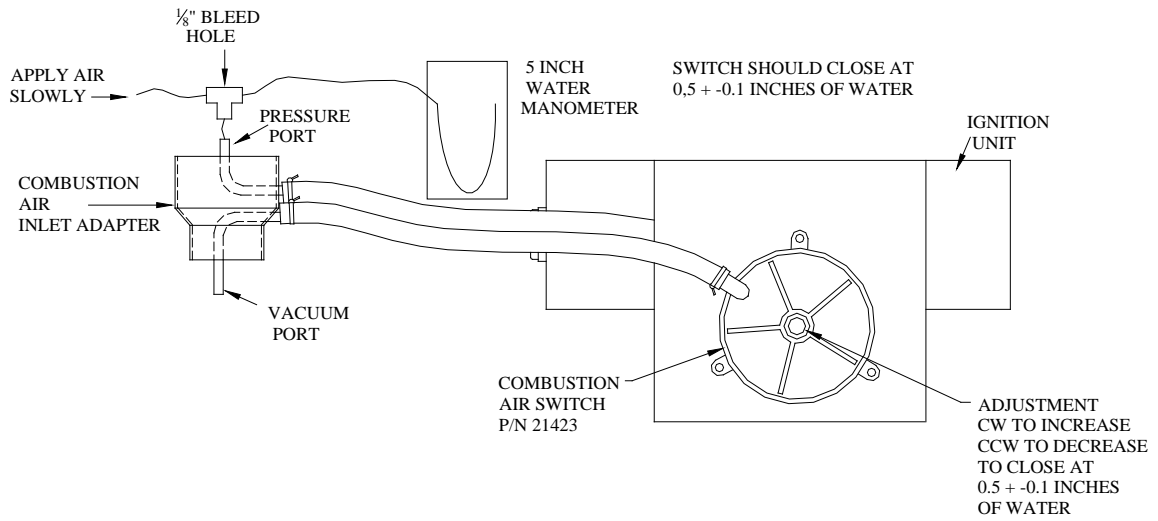


FIGURE 27A: COMBUSTION AIR SWITCH TESTING



FIGURE 27B: COMBUSTION AIR SWITCH INSTALLATION

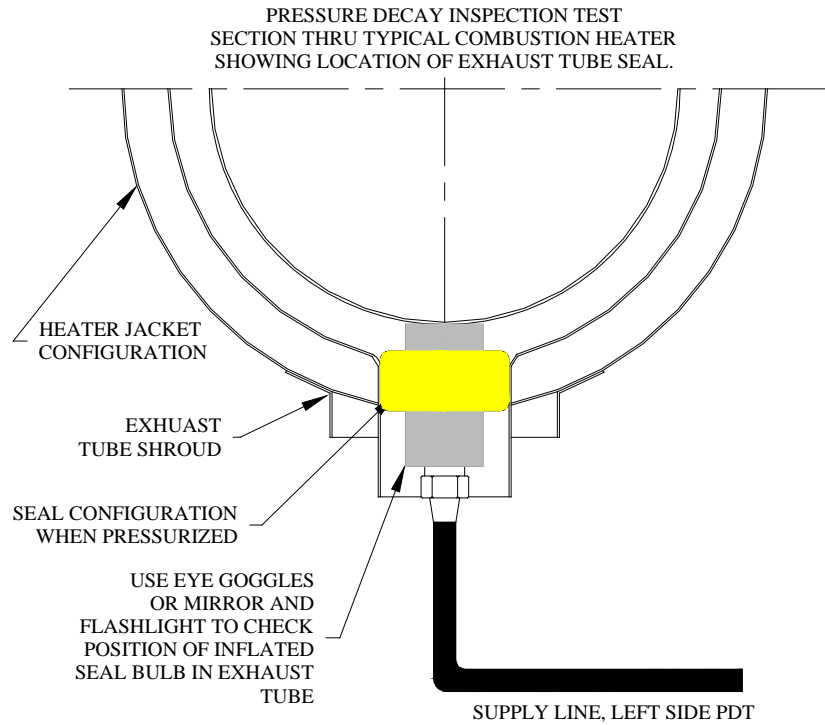
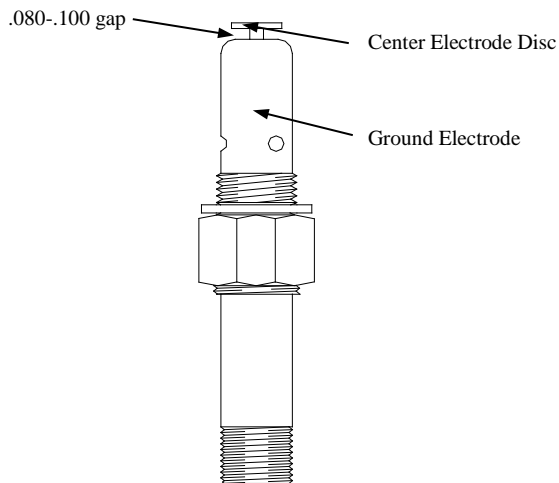


FIGURE 28A: TYPICAL EXHAUST TUBE SEAL SHOWN INSTALLED



FIGURE 28B: TYPICAL EXHAUST TUBE SEAL SHOWN INSTALLED

FIGURE 29A:
Type III Spark Plug (P/N CD22080)



NOTE: No re-gapping of this type spark plug is possible – Do not bend the center electrode or the disk on top of the center electrode.

Replace if out of tolerance.

Apply 28 ft. lbs. torque when installing spark plug. When installing the ignition lead, tighten nut to 15-20 ft. lbs. at plug and 12-15 ft. lbs. at ignition unit.



FIGURE 29B

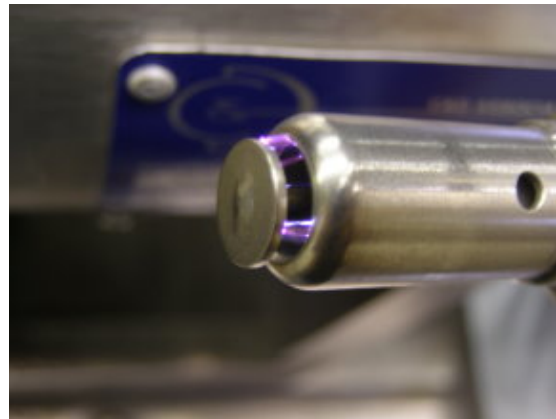


FIGURE 29C

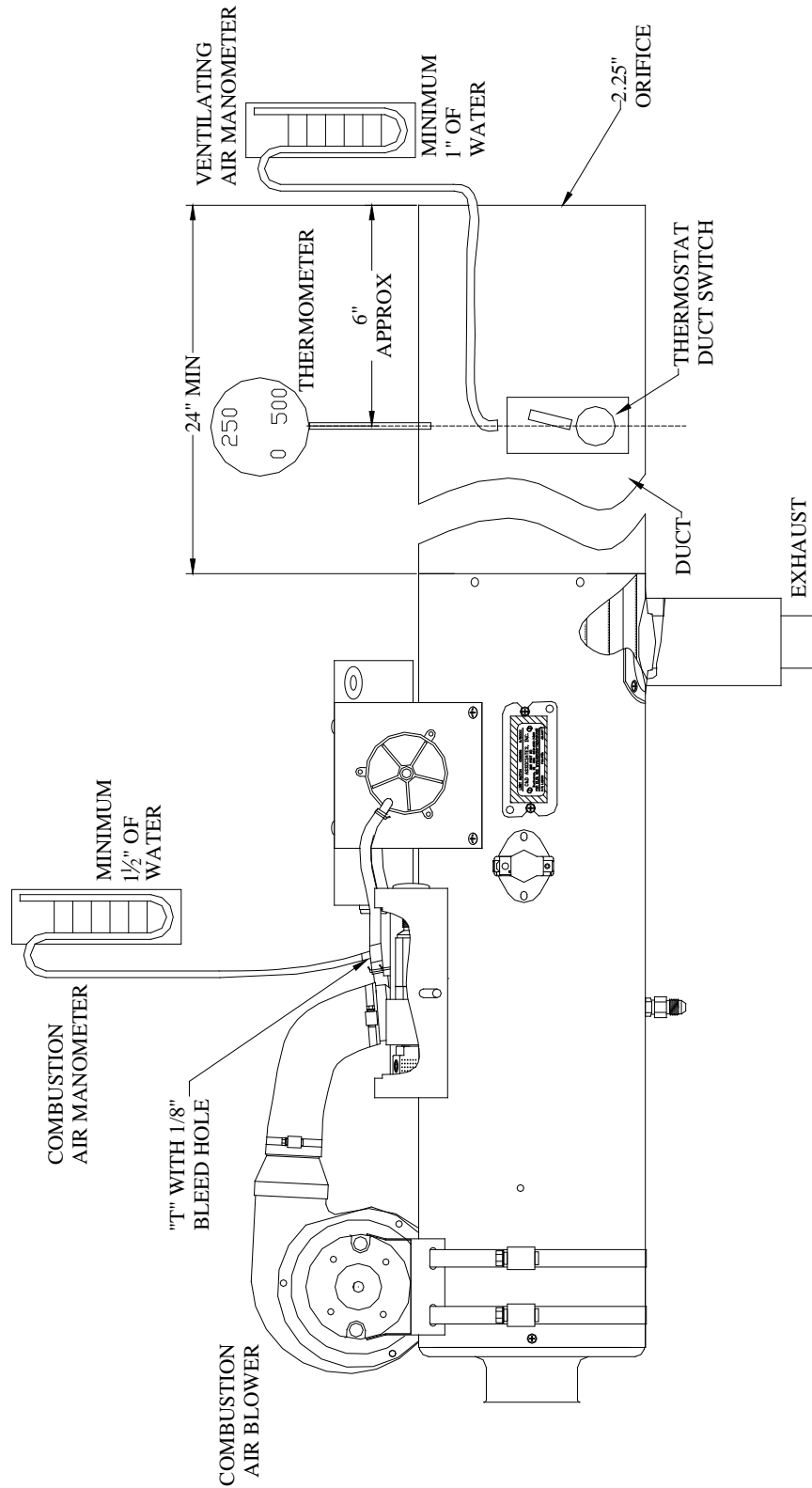


FIGURE 30: TYPICAL TEST SETUP

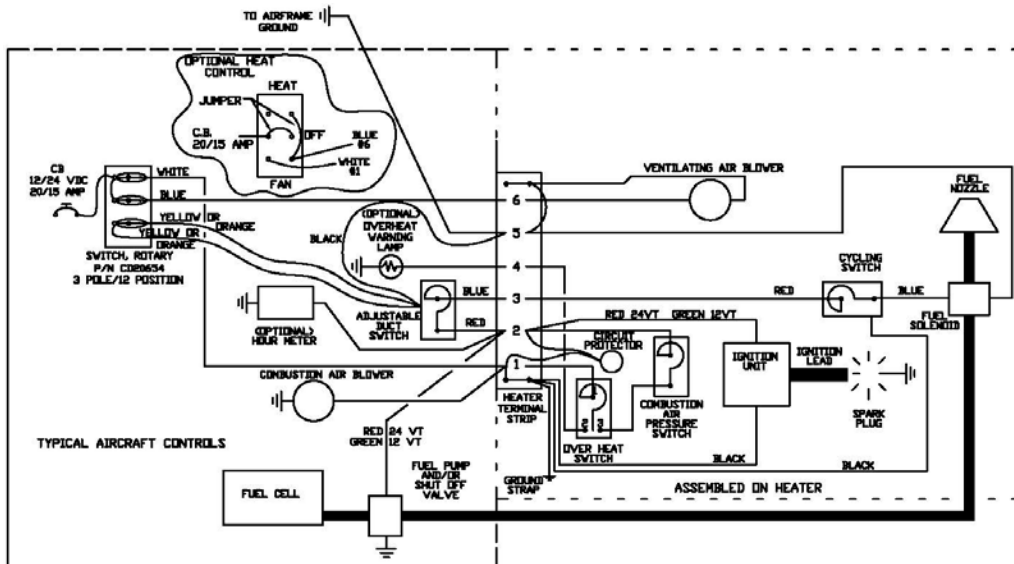


FIGURE 31A:
TYPICAL
WIRING
SCHEMATIC:
HET HEATER

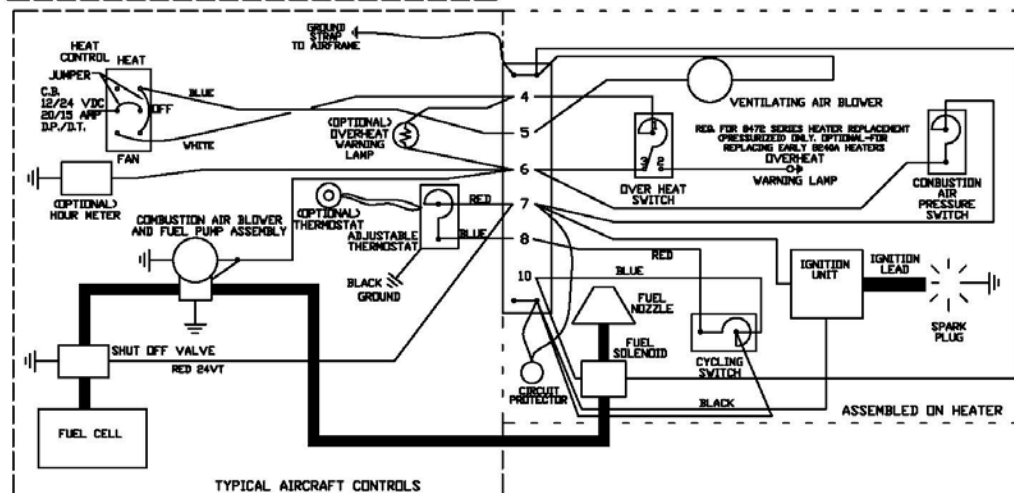


FIGURE 31B:
TYPICAL
WIRING
SCHEMATIC:
HET *NON-
PRESSURIZED*
HEATER

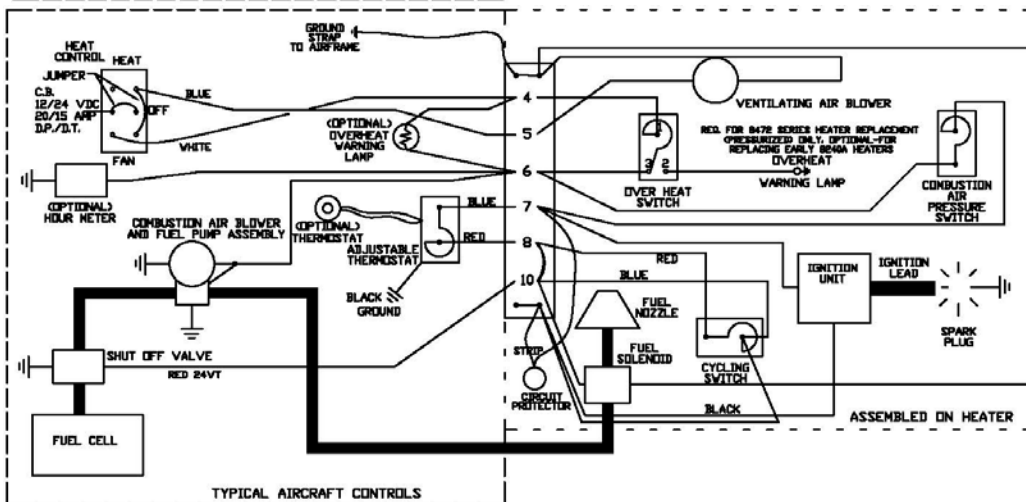


FIGURE 31C:
TYPICAL
WIRING
SCHEMATIC:
HET *PRESSURIZED*
HEATER

APPLIES TO S/N
1942 AND UP.
FOR EARLIER
S/N'S REFER TO
FIGURE 31B

13. PARTS VIEW – TYPICAL ILLUSTRATED PARTS BREAKDOWN (IPB)

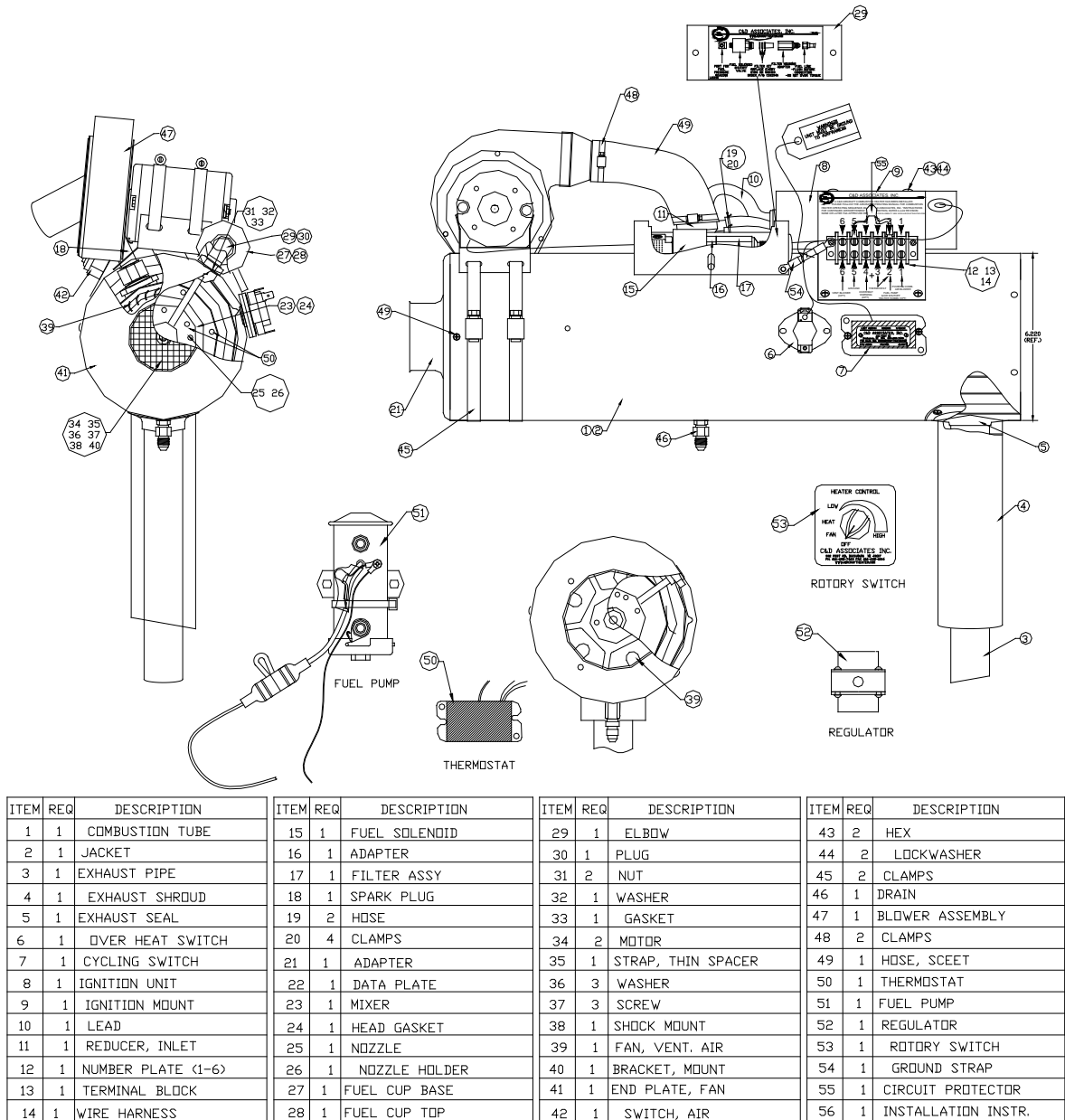


FIGURE 32

14. ACCESSORIES

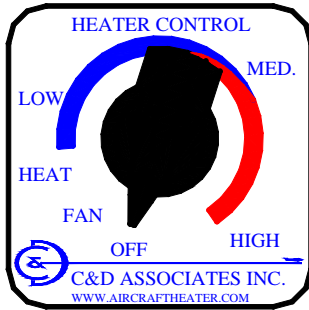


FIGURE 33

Rotary Heater Control
 Used with CD20654

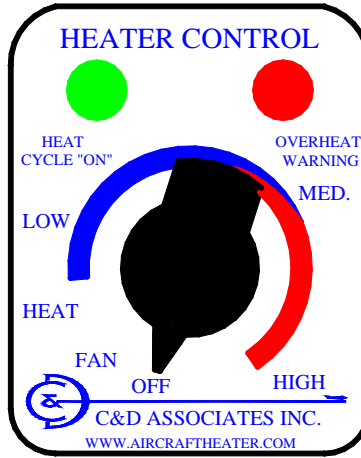


FIGURE 34

Rotary Heater Control
 with overheat and cycling
 Used with CD20654

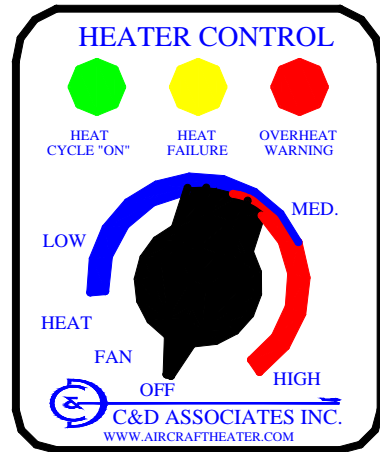


FIGURE 35

Rotary Heater Control
 with overheat, cycling and
 heater failure
 Used with CD20654



CD20654A & B
 Rotary Heat Control

FIGURE 36



CD21255
 Rotary Rheostat Control

FIGURE 37



CD21399
 Linear Rheostat Control

FIGURE 38



P/N CD21253 Thermostat

FIGURE 39

This thermostat sensor is used with the previous controls.

Typical Fuel Pump
-Aviation fuel-
P/N's vary



FIGURE 40

Typical Fuel Pump
-Jet fuel-
P/N 21190



FIGURE 41

P/N CD29124
Regulator – Mechanical Bypass

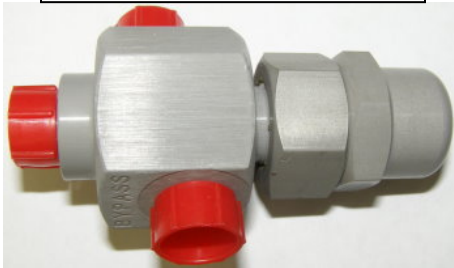


FIGURE 42

P/N CD20800 Series
Regulator - Electrical



FIGURE 43

P/N CD29127 - Fuel Train

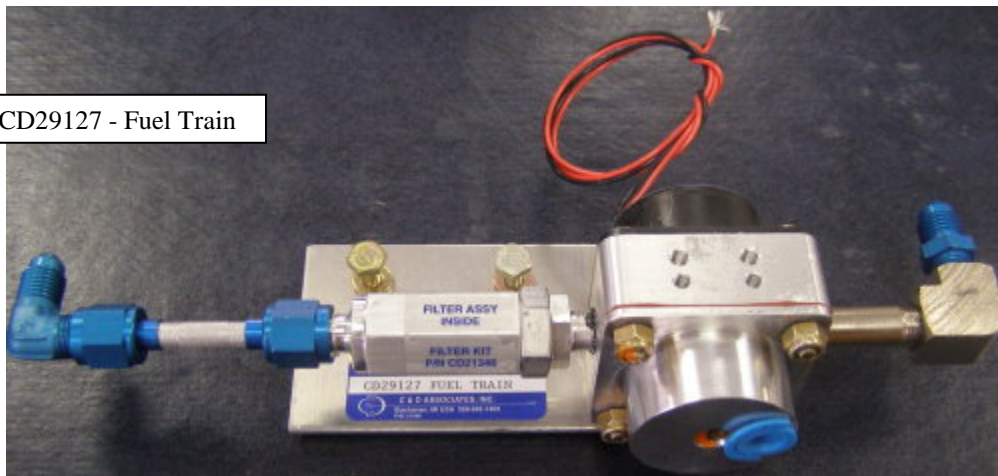


FIGURE 44