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AIRCRAFT ALTERNATOR OWNER'S MANUAL

P/N ES1032

ALTERNATOR MODELS ES-6904

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Thank you for purchasing a Hartzell Engine Technologies alternator. We encourage you to read this manual thoroughly. It contains a wealth of information about how to properly install and maintain your alternator so that it may give you many years of safe and reliable service.

Should you have a question regarding your alternator that is not covered in the manual, Hartzell Engine Technologies Product Support is ready to assist you. We may be reached at the following contact information:

Phone: +1.334.386.5400, option 2
E-mail: techsupport@HartzellEngineTech.com
Fax: +1.334.386.5450
Web: www.Hartzell.aero/contact/

WARNING:

People who fly should recognize there are various types of risks involved in this activity; and they should take all precautions to minimize them, since they cannot be eliminated entirely. The alternator is an important component of the aircraft. An alternator failure could result in an unplanned landing or even more severe consequences creating an unsafe condition that may result in death, serious bodily injury, and/or substantial property damage. It is, therefore, essential for the alternator to be properly maintained according to the recommended service procedures and monitored to detect impending problems before they become serious. Any unusual operation should be investigated and corrected, as it may be a warning of impending failure.

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Record of Revisions

Revision Letter	Issue Date	Page Revised	Description	Inserted Date	Inserted By
New	8-04-16	N/A	Original		

Record of Revisions

Revision Letter	Issue Date	Page Revised	Description	Inserted Date	Inserted By

Record of Temporary Revisions

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

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Service Publication List

Pub. Number	Description	Alternator Affected

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Pub. Number	Description	Alternator Affected

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AIRWORTHINESS LIMITATIONS

A.0 General Information

CAUTION:

THE AIRWORTHINESS LIMITATIONS IN THIS MANUAL ARE THOSE MANDATED BY HARTZELL ENGINE TECHNOLOGIES. THESE LIMITATIONS ARE THE MINIMUM REQUIRED TO MEET CONTINUED AIRWORTHINESS BUT MAY BE SUPERSEDED BY MORE STRINGENT REQUIREMENTS AS PUBLISHED BY THE FAA, AIRCRAFT, ROTORCRAFT OR OTHER MANUFACTURERS THAT USE THESE COMPONENTS IN THEIR APPLICATIONS.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.

A.1 Airworthiness Limitation Statement

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

FAA APPROVED

By: _____ Date: 8/3/16

Manager, Chicago Aircraft Certification Office
ACE115C
Federal Aviation Administration

Airworthiness Limitation Revisions Log

Revision Number	Description of Revision

AIRWORTHINESS LIMITATIONS (cont'd)

A.2 Life Limits

A. The FAA establishes specific life limits for certain component parts as well as the complete alternator. Such limits require replacement of the identified parts after a specified number of cycles or hours of use.

B. Additions of, or changes to, any life limit for the alternator or its components, will be noted in the Airworthiness Limitation Revision Log.

C. Life Limits

(1) Alternator models and their component parts affected by this manual currently do not have any life limited parts.

(2) There are no new (or additional) Airworthiness Limitations associated with this equipment.

FAA APPROVED

By: _____ Date: 8/3/16

for Manager, Chicago Aircraft Certification Office
ACE115C
Federal Aviation Administration

INTRODUCTION

1.0 General Information

WARNING:

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

DO NOT USE OBSOLETE OR OUTDATED INFORMATION. PERFORM ALL INSPECTIONS OR WORK IN ACCORDANCE WITH THE MOST RECENT REVISION OF THIS MANUAL. INFORMATION CONTAINED IN THIS 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 MANUAL INDEX FOR THE MOST RECENT REVISION LEVEL.

The accuracy and applicability of this manual has not been verified for any assembly, component or part not manufactured by Hartzell Engine Technologies LLC (HET). Any use of the manual for other than its intended or implied purpose is prohibited. The use of the manual for the purpose of performing any installation, maintenance, replacement, adjustment, or inspection of any assembly, component or part not manufactured by HET is not approved, endorsed, or sanctioned by HET.

This manual has been reviewed and accepted by the FAA. Additionally, the Airworthiness Limitations Section of this manual has been approved by the FAA.

This manual has been approved by Hartzell Engine Technologies LLC as the proper methods and procedures that FAA or other airworthiness authority Certificated Repair Stations and A/P Mechanics should use in the inspection and maintenance of the subject Hartzell Engine Technologies LLC alternator.

No liability will be assumed by Hartzell Engine Technologies LLC for actual, consequential, incidental or other types of damages directly or indirectly resulting from the unauthorized use of this manual for other than its stated purposes.

The liability for use of the authorized data in this manual for the maintenance, or return to service is limited to the specific terms and conditions stated under the applicable Limited Warranty in effect for each piece part, component, assembly or whole unit sold by HET.

Because of the numerous modifications, Supplemental Type Certificates (STC), Parts Manufacturing Approvals (PMA), or Form 337 Field Approvals that may apply, it is the responsibility of the repairman, mechanic or maintenance facility to determine the proper engine or aircraft application of this alternator assembly. 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, or inspection of any HET assembly, component or part, it is imperative that the latest revision of this HET manual or other product support document be referenced. Reference the HET website to be sure you have the latest revision before performing any work. (http://www.hartzell.aero/maintenance-manuals/)

All reasonable attempts were made to make this manual as complete and accurate as possible. If you have any questions, comments, corrections or require clarification of any information contained in this manual, please write to Hartzell Engine Technologies LLC, 2900 Selma Highway, Montgomery, Alabama, 36108 USA. TEL +1.334.386.5400, FAX +1.334.386.5410, or http://hartzell.aero/contact/.

1.1 General Specification (manual)

A. This manual follows unique HET formatting using ATA 100 identification as required. Principle units of measure in the manual are U.S. units with International System of Units (SI) in parentheses.

B. The ES-6904 series (24v) alternator models are considered in this manual. Variations of these alternators may be noted as applicable.

C. All aircraft, rotorcraft, or engine applications are limited to the holder of the TC, STC, PMA or TSO and only at the date of that document publication or revision.

D. Only approved, competent persons with the necessary skills may do maintenance tasks described in the manual.

E. The manual describes maintenance on components as they are installed on aircraft and tasks that should be accomplished in a properly equipped service facility.

F. Maintenance tasks and subtasks are referenced in the manual but will have no specific identification numbers.

G. The manual contains: Description and operation, Troubleshooting, Instruction for Continued Airworthiness (ICA) and Maintenance information along with part numbers required for basic maintenance tasks.

1.2 How to use the manual:

A. Make sure the manual contains information applicable to your aircraft, engine, or replacement alternator. Look for the model number on the Title Page and if applicable, the part number of the replacement or superseded component.

B. It is imperative that you read, understand, and observe all the applicable **WARNINGS** and **CAUTIONS** before you do any work on this component.

C. Use only the sections needed. Use the check section to determine what actions may be needed periodically and the maintenance sections for servicing the alternator.

D. If you need to identify a part or find a part number, refer to illustrations or reference in this manual or in the applicable aircraft or engine service or maintenance manual.

E. Refer to the troubleshooting section to assure that the observed or reported condition lies with the alternator.

F. Fully test the alternator per the instructions in this manual when running the aircraft. Utilize the aircraft and/or engine manufacturer's service manuals and publications before returning the aircraft to service. Use the AFM or POH for aircraft operations.

1.3 Measurements

The measurements given in the manual are taken from original manufacturing drawings.

Measurements are given in U.S. Units followed by SI Units in parentheses.

1.4 Units of Measure

A. SI Units

A	Ampere
Ah	Ampere hours
g	Gram
min	Minute
N	Newton
Nm	Newton meter
VDC	Volt direct current
ºC	Degree Celsius
%	Percent
Ω	Ohm
W	watt
Hz	Hertz

B. U.S. Units (SI units)

ft (m)	Foot (meter)
in (c)	Inch (centimeter)
lb (kg)	Pound (kilogram)
lb-in (Nm)	Pound inch (Newton meter) torque
lb-ft (Nm)	Pound foot (Newton meter) torque
^{o}F (^{o}C)	Degree Fahrenheit (centigrade)

C. Multiplying Prefixes

µ	Micro
m	Milli
k	Kilo
M	Mega
p	pico

1.5 Abbreviations

A. The abbreviations given below are used in the manual: (upper or lower case)

ACU	Alternator Control Unit
AFM	Aircraft Flight Manual
ALT	Alternator
ATA	Air Transport Association of America
DE	Drive End (housing)
DIA	Diameter
FAA	Federal Aviation Administration (USA)
FIG.	Figure
GAMA	General Aviation Manufacturers Association
IPC	Illustrated Parts Catalog
ID	Inside Diameter
HET	Hartzell Engine Technologies LLC
MAX	Maximum
MFR	Manufacturer
MIN	Minimum
NO.	Number
N/A	Not Applicable
OD	Outside Diameter
PCB	Printed Circuit Board
POH	Pilots Operating Handbook
P/N	Part Number
PARA.	Paragraph
REF.	Refer To
S/A	Subassembly
S/N	Serial Number
STC	Supplemental Type Certificate
SRE	Slip Ring End (housing) *Same as CE*
TBD	To Be Defined
TC	Type Certificate
TIS	Time In Service
TOL	Tolerance

1.6 Definitions

A. 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 injury, damage to equipment and/or facilities. **Notes** call attention to procedures which make the job easier.

B. The following are basic definitions of the terms used in this manual:

ALTERNATOR: The complete unit which transforms rotational energy from a powerplant into electrical energy. At a given voltage, produces alternating current (AC) which is converted to direct current (DC).

ALTERNATOR CONTROL UNIT: Device which controls alternator functions on, off, regulation of high/low voltage, field current and output current.

BRUSH: Device for conducting current to the slip rings of the rotor. It is a composite carbon block which includes a spring, lead and contact.

BRUSH HOLDER ASSEMBLY: Device that retains multiple brush assemblies and is comprised of a holder, brushes, springs, contacts, and terminals.

CARBON PILE: Regulator device used in testing. The carbon pile is basically a large resistor that may be adjusted. It is formed of carbon granules, and its resistance is dependent on the pressure applied across the granules. Mechanical adjustment controls the pressure across the granules in such a way as to increase or decrease resistance (basic regulator).

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

COOLING COVER: Device attached to the alternator to provide cooling air from an external source. May be provided with alternator or installed by the airframe manufacturer. (Also known as the “Blast Tube”, referring to ram air cooling source.)

EMI: Electro Magnetic Interference. A disturbance in the radio-frequency spectrum that is generated by an external source that affects electrical devices or circuits by electromagnetic induction, electrostatic coupling, or conduction.

FRONT HOUSING: Part of the external housing which contains the components of the alternator. This end has structure typically used for mounting. It may also be referred to as the Drive End Housing or D.E.

INSULATOR: Component that does not allow electricity to flow through it easily. Insulators do not allow electricity to flow through them easily because the electrons in their atoms do not move easily from atom to atom.

MULTIMETER: Device for the measurement of voltage, current, or resistance.

LEAKAGE: Dissipation of voltage or current from a component or connection.

OPEN: Electrical term for a complete disruption of a conductive path in an electrical circuit. Will read infinite resistance.

PEAK INVERSE VOLTAGE: (PIV) The maximum rated value of a AC voltage acting in the direction opposite to that in which a device is designed to pass current.

PHASE: The position of a point in time (instant) on a waveform cycle. A complete cycle is defined as 360 degrees of phase. Phase can also be an expression of relative displacement between or among waves having the same frequency.

POLARIZE: To induce polarization i.e., the partial or complete polar separation of positive and negative electric charge in an electrical system.

REAR HOUSING: Part of the external housing which contains the components of the alternator. It may also be referred to as the Slip Ring End or S.R.E.

RECTIFIER: An electrical circuit used to convert AC into DC current. The rectifier is a network of diodes that causes the current to flow in only one direction.

RFI: Radio Frequency Interference. Electromagnetic energy in the radio-frequency spectrum. Electrical interference may be created by poor slip ring/brush connection, defective rectifiers, or other poor connections. This is a normal by-product of electrical generators.

ROTOR: Rotating electro magnet used to create a magnetic field.

SLIP RING: Device which provides a sliding contact surface for the brush assemblies. The slip rings are smooth surface copper “rings” pressed onto the rotor shaft.

SHORT: Common term for a connection which has very little or no resistance as seen on an Ohmmeter in an electrical circuit. Typically an undesirable condition with respect to grounded elements.

SPLINE: A series of uniformly spaced ridges (teeth) on a shaft, parallel to its axis that fit inside corresponding grooves in the hub of a gear used to transmit torque.

STATOR: A stationary set of conductors wound in coil form on an iron core.

TEST BENCH: Device so constructed as to allow testing of the alternator or component parts.

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

THROUGH BOLT: Special bolts which connect front and rear alternator housings.

VOLT/OHM METER: Device for the measurement of voltage or resistance.

1.7 Disposal

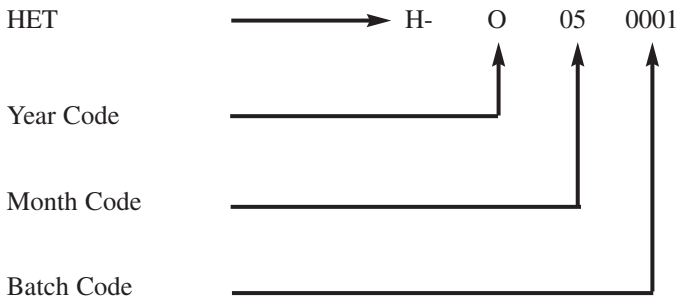
A. HET alternator assemblies are designed to allow for overhaul and re-use of many of the subassemblies and components.

1. Disposal of unairworthy parts and assemblies as well as required replacement parts should be as follows:
   a. Rejected parts should be tagged and scrapped per FAA requirements and parts deemed unairworthy must be rendered unusable prior to discard.
   b. Rectifiers and PCB components may be considered hazardous waste and should be discarded whole through your local hazardous waste management system.

1.8. Model Identification

ES-6904 Gear Driven (24 Volt)

1.9. Serial number Identification



Example above: HET, 2014, May, first unit of the month (batch)

Year Code: O = 2014, P = 2015, Q = 2016, etc.

1.10 Warranties

A. Hartzell Engine Technologies LLC (HET) offers a Limited warranty with each new alternator assembly or component (part) it sells through it's distribution system. **NO expressed or implied warranty exists** when repairing, or replacing any assembly or component using this manual except as it may apply to a new HET replacement part purchased. If you suspect that any warranty applies to the alternator assembly, it must be returned through an authorized HET distributor in a manner prescribed by that specific distributor. The affected alternator 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 alternator received altered, modified, or disassembled.)***

B. The HET Limited warranty policy in affect for your alternator is determined at the time of purchase. *(As the Warranty policy is revised from time to time, you must download the policy in affect for your unit for specific terms and conditions should a warranty condition occur. Only the terms and conditions stated in the warranty at the time of purchase will apply. For warranty information, visit our website at http://www.hartzell.aero/warranty/.)*

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DESCRIPTION OF OPERATION

2.0 GENERAL

A. Hartzell Engine Technologies (HET) direct drive alternators have been designed and constructed to provide extended periods of trouble-free operation with a minimum amount of maintenance. They are designed to supply a large electrical load variation and are intended to withstand normal vibration and temperature changes encountered in aircraft applications.

B. The ES-6904 is an isolated ground device, meaning the case of the machine does not carry return current. A dedicated ground terminal (negative) carries all return current flow for the unit.

2.1 BASIC COMPONENT DESCRIPTION

A. The principle components of the aircraft alternators described in this manual are the slip ring end housing assembly with bearing, the rectifier assembly, the stator, the rotor, the drive end housing with bearing and the brush holder assembly with spring and brushes.

B. A simplified electrical diagram, which shows the basic electrical operating points and connections, is shown in Figure 2.1.

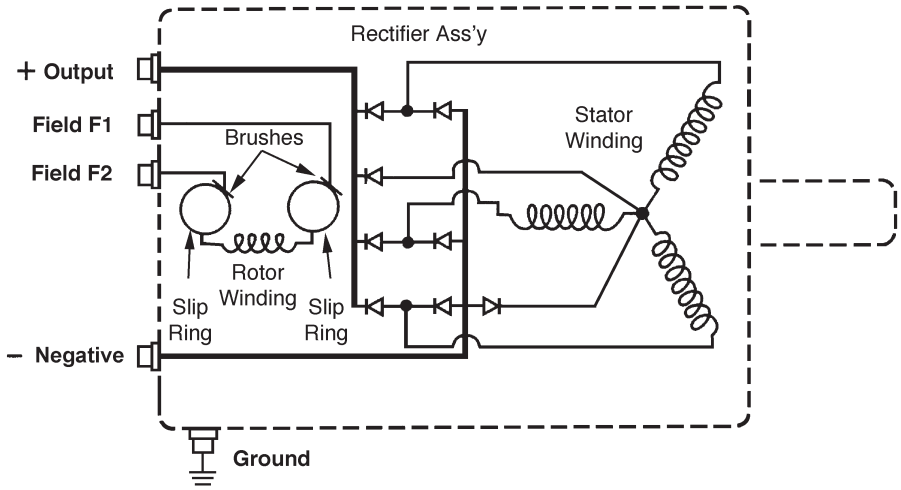

Figure 2.1
Alternator Simplified Electrical Diagram, Wye Connected Stator

2.2 TECHNICAL PURPOSE

A. The purpose of the alternator is to produce electrical energy. This energy is used to maintain the proper state of charge in the battery and supply current to the electrically powered equipment and accessories in the aircraft. It performs this function by converting mechanical energy derived from its rotating parts into electricity.

(1) The BATTERY is the source of electrical power whenever the BAT Master Switch is ON and is the normal source of power for starting the aircraft. The ALTERNATOR can supply electrical power whenever the engine is running and the ALT Switch is turned ON. (Control systems may vary with the aircraft/rotorcraft.)

2.3 PHYSICAL DETAIL

A. The brush holder assembly consists of a brush holder housing and two brush assemblies. The brush assemblies are made from a carbon-graphite brush having a flexible braided copper wire lead fitted to a coil spring. Each brush is electrically connected to a separate terminal stud mounted in the brush holder housing. These studs are the F1 and F2 terminals. The brush holder assembly is mounted in the SRE housing in a position and manner that allows one brush to ride on each ring of the rotor slip ring assembly providing for a continuous sliding electrical connection while the rotor spins.

B. The rotor assembly is composed of a shaft, two pole-shoes, a coil assembly and a slip ring assembly. The coil assembly is a simple enameled-wire coil wound on a bobbin form. The coil is fitted between two iron pole-shoes which serve as magnetic flux guides. The rotor shaft is pressed through the pole-shoes forming a heavy interference fit making a permanent assembly fixing the poles in place on the shaft. The slip ring assembly is composed of two copper rings mounted on a non-metallic, insulating hub. The hub is fixed to the rotor shaft with one ring electrically connected to each end of the coil winding.

   (1) The drive spline (coupling to engine) is integral to the rotor shaft and is part of the rotor assembly. The shaft of the rotor contains a specific “shear” section which will break upon any overload produced by the alternator or engine. It provides protection to the engine accessory gear box.

C. The stator assembly is formed by winding three separate coils of enameled copper wire on a common laminated iron core. The coils are symmetrically spaced around the core and overlap one another. Slot insulators are used to protect the windings from abrasion damage due to contact with the core. For Wye-connected stators, one end of each coil is joined in a common connection. The opposite ends of each coil remain free, resulting in four leads emanating from the stator assembly. These leads are electrically connected to the bridge rectifier network.

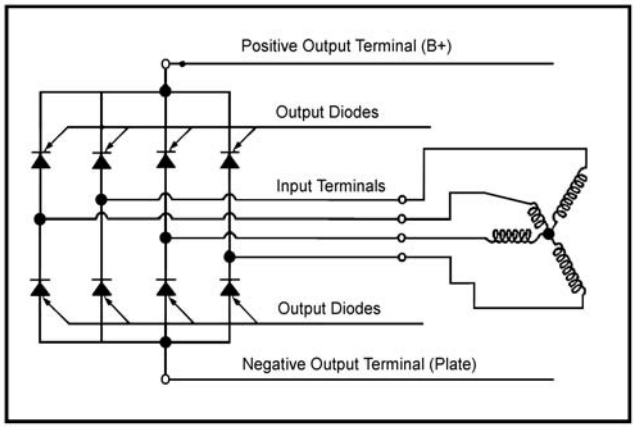

Figure 2.2 Stator Wiring Diagram (Typical).

D. A full-wave bridge rectifier is formed from discrete positive and negative diodes mounted within the alternator. The positive rectifiers are installed in a crescent-shaped aluminum heat sink. The mechanical connection between the rectifier casings and the heat sink forms the positive electrical connection for the bridge leaving the heat-sink electrically energized. As such, the heat sink is mounted in a manner that keeps it electrically isolated from the alternator housings. The alternator's battery terminal (B+) is mechanically and electrically connected to the heat sink. The negative rectifiers are also installed in a separate crescent-shaped aluminum heat sink. The mechanical connection between the rectifier casings and the heat sink forms the negative electrical connection for the bridge. The alternator's negative terminal is mechanically and electrically connected to the heat sink.

2.3 PHYSICAL DETAIL (cont'd)

E. The rotor assembly is supported by bearings at either end allowing the rotor to spin freely. The bearings are mounted in the DE and SRE housings. The stator assembly is so arranged within the DE and SRE housings as to align concentrically with the rotor assembly. The laminated iron core of the stator assembly surrounds the pole-shoes of the rotor assembly. The slip rings align with the brushes so as to allow one brush to contact one ring. See Figure 2.3.

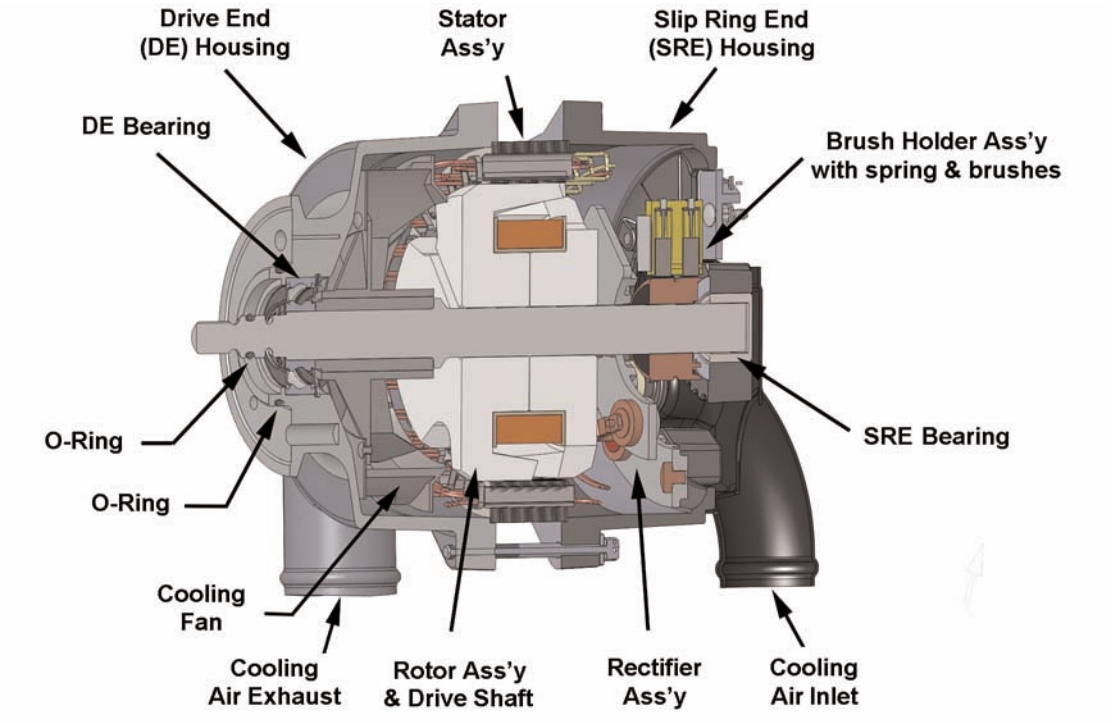

Fig. 2.3 - Typical Alternator Cutaway (Basic Components)

2.4 THEORY OF OPERATION

A. Power to drive the alternator is derived from the aircraft powerplant by means of an accessory drive pad. Torque in transmitted though the drive to the alternator rotor shaft resulting in rotor rotation.

B. During operation, the F1 terminal is electrically excited by an external voltage regulator. The F2 terminal is externally connected to the aircraft electrical system ground or the ACU. As current flows through the rotor coil a magnetic field is created with lines of flux being concentrated between the pole-shoe fingers. As the rotor turns these lines of flux are swept over the stationary stator coil windings inducing an alternating current flow within them. This three-phase alternating current is conducted to the bridge rectifier circuit which converts the alternating current to direct current. This rectified, DC current is made available to external loads via the +B terminal.

2.5 SELF EXCITATION

A. The HET alternator model ES-6904 is not rated as self-exciting.

2.6 OPERATIONAL DATA

Table 2.1 - Operational Specifications

Alternator Model	ES-6904
Drive Type	Direct
Cooling	Internal-Fan
Temp Range (F)	up to +240˚ F
Temp Range (C)	up to + 116˚ C
Min Regulation Speed	2,500 RPM
Max Continuous Speed	10,000 RPM
Voltage, Bus	24 volt
Voltage, Rated	28 volt
Current, Rated	120 Amp
Rated Altitude (feet)	31,900 feet MSL
Rated Altitude (meter)	9,723 meters MSL
Weight (lbs / kgs)	14.0 lbs (6.35 kgs)
Field Type	Isolated
Filter Type	None
Field Resistance	6.5-7.5 ohm 25˚ C

2.7 APPEARANCE

A. Features - ES-6904

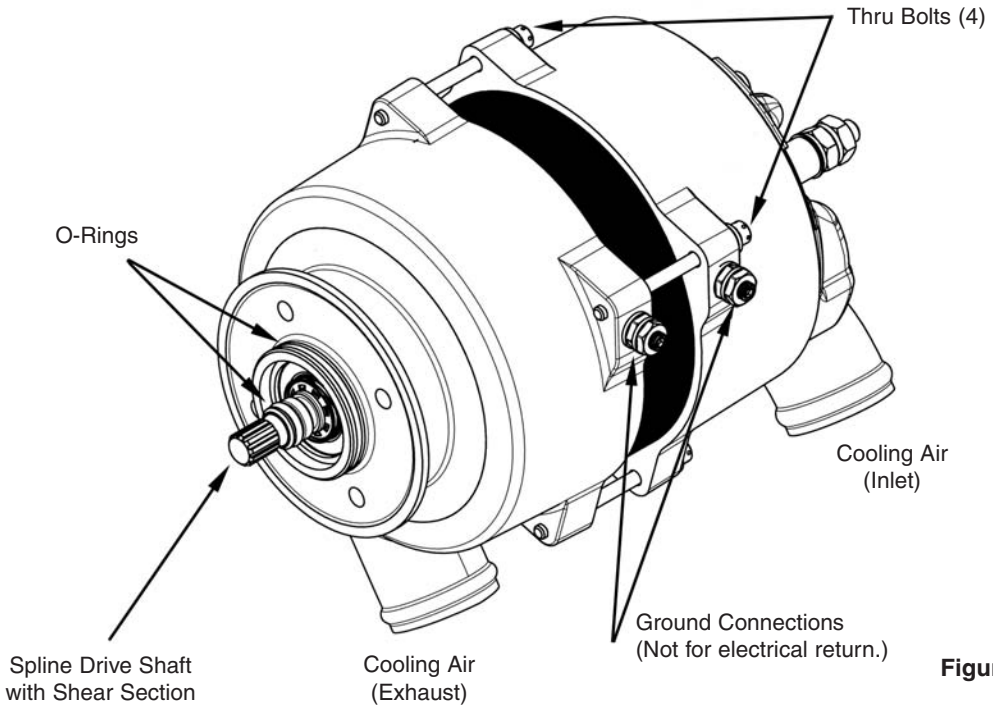

Figure 2.4a - ES-6904
Front View

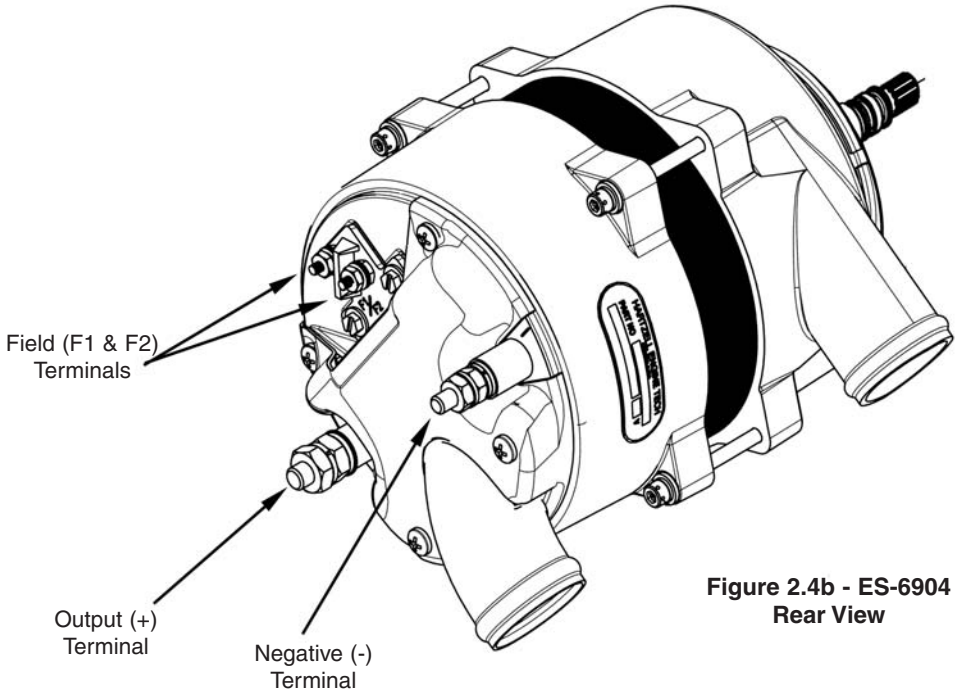

Figure 2.4b - ES-6904
Rear View

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TROUBLESHOOTING

3.0 General

A. In the event of a malfunction in electrical power, an alternator fault should not be assumed before employing proper troubleshooting procedures. The objective in troubleshooting is to find the cause of trouble and take corrective action to prevent a recurrence. Even perfectly operational alternators cannot compensate for improper adjustments, corroded or worn parts, improper installation or lack of maintenance.

B. This section provides general troubleshooting procedures for the alternator assembly for unscheduled maintenance and for possible fault detection prior to maintenance activity. It gives procedures to follow to determine the best course of action prior to disassembly. Block type troubleshooting charts are also provided. Upon determination of fault(s), refer to the TESTING (section 5) for applicable test procedure(s).

3.1 Procedure

WARNING:

WHEN SERVICING, REPAIRING, OR OVERHAULING THE ALTERNATOR, CAUTION MUST BE TAKEN TO AVOID HAZARDOUS SITUATIONS. THE ALTERNATOR, WHEN MOUNTED ON AN AIRCRAFT OR ROTORCRAFT, PRESENTS A PHYSICAL HAZARD FROM PROPELLERS, ROTORS AND OTHER ROTATING DEVICES. THE ALTERNATOR PRODUCES A HIGH ELECTRICAL CURRENT OUTPUT AND ALSO PRESENTS AN ELECTRICAL SHOCK HAZARD THAT CAN RESULT IN SERIOUS INJURY IF PROCEDURES IN THIS MANUAL OR THE AIRCRAFT/ROTORCRAFT SERVICE MANUALS ARE NOT FOLLOWED.

CAUTION:

IT IS REQUIRED TO REFERENCE THE AIRCRAFT OR ROTORCRAFT AFM OR POH AS WELL AS THE APPLICABLE SERVICE OR MAINTENANCE MANUAL AS REQUIRED.

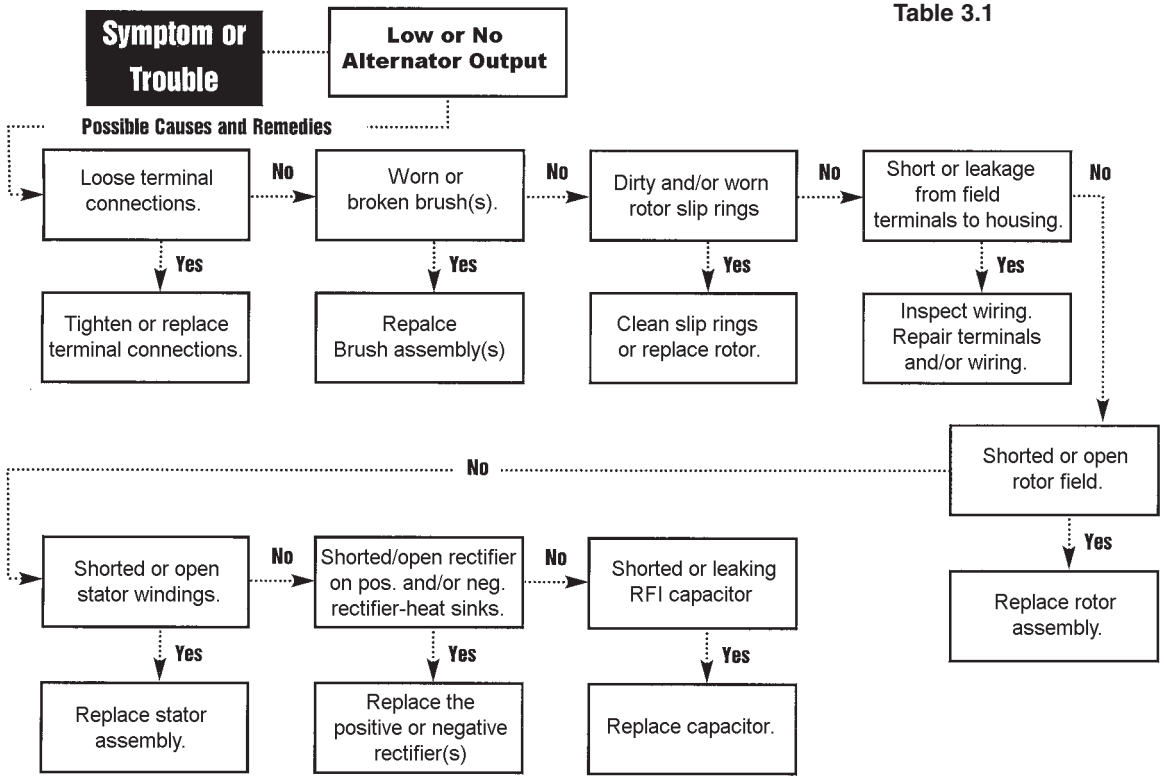
A. The Charts on the following pages represent potential faults in an alternator. Choose the applicable symptom and follow the trouble shooting chart flow. Below each chart is a discussion of each point.

3.1. Low or No Output.
3.2. Battery is Discharged.
3.3. Battery is Overcharged.
3.4. Noisy in Operation (acoustic).
3.5. Noisy in Operation (electrical).
3.6. Ammeter Erratic or Lights Flicker.

3.2 Troubleshooting Charts

Troubleshooting - Low/No Alternator Output

Table 3.1



Loose terminal connections: Inspect the terminals and tighten if possible. If not the alternator may need to be disassembled to replace studs or receptacles. Also observe the wire terminal ends to assure they are crimped properly on the wire with no corrosion or burns present. If disassembly is required, replace or overhaul alternator.

Worn or broken brushes: Remove and examine brush material, spring, and leads. If spring in broken or the lead is coming out of brush, or if brush is chipped or worn past 50% replace brush.

Dirty or worn rotor slip rings: If dirty, the slip rings may be cleaned. Take care not to scratch the surface. If the slip rings appear worn or have grooves, replace or overhaul alternator (see section 6, Maintenance).

Short or leakage from field terminals to housing: Unless it is determined the wire terminal is shorting to the housing, replace the field terminals and insulators. If disassembly is required, replace or overhaul alternator.

Shorted or open rotor field: Perform the tests for rotors per section 5, Testing. Rotor removal may be required to verify the symptom. Replace or overhaul alternator (no repairs allowed on rotors).

Shorted or open stator windings: Perform the alternator tests per section 5, Testing. Stator removal may be required to verify the symptom. Replace or overhaul alternator if failed (no repairs allowed on stators).

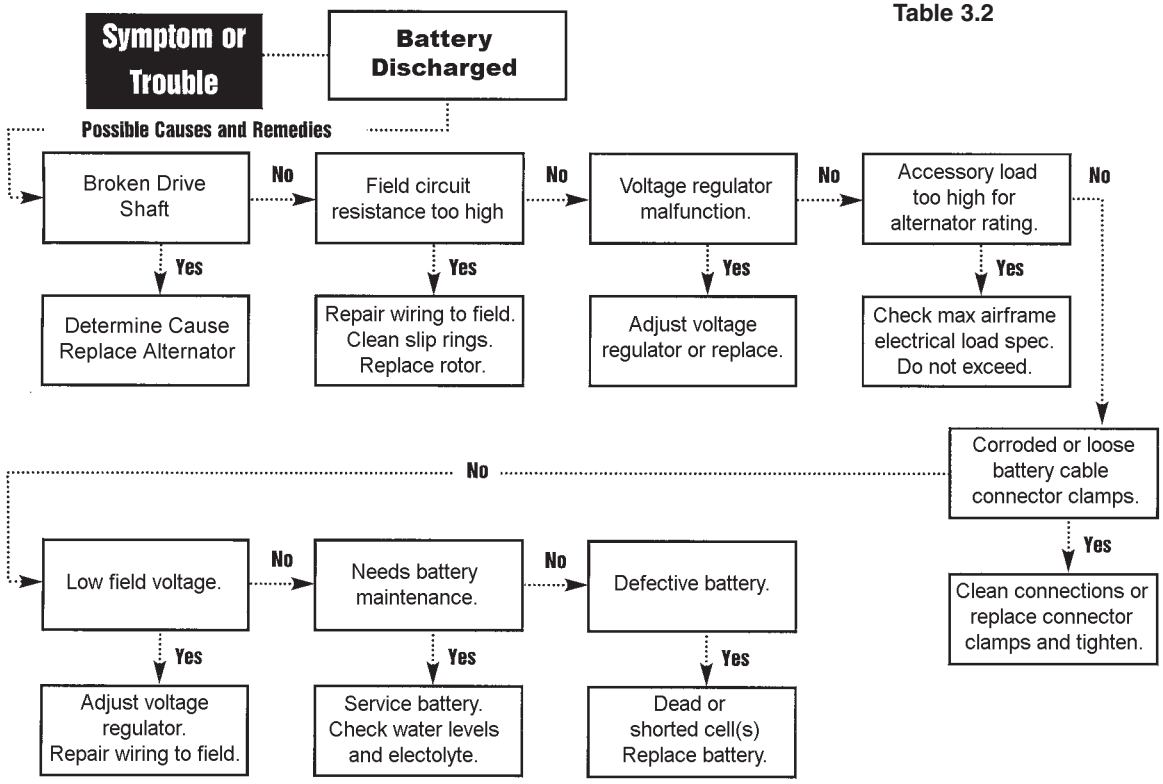
Shorted or open rectifier on heat sinks: Low or erratic output indicate failed rectifiers. Tests for rectifiers (positive and negative) require disassembly. Replace or overhaul alternator.

Shorted or leaking RFI capacitor (airframe, engine, HET external filter): Remove capacitor and perform capacitance check and wire lead to case resistance check. Replace filter capacitor if failed (external filter only).

3.2 Troubleshooting Charts (cont'd)

Troubleshooting - Battery Discharged

Table 3.2



Drive Spline Broken: Inspect the condition of the drive spline. (as applicable) The alternator must be removed to check for this condition.

Field circuit resistance too high: Check wiring and terminal ends and repair as necessary. Check condition of the slip rings and clean. Check rotors per section 5, Testing and if failed, replace or overhaul alternator.

Voltage regulator malfunction: Check the voltage regulator per the aircraft service manual and adjust if necessary. If adjustment is not possible, check wiring and replace voltage regulator.

Accessory load too high for alternator rating: Refer to the AFM or POH (and aircraft service manual) for the maximum allowable load specification. Reduce electrical load to meet these limitations.

Corroded or loose battery cable connector clamps: If connections to the battery are corroded, disconnect and clean. Clean battery posts or terminals. If aluminum cable is installed, make sure that corrosion has not spread under the insulation. If severe, replace cables or clamps. Tighten battery connections.

Low field voltage: Check the voltage regulator per the aircraft service manual and adjust if necessary. If adjustment is not possible, check wiring and replace voltage regulator.

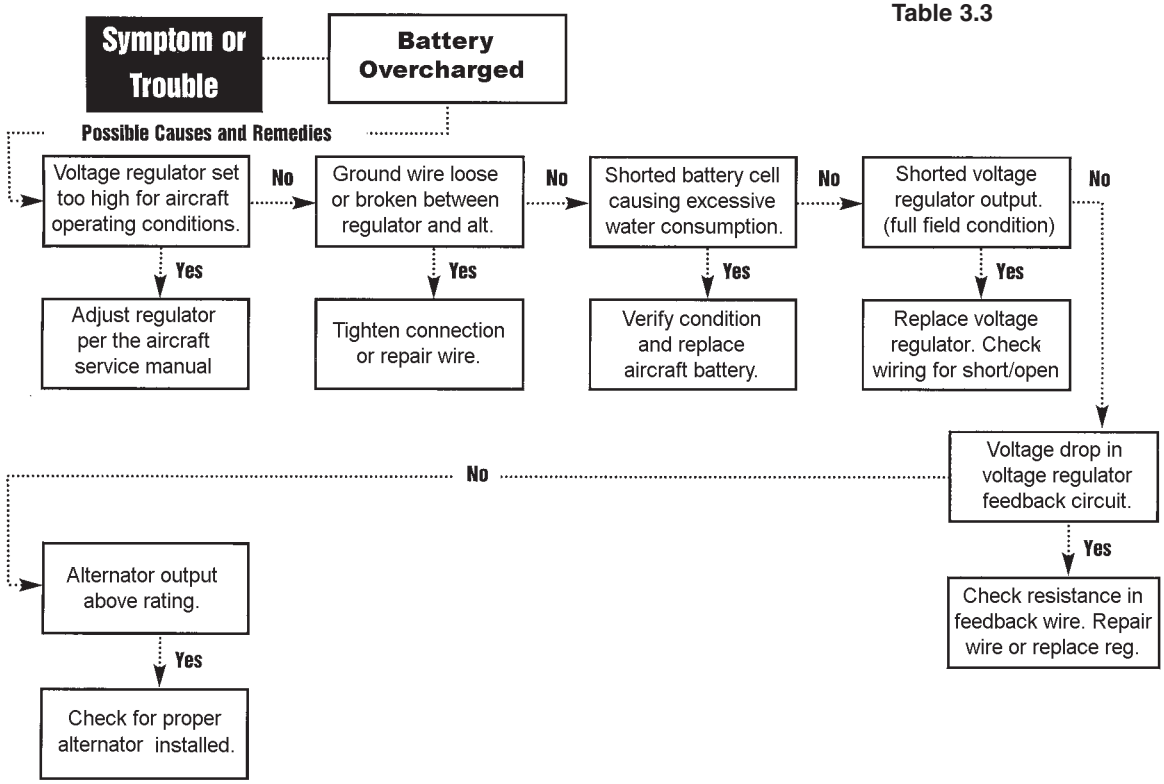
Needs battery maintenance: Perform normal battery maintenance. Check water level and electrolyte condition, service per the aircraft service manual.

Failed battery: Determine battery age and check for expected life. If near or beyond normal life, replace battery. If battery discharges frequently, check for dead or shorted cells, if found replace battery.

3.2 Troubleshooting Charts (cont'd)

Troubleshooting - Battery Overcharged

Table 3.3



Voltage regulator set too high for aircraft operating conditions: Check the voltage regulator setting per the aircraft service manual. Adjust if necessary. If adjustment is not possible, check the wiring harness before replacing the voltage regulator.

Ground wire loose or broken between regulator and alternator: If wire is broken, make sure there is adequate strain relief and clear chaffing areas. Repair or replace wire. If loose, tighten connection.

Shorted cell in battery causing other cells to use water excessively: Remove and place battery on battery tester to verify the condition. Replace failed battery.

Shorted voltage regulator output - full field condition: Before replacing the voltage regulator, check wiring harness for shorts or open conditions. If harness is burnt or shows signs of overheating, replace harness. If, wiring is good replace voltage regulator.

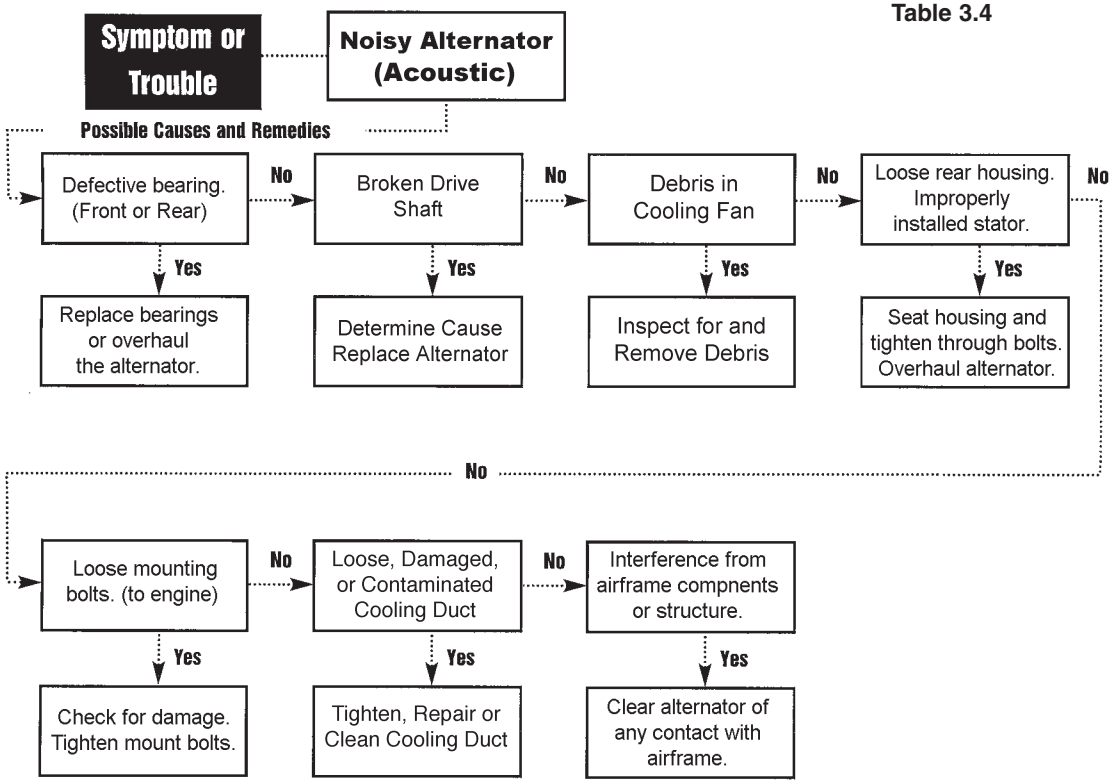
Voltage drop in voltage regulator feedback circuit: The "feedback" line is commonly known as the sense line. Before replacing the voltage regulator, check sense line wire for resistive or short conditions. Check terminal connections, Replace or repair wire if failed. If, wiring is good replace voltage regulator.

Alternator output above rating: As output is related to alternator speed, check that the proper alternator has been installed. Check airplane records to determine that the proper alternator model and rating is installed per the aircraft TC or STC.

3.2 Troubleshooting Charts (cont'd)

Troubleshooting - Noisy Alternator (Acoustic)

Table 3.4



Failed bearing: To perform a test for failed bearings, hold the alternator in one hand and snap-spin the shaft with the other. A failed bearing will be heard or felt. Replace the bearing by overhaul or replacement of the alternator.

Drive spline broken: Inspect the condition of the drive spline. (as applicable) The alternator must be removed to check for this condition.

Debris in the cooling fan: Check alternator cooling fan to see if debris have entered the alternator housing and are rubbing internally.

Loose rear housing or improperly installed stator: Examine through bolts. If loose and distorted or severe "smoking" or black areas appear at the head of the bolt, the alternator should be overhauled or replaced.

Loose mounting bolts: Inspect mount points for damage and if found overhaul the alternator. If not, re-torque mounting bolts per the engine or aircraft service manual.

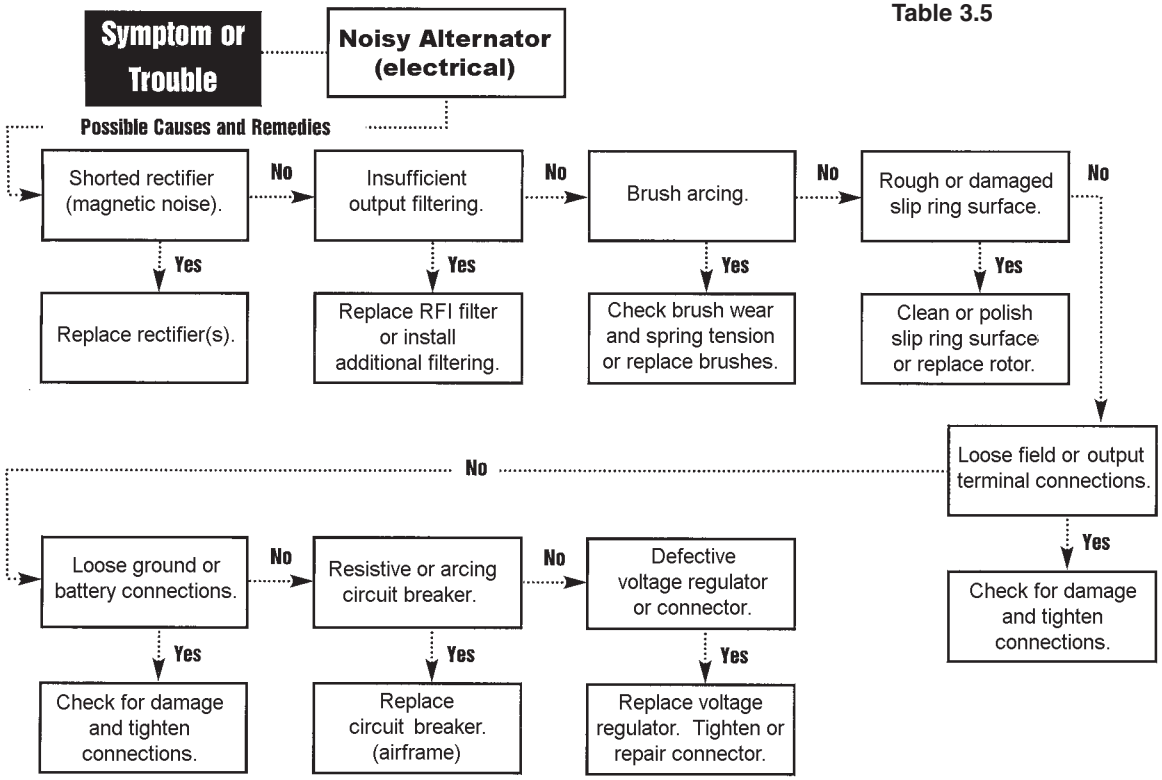
Loose cooling duct connection: If cooling duct is installed incorrectly (normally an airframe component), adjust and tighten the mounting connection (as applicable). Check and clear any interference with the airframe structure.

Interference from airframe components or structure: Examine the alternator and large electrical cables for contact or chaffing on airframe structure. Check and clear any interference areas.

3.2 Troubleshooting Charts (cont'd)

Troubleshooting - Noisy Alternator (Electrical)

Table 3.5



Shorted rectifier (magnetic noise): Magnetic (radio) noise indicates failed rectifiers. Tests for rectifiers (positive and negative) require disassembly. Replace or overhaul alternator.

Insufficient output filtering: Check the RFI filter by performing a capacitance check. Replace RFI filter if failed (external filter only). In some cases, additional RFI filters may be installed. Be sure that a check is performed on each. If only one RFI filter is installed, additional filters may be required to reduce noise.

Brush arcing: Remove and examine brush material, spring, and leads. If the spring is broken or the lead is coming out of brush, replace brush. If the brush is chipped or worn past 50%, replace brush. Examine slip ring surface for condition and clean as required.

Rough or damaged slip ring surface: If the slip rings show minor surface roughness they may be polished. If the slip rings appear worn or have grooves, replace or overhaul alternator (see section 6, Maintenance).

Loose field or output terminal connections: Check terminal connections for damage. Provide adequate strain relief to the wiring and tighten terminals properly.

Loose negative, ground, or battery connections: Check negative, ground & battery connections for damage. Provide adequate strain relief to the cables and tighten properly. (See engine or aircraft service manuals.)

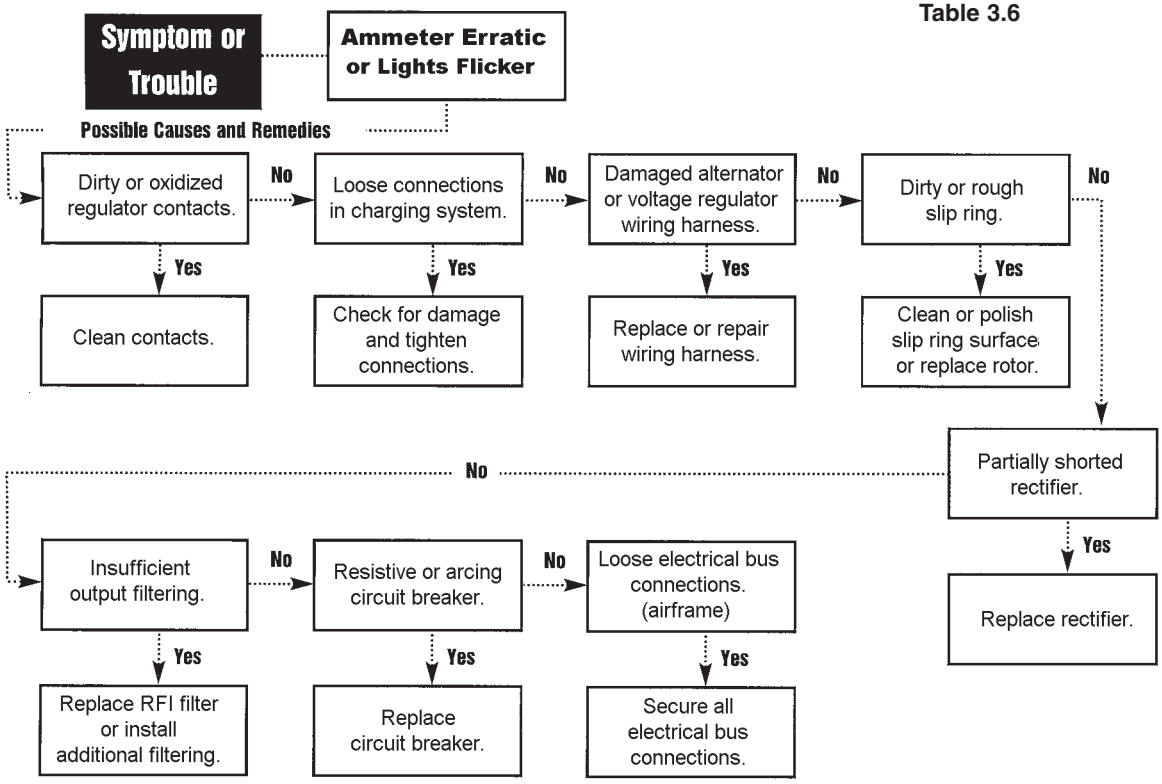
Resistive or arcing circuit breaker: Make a resistance check of the circuit breaker. There should be no resistance. Check breaker function. Old circuit breakers should be replaced.

Failed voltage regulator or connector: Check to see if the regulator connector is attached properly. Remove and examine connector. Look for arcing or overheating. Check wiring harness and replace the voltage regulator if failed.

3.2 Troubleshooting Charts (cont'd)

Troubleshooting - Ammeter Erratic or Lights Flicker

Table 3.6



Dirty or oxidized regulator contacts: Inspect both the male and female connector contacts. Clean using an aviation quality contact cleaner. For circuit board edge contacts, first us a pencil eraser on the edge followed by contact spray cleaner.

Loose connections in charging system or damaged wiring harness: Inspect the terminals and tighten if possible. Also examine the wire terminal ends to assure they are crimped properly on the wire and no corrosion or burns are present. Check harness from end to end and repair any damaged wiring.

Damaged alternator or voltage regulator wiring harness: Check alternator and regulator wiring harness for damage and repair. If wiring damage is found, check voltage regulator for function and replace if necessary.

Dirty or rough rotor slip rings: Take care not to scratch the surface. If the slip rings appear worn or have grooves, replace or overhaul alternator (see section 6, Maintenance).

Partially shorted rectifier: Flickering lights or erratic ammeter indication due to failed rectifiers. Tests for rectifiers (positive and negative) require disassembly. Replace or overhaul alternator.

Insufficient output filtering: Check the RFI filter by performing a capacitance check. Replace RFI filter if failed (external filter only). In some cases, additional RFI filters may be installed, be sure that a check is performed on each. If only one RFI filter is installed, additional filters may be required to reduce noise.

Resistive or arcing circuit breaker: Make a resistance check of the circuit breaker. There should be no resistance. Check breaker function. Old circuit breakers should be replaced.

Loose electrical bus connections: Check aircraft electrical bus for loose wire connections. Tighten or repair as required.

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CHECK

4.0 General

A. This section defines the various checks and inspections needed to assure reliable and safe operation of the alternator while in service. They are listed in hours time in service (TIS) or in calendar time, whichever is applicable and are the first to occur when offered a choice. Some maintenance is one time initial and others are recurring.

B. HET recommended maintenance and checks including TIS may be superseded by the aircraft or engine manufacturer's established time limits and schedules based on experience and/or unique requirements under engine or airframe Type Certificate.

4.1 Inspection Checks (alternators in this manual)

A. 100 Hours TIS & each 100 hours thereafter. (or each annual/event, the first to occur)

(1) Perform a check of the alternator assembly. Note through bolt security and proper safety wire application and re-torque bolts if found loose.

(2) Check the alternator to engine V-clamp nut security. If T-bolt safety wire is loose, check nut for proper torque per aircraft, rotorcraft and/or engine maintenance manual.

(3) Inspect area around the brush holder for soot. If a large amount of soot appears, remove brush holder and check for wear or damaged brushes.

(4) If wear has occurred, check slip rings for gouges or scratches.

(5) Check electrical terminal hardware for tightness and insulators for condition.

B. **500 Hours TIS & each 500 hours thereafter. (or each two years, the first to occur)**

(1) Remove brush holder and check each brush for wear or damage. If brush shows more than 50% wear or has chips or damage, replace brushes (brushes must be replaced as a set only). New brushes are 0.50 inch (12.7 mm) long.

(2) With the alternator removed, check the alternator to engine V-band clamp and nut for cracks or damage. Check the T-bolt for wear or cracks at the tee section and replace the V-band clamp if necessary.

(3) Examine the alternator insulators and replace if cracked, deformed, or indications of thermal distress are observed.

(4) Inspect the aluminum housing for surface corrosion, clean as necessary.

(5) Inspect the housings for cracks around the through bolt holes and ears. Replace the housings if necessary.

(6) Clean the spline thoroughly prior to installing the alternator.

(7) Install V-band clamp and nut.

(8) Torque T-bolt nut per Table 6.1 unless superseded by the OEM's applicable service information or maintenance manual and safety wire.

C. TBO Coincident with engine TBO

(1) Overhaul or replacement is based on the condition of the alternator but shall not exceed 12 (twelve) calender years regardless of operating time in service.

Overhaul time may vary based on cooling, electrical load, and general service. When published, the aircraft OEM TBO shall supersede this HET recommendation.

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INSPECTION AND TESTING

5.0 General

A. This chapter outlines the tests and inspections required to determine the condition of the alternator removed for scheduled and unscheduled maintenance. Refer to the procedures given in the TROUBLESHOOTING Section prior to applying any test for maintenance.

B. Where applicable, components called out this section will correspond to the item number listed in MAINTENANCE Section 6.

5.1 Testing

A. Equipment

(1) Standard tools

- Standard mechanic's handtools.
- Torque wrench ounce-inch (gram-centimeter).
- Torque wrench pound-foot (newton-meter).
- Safety gloves.
- Protective goggles (eye protection).
- Ear Plugs (hearing protection).
- Safety shoes.
- Protective cotton apron.
- Air compressor (shop air).

(2) Special tools

Standard and special tools used in this chapter are limited.

- Voltmeter (0 to 30 VDC)
- Ammeter, 0 to 200 Amp.
- Carbon Pile (or equivalent).
- Alternator test bench (12/24 volt, 0 - 200 A). (if removed to test)

(3) Instruments

- A multimeter, (Simpson 260 or Fluke 87) or equivalent (accuracy 2%).
- Optical tachometer.

B. Test conditions

(1) Ambient temperature: 70 to 80 ^{o} F (21 to 27 ^{o} C).

5.1 Testing (cont'd)

C. Precautions

Regular maintenance must be accomplished per this manual and per the applicable aircraft and/or engine service manuals and publications. In addition, observe the following precautions:

(1) **DISCONNECT THE BATTERY** before connecting or disconnecting test instruments (except voltmeter), or before removing or replacing any unit or wiring. Accidental grounding or shorting at the regulator, alternator, ammeter or accessories, will cause severe damage to the units and/or wiring.

(2) **DO NOT REMOVE THE OUTPUT LEAD.** The output lead must not be removed from the alternator while the rotor winding is energized and the alternator is operating.

(3) **DO NOT GROUND THE OUTPUT TERMINAL.** Grounding of the alternator output terminal may damage the alternator and/or aircraft electrical circuit.

(4) **DO NOT REVERSE BATTERY CONNECTIONS.** Reversed battery connections may damage the rectifiers, aircraft wiring or other components of the charging system. Battery polarity should be checked with a voltmeter before connecting the battery.

(5) **ASSURE PROPER CONNECTIONS TO THE BATTERY.** If a booster-battery or fast-charger is used, its polarity must be connected correctly to prevent damage to the electrical system components.

(6) **DO NOT ALLOW IMPACT CONTACT WITH DRIVE SPLINE.** The shear section of the input shaft can be damaged if exposed to impact loads.

5.2 Testing & Inspection

A. Arc Marks on Terminals (Visual Inspection):

(1) Before removing the alternator, the threads and each terminal stud should be inspected for signs of arcing.

(2) Arc marks are usually caused by a loose wire terminal connection resulting from failure to tighten the attaching nut.

(3) Arc marks can also be caused by improper service techniques that permit wires to be connected and disconnected while current is flowing. A loose connection at the alternator output (battery) terminal can erode completely through the terminal stud over time.

(4) Diode damage can occur because of the inductive voltage spikes generated by the make and break of loose terminal connections. The positive and negative rectifiers must be replaced at next alternator repair or overhaul.

(5) Voltage regulator and mechanical field relay damage can also be expected due to the chattering contacts each time the loose connection makes or breaks. Chattering contacts that are excessive will result in rapid contact erosion.

(6) Solid state field relays will not be damaged, however they may generate electrical noise.

B. Bearing Inspection (For Troubleshooting Purposes):

(1) A simple bearing test should be performed regardless of the reason for alternator removal from the engine. The alternator must be removed for this test. The purpose of the test is to determine if either of the bearings are a potential for noise or failure.

(2) To perform a test for faulty bearings, with the alternator in one hand, oriented with the shaft horizontal, snap-spin the shaft with the other. A defective bearing will be heard or felt. Snap-spin the shaft a few times to verify.

(3) Grasp the drive spline (rotor shaft) and push-pull the shaft in a direction parallel to the axis. Movement should be less than .0062 inch (.1575 mm).

(4) Grasp the drive spline (rotor shaft) and push-pull the shaft in a direction that is perpendicular to the axis. Movement should be less than .001 inch (.025 mm).

(5) If either bearing sounds noisy, movement is not smooth, or excessive movement (axial or radial) is observed, the alternator should be repaired, overhauled, or replaced.

C. Field Circuit Open or Ground Test Procedure:

(1) Using a multimeter on low range scale (0 to 25 ohm), connect one lead of ohmmeter to the “F1” terminal and the other lead to “F2” terminal with the “F1” and “F2” terminals isolated from the aircraft electrical system.

(2) Spin the output shaft and note ohmmeter reading. Meter should read between 7 and 20 ohms while rotor is turning.

(3) A reading lower than 3.5 ohms indicates either a grounded field terminal or a failed rotor. Field repair or send alternator for repair, overhaul, or replacement.

(4) A reading higher than 20 ohms indicates: either worn out or hung brushes, an open brush lead or a failed rotor.

(5) Items (2) and (3) reading may be addressed by replacement of the brushes or the brush holder assembly. Refer to section 6.6 (Maintenance) for brushes.

(6) Item (3 & 4) failed rotor requires overhaul or replacement of the alternator.

5.2 Testing & Inspection (cont'd)

D. Mounting Hardware:

(1) Inspect and replace any removed metallic hardware, i.e., screws, flat washers, nuts, shaft spacer, shaft woodruff key, etc., exhibiting damage, wear, corrosion, or distortion.

(2) Hardware that will be reused shall be cleaned as necessary using a non-corrosive chemical degreaser. Air-dry parts with filtered dry low pressure compressed air or wipe dry with clean, lint free cloth.

E. Insulators (Washers and Spacers):

(1) Inspect parts for cracks, deformation, and burn marks.

(2) Parts that are suitable for reuse shall be cleaned as necessary using isopropyl alcohol. Any other cleaner may damage insulators. Air-dry parts with filtered dry low pressure compressed air or wipe dry with clean, lint free cloth.

(3) Cracked, deformed, or failed insulators require replacement or overhaul of the alternator as it must be disassembled to replace damaged parts.

F. Brush holder, Brushes and Springs:

(1) Inspect brush holder for cracks or breaks and brushes for condition.

(2) If damaged, discard the brush holder assembly and replace with new.

(3) If brushes are excessively worn or damaged in any way, replace brushes in pairs with new. Never attempt to replace a single brush.

(4) New brushes are 0.50 inch (12.7 mm) long and must be replaced if worn below 0.25 inch (6.35 mm).

G. Drive Spline:

(1) Clean spline with mild solvent to remove oil and debris. (Cleaning procedures found in the engine manufacturers maintenance manual shall supersede this procedure.)

(2) Visually inspect spline for wear or indications of spalling or abrasion. Erosion should not exceed 0.020 inch (0.508 mm) on any tooth flank.

(3) Inspect shear section under lighted, 3X magnification for indications of cracks. (Refer to Figure 6.1 for shear section location on the rotor shaft.)

(4) Failure of 2 or 3 above require replacement of the alternator.

5.3 Alternator Bench Testing

CAUTION 1:

TEST BENCH PROCEDURES MUST BE PERFORMED BY APPROPRIATELY RATED MECHANICS IN AN ADEQUATELY EQUIPPED FACILITY. PRIOR TO BEGINNING THESE PROCEDURES, REFER TO AND OBSERVE THE PRECAUTIONS LISTED IN TESTING SECTION 5.1(C).

CAUTION 2:

NO SIDE LOADS MAY BE APPLIED TO THE DRIVE SHAFT DURING TEST OPERATIONS. IF NOT OBSERVED, ALTERNATOR FAILURE AND OTHER EQUIPMENT DAMAGE MAY OCCUR.

A Alternator Output Test Conditions:

The preferred method of testing the alternator is by a commercially available alternator test bench (rated 28 volt, 0 - 140 A), however the procedures below are considered adequate for testing purposes. A special drive stand adapter will be required to test the alternator.

(1) The alternator is to be at room temperature 70-80 degrees Fahrenheit (21-27 degrees Celsius) before beginning the test.

(2) The alternator is to be connected so that it is supplying its own field current.

(3) The output is to be controlled by an adjustable load.

(4) The alternator is not to be run for longer than 30 seconds for each test point.

B Test Set Up:

(1) Manufacture and connect the test set up as shown in Figure 5.1.

(2) This consists of a battery (24 volt DC, 50 ah min.), common carbon pile, test voltmeter (0-28 VDC), test ammeter (0-140 amp), and an appropriate length of jumper wire.

(3) Prepare to use an optical tachometer to observe RPM. (per manufacturers instruction)

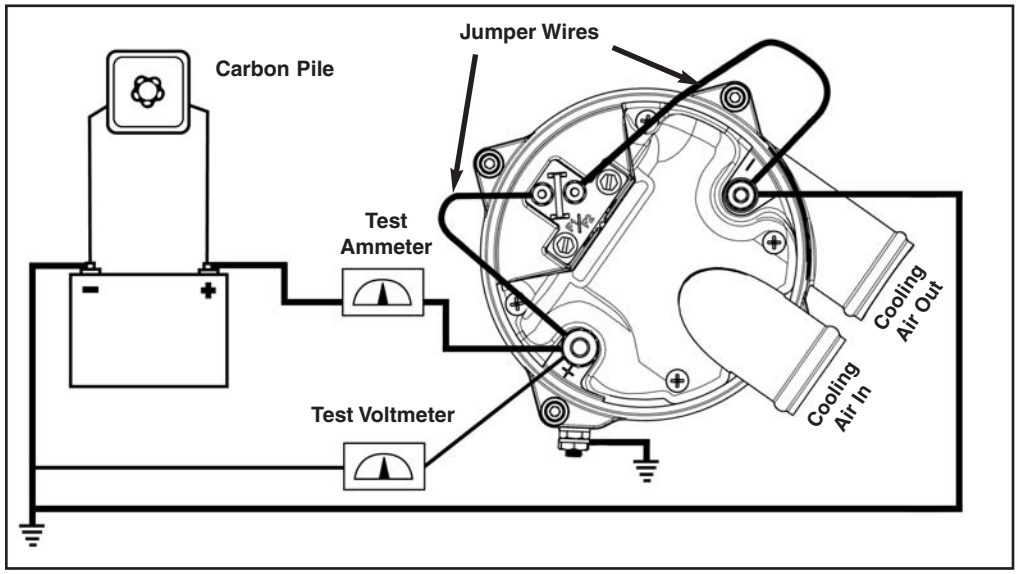

Figure 5.1 - Typical Bench Testing Set Up.

5.3 Alternator Bench Testing (cont'd)

C. Ventilation:

WARNING:

DIRECT DRIVE ALTERNATORS REQUIRE A SOURCE OF VENTILATION. DO NOT TEST THESE ALTERNATORS IN AN ENCLOSED SPACE AT FULL RATED OUTPUT FOR MORE THAN 30 SECONDS UNLESS A COOLING AIR SOURCE IS SUPPLIED. FAILURE TO VENTILATE MAY CAUSE EQUIPMENT DAMAGE WHICH MAY RESULT IN INJURY OR DEATH.

(1) The alternator is cooled entirely by air pressure through hose type connections on the drive end and slip ring end housings. When bench testing this type of alternator, make output tests as short as possible unless adequate air pressure for cooling is supplied (3" H_2O minimum delta pressure across the unit).

(2) Adjust the carbon pile to obtain the specified voltage (refer to Table 5.1). After bench testing the alternator, install the safety wire in the through bolts. The alternator is now ready for installation on the engine. Always refer to the aircraft manufacturer's wiring diagram when installing the alternator or testing the alternator on the aircraft.

D. Test Procedures:

(1) Adjust the carbon pile as necessary to obtain the specified voltage shown in Table 5.1.

WARNING:

EXCEEDING THE BATTERY VOLTAGE RATING MAY DAMAGE THE BATTERY OR CAUSE AN EXPLOSION. THIS MAY RESULT IN INJURY, BURNS, AND EQUIPMENT DAMAGE.

(2) Apply power while observing the voltmeter, observe RPM using the optical tachometer and the output current on the ammeter.

(3) Vary the RPM while maintaining 28.7 volts DC. Observe the amperage at each RPM. At each RPM, the Min. Output Amps must be achieved as specified in Table 5.1.

(4) If alternator is to be reinstalled, refer to section 6.12 (Installation on Aircraft).

E. Alternator Output Test Specifications (Without Regulator)

Alternator Series: ES-6904

Output Voltage	Min. Output Amps	Max Alternator RPM
28.7 ± .4 Vdc	18	2500 ± 50
28.7 ± .4 Vdc	101	4000 ± 50
28.7 ± .4 Vdc	125	5000 ± 50

Table 5.1 - Output Test Specifications

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MAINTENANCE

6.0 General

A. This section contains information regarding recommended maintenance for all alternators listed in this manual. These recommendations assure reliable and safe operation of the alternator while in service. Maintenance is listed in hours time in service (TIS) or calendar time, whichever is applicable but each are the first to occur. Some maintenance is one time initial and others are recurring. Refer to Chapter 4, “Checks” for required inspections.

B. HET recommended maintenance, checks and TIS may be superseded by the aircraft or engine manufacturers established time limits and schedules based on experience and/or unique requirements under it’s Type Certificate or other certifications.

6.1 Periodic Maintenance

NOTE: The aircraft and/or engine manufacturers periodic or event checks are contained in the respective maintenance manual or service information.

A. The electrical charging 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 is operated. Since many airframe related maintenance tasks directly or indirectly affect alternator function, it is recommended that the aircraft manufacturers periodic inspection/maintenance be followed prior to or in conjunction with any HET prescribed alternator maintenance. These include:

(1) ***Battery*** - A battery condition and capacitance check.

(2) ***Wiring*** - An alternator circuit wiring and terminal condition check.

(3) ***Spline Drive*** - If the alternator is removed at any time, the spline should be checked for wear of spline teeth or other damage per section 6.3. Whenever the alternator is removed, the small shaft O-ring and larger alternator O-ring must be replaced.

(4) ***Operation*** - An operational check of the alternator after any maintenance is performed on the aircraft or engine electrical systems. Use the appropriate AFM, POH, service information or maintenance manual as applicable.

6.2 Torque Information

CAUTION: APPLYING TORQUE BEYOND THE VALUES SET IN TABLE 6.1 WILL SEVERELY DAMAGE THE ALTERNATOR. EXCEEDING THESE VALUES MAY REQUIRE OVERHAUL OR REPLACEMENT OF THE ALTERNATOR.

Table 6.1 - Torque Specifications

Reference	Description	Torque Value (US)	Torque Value (SI)
Figure 6.1b	Through Bolts	45-55 in-lbs	5.08-6.21 Nm
Figure 6.1b	Nut, V-clamp T-bolt*	85 in-lbs	9.6 Nm
Figure 6.3.a	Output Nut (POS)*	40-50 in-lbs	4.52-5.65 Nm
Figure 6.3.a	Output Nut (NEG)*	30-40 in-lbs	3.39-4.52 Nm
Figure 6.2b	Screws (Brush Holder)	11-14 in-lbs	1.24-1.58 Nm
Figure 6.3b	Field Nut (F1 & F2)	6-8 in-lbs	0.68-0.90 Nm
Figure 6.3.a	Ground Nut (bottom/top)	75-85 / 30-40 in-lbs	8.47-9.60 / 3.39-4.52 Nm
Figure 6.3a	Ground Stud	70-85 in-lbs	7.91-9.60 Nm

* Attachment of Ground, Output Positive (+), Output Negative (-), Field wires, or V-Band Clamp on the engine or airframe may use above torque unless value differs from engine/airframe OEM torque. OEM torque shall supersede HET value. ***Reminder, always secure the bottom nut when applying torque to top nut to prevent over torque of bottom nut.***

6.3 Alternator Spline Drive Inspection & Maintenance

A. The alternator spline drive is part of the alternator rotor and is fundamental to the operation of the HET alternator.

B. If an alternator fault is determined, note that the HET ES-6904 alternator has a drive spline incorporating a shear section integral to the alternator rotor. If the shear section is overloaded it will snap and normal alternator output will cease.

(1) Check the general condition of the drive spline. (500 TIS removal of the alternator)

(2) Check condition of the spline teeth. Tooth erosion in excess of 0.020 inch (0.508 mm) is cause for rejection. If this condition is present the alternator must be replaced or overhauled.

(3) Check the condition of the drive spline shaft and shear section. Clean the shaft and inspect for cracks or other damage using a 10X magnifying glass.

(4) The small shaft O-ring (P/N M8324B/1-111) and the larger alternator pilot O-ring (P/N M8324B/1-131) must be replaced any time the alternator is being installed.

a. When installing the alternator small shaft O-ring and the larger pilot O-ring, care must be taken not to nick or otherwise damage the O-ring as an oil leak will occur.

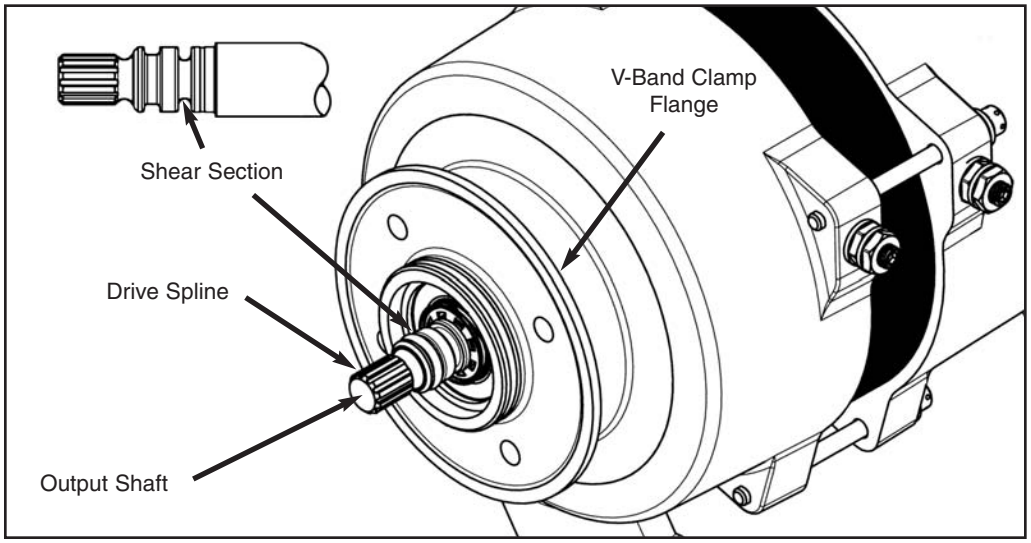

Figure 6.1a - Spline Drive with Shear Section.

6.4 Removal from the Aircraft

A. To remove the alternator from a specific engine, refer to the aircraft and/or engine service and maintenance manuals for detailed instructions.

B. General Removal

(1) Make sure all external power has been disconnected. Unless otherwise advised, gain access and disconnect the ground (-) cable from the battery post followed by the positive (+) terminal. Isolate and secure the ground (-) terminal.

(2) Disconnect the cable from the output negative (-) then the positive (+) terminals.

(3) Disconnect the Field wires and cable from the alternator Ground stud.

(4) Remove the safety wire or cable from the V-clamp and T-bolt and while supporting the alternator, remove the T- bolt nut. Refer to Figure 6.1b.

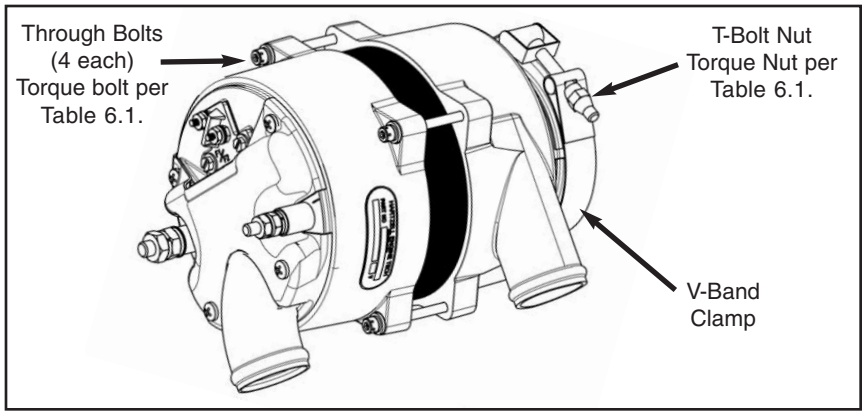

Figure 6.1b - V-Band Clamp Attachment

CAUTION:

FAILURE TO PROPERLY SUPPORT THE ALTERNATOR MAY DAMAGE THE SHEAR SECTION. (REF FIG. 6.1A.) AVOID SIDE LOADING THE DRIVE SHAFT DURING ALTERNATOR REMOVAL AND INSTALLATION

(5) Spread open the V-band clamp. Be sure to hold the alternator by hand so the full weight will not load the spline shaft. Carefully remove the alternator from the aircraft engine. .

(6) Remove the large and small “O” Rings and discard. The “O” Rings must be replaced each time the alternator is removed.

6.5 Exterior Cleaning

A. Prior to cleaning the alternator, whether mounted on the aircraft or as removed, observe and note condition. Look for any arcing, wear marks, fretting or other indicators of wear.

B. If mounted on an aircraft to engine, initial cleaning may be done using mineral spirits or isopropyl alcohol under pressure. Blow dry using clean shop air.

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

6.6 Brush Brush Removal and Installation

A. **Removal**:

(1) Make sure aircraft battery and external power source has been disconnected.

(2) Disconnect the two top terminal nuts for F1/F2 while holding the bottom nut.

a. Temporarily insulate the terminals to prevent possible sparking. Refer to Figure 6.2a.

(3) Remove the two screws that hold the brush holder assembly in the slip ring end housing (SRE). Refer to Figure 6.2a.

(4) Slowly remove the brush holder assembly from the SRE taking care not to drop the brushes into the alternator (brushes are spring loaded).

a. If checking brushes only, be sure to mark and note the position and orientation of each brush. Discard the brushes if replacing.

(5) If both brushes are not present upon removal of the brush holder, the missing brush must be located and recovered from the alternator before proceeding.

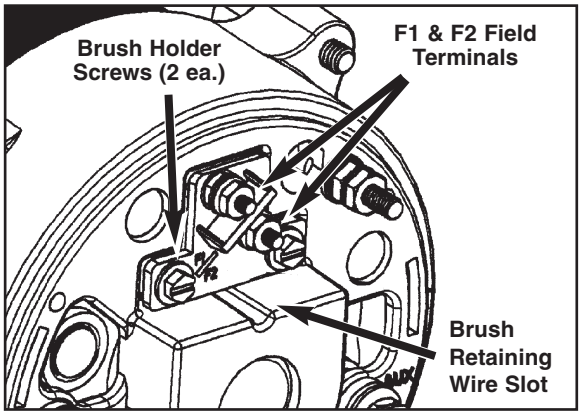

Figure 6.2a- Brush Holder Location

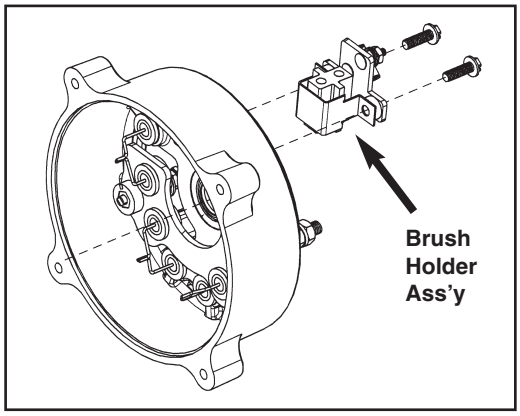

Figure 6.2b- Brush Holder Installation

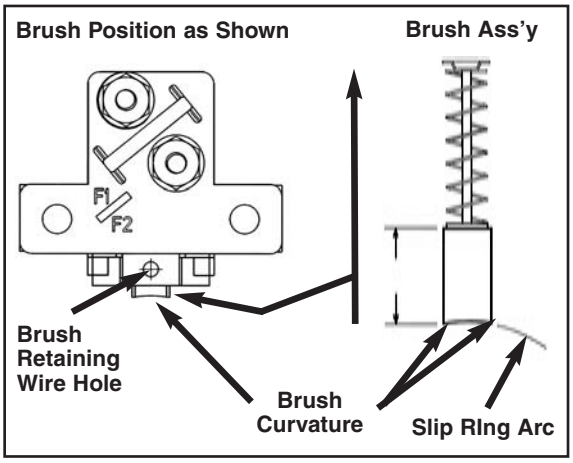

Figure 6.2c- Brush Position in Holder

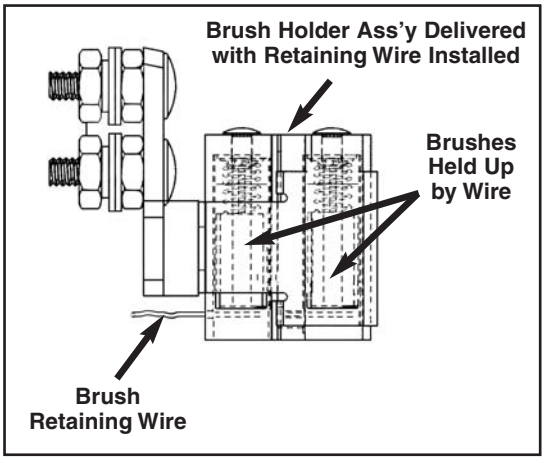

Figure 6.2d- Brush Retaining Wire

B. **Installation:**

(1) Brushes must be replaced in pairs. If replacing brushes only, order two (2) each, HET P/N ALE-13A brushes from an authorized HET distributor. HET recommends replacing the brush holder assembly HET P/N ALU-3045BS which includes new brushes pre-installed with a brush retaining wire installed.

(2) Install a new set of brushes, HET P/N ALE-13A into the brush holder. Place each new brush into the brush holder.

a. Brushes must be oriented such that the axis of the curvature of the brush face is parallel with axis of F1/F2 terminals. Refer to Fig. 6.2c.

b. If checking brushes only, be sure to return them in the same position and orientation as removed.

c. Install a two inch, stiff 22 gage insulated wire into the hole provided in the side of the brush holder while pushing in each brush with a soft tool like a wood or nylon dowel.

d. The wire will retain the brushes for installation of the holder. Refer to Fig. 6.2d.

(3) Install the brush holder assembly with the insulated brush retaining wire in place. Install the two brush holder screws. Refer to Fig. 6.2b.

a. Torque the brush holder screws 11 to 14 in-lbs (1.24 to 1.58 Nm). Refer to Fig. 6.2a.

(4) Spin the shaft several rotations to check for interference between the brush holder and rotor.

(5) Remove insulated brush retaining wire from brush holder assembly. Rotate shaft in running direction and listen for smooth operation. Refer to Figure 6.2d.

(6) If brushes were checked or changed without removing the alternator, connect the F1 and F2 wire terminals and torque 6-8 in-lbs (0.68-0.90 Nm).

(7) Restore aircraft battery and/or other power source which has been disconnected. If alternator was removed, refer to Installation on the Aircraft, section 6.12 .

6.7 Through Bolts

The alternator through bolts are designed to retain proper torque for the life of the alternator. Occasionally, unusual vibrations from the engine or other sources may loosen the through bolts. This may be noticed by broken or loose safety wire or cable and may appear as a blackened area at the through bolt head or threads. If loose, the following procedures apply:

A. Inspect the through bolt while installed. The through bolt must not be bent, cracked, or damaged.

WARNING:

LOOSE AND/OR DAMAGED THROUGH BOLTS MAY INDICATE SERIOUS INTERNAL DAMAGE IN THE ALTERNATOR WHICH MAY RESULT IN THE UNEXPECTED FAILURE OF THE ALTERNATOR.

B. If any through bolt is bent, cracked, damaged or housings are loose, the alternator should be replaced or overhauled.

C. If the through bolts are not damaged but appear only to be loose, it is permissible to apply proper torque. This may be accomplished by removing the alternator or in the aircraft as space permits.

(1) Cut the safety wire or safety cable from the bolt head at the drive end of the alternator and discard. Using a calibrated torque wrench in inch-pounds, apply 45-55 in-lbs (5.08-6.21 Nm) torque to the loose through bolt. After application of torque, check and apply the proper torque to the remaining through bolts.

(2) Apply new 0.032 inch stainless steel safety wire or safety cable (HET P/N RX-1961) through the drilled hole in the through bolt head at the drive end of the alternator. Refer to section 6.10 or 6.11 as applicable.

6.8 Terminal Hardware Removal and Installation

NOTE: The alternator must be disassembled to replace the insulator bushings and/or reestablish proper bottom nut torque.

A. Removal:

(1) Output Positive (+) Terminal: Using a 9/16 inch wrench, hold the bottom nut and loosen the top nut as shown in Fig. 6.3a Output Positive Terminal. This is required to prevent the loss of factory torque of the bottom nut. Remove & discard lockwasher.
   a. Output nuts are HET P/N MS35650-3312.
   b. Lockwashers are HET P/N MS35338-45.

(2) Output Negative (-) Terminal: Using a 7/16 inch wrench, hold the bottom nut and loosen the top nut as shown in Fig. 6.3a Output Negative Terminal Terminal. This is required to prevent the loss of factory torque of the bottom nut. Remove & discard lockwasher.
   a. Output nuts are HET P/N 8X-1063.
   b. Lockwashers are HET P/N 12X-0199.

(3) Ground Terminal: Using a 7/16 inch wrench, hold the bottom cupped nut and loosen the top cupped nut shown in Fig. 6.3a GROUND Stud. This is required to prevent the loss of factory preset torque of bottom nut.
   a. Ground nuts, HET P/N 40296.
   b. Ground stud is HET P/N 41038.

(4) Field Terminal(s): Using a thin 5/16 in. wrench, hold the bottom nut and loosen the top nut as shown in Fig. 6.3b Field Terminal. This is required to prevent the loss of the factory torque of the bottom nut. Remove and discard lockwasher.
   a. Field nuts are HET P/N 8X-0140.
   b. Lockwashers are HET P/N 12X-0194.

B. Installation:

(1) Output Positive (+) Terminal: Place new lockwasher, HET P/N MS35338-45 and the existing Output nut, HET P/N MS35650-3312 on the Output terminal. Using a 9/16 wrench, hold the bottom nut and tighten the top nut to a torque of 40 to 50 in-lbs (4.52-5.65 Nm). Refer to Fig. 6.3a Output Positive (+) Terminal.

(2) Output Negative (-) Terminal: Place new lockwasher, HET P/N 12X-0199 and the existing nut, HET P/N 8X-1063 on the output terminal. Using a thin 7/16 inch wrench, hold the bottom nut and tighten the top nut to a torque of 30 to 40 in-lbs (3.39-4.52 Nm). Refer to Fig. 6.3a Output Negative Terminal.

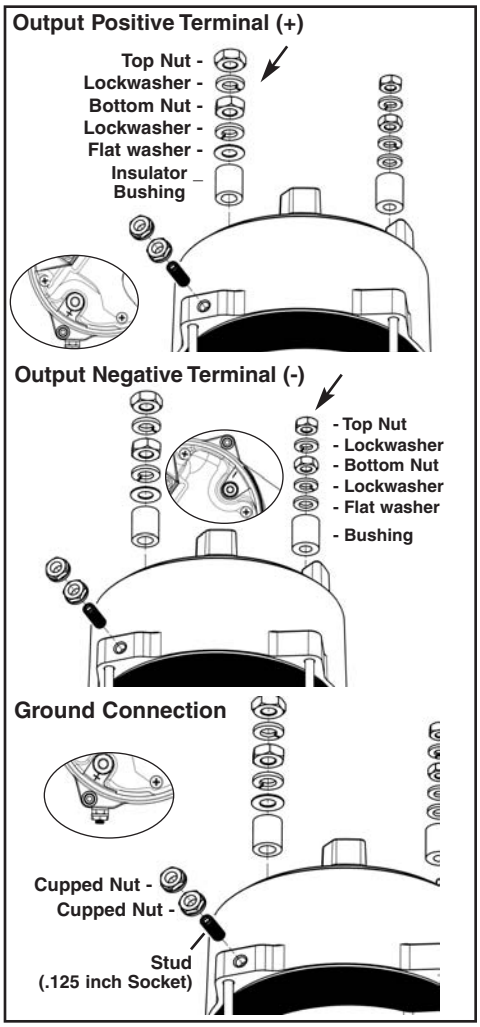

Figure 6.3a - Terminal Hardware Stack

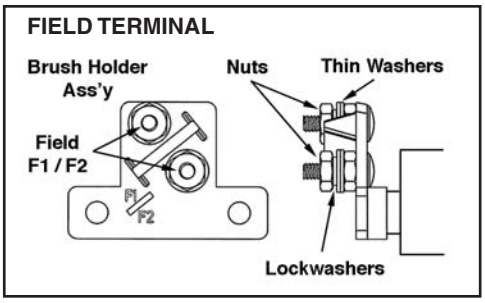

Figure 6.3b - Field Terminal Hardware Stack

(3) Ground Connection: Place the existing Ground Stud cupped nut, HET P/N 40296 on the Ground stud. Using a 7/16 inch wrench, hold the bottom cupped nut and tighten the top cupped nut to a torque of 30 to 40 in-lbs (3.39-4.52 Nm). Refer to Fig. 6.3a GROUND Stud terminal.

a. If the ground stud is loose, it may be replaced with a new HET P/N 41038 Stud and torqued to 70 to 85 in-lbs (7.91-9.60 Nm) using a 1/8 inch allen wrench. Torque the bottom cupped nut to 75 to 85 in-lbs (8.47-9.60 Nm).

(4) Field Terminal(s): Place new lockwasher, HET P/N 12X-0194 and the existing Field nut, HET P/N 8X-0140 on the Field stud. Using a thin 5/16 in. wrench, hold the bottom nut and tighten the top nut to a torque of 6 to 8 in-lbs (0.68-0.90 Nm). Refer to Fig. 6.3b Field Terminal.

(5) As standard practice, always apply a torque seal stripe to hardware once proper torque is achieved.

6.9 Materials

This section presents the current materials available for maintenance. Items are available through an HET authorized distributor and are the only parts available at this time. Some parts such as mounting hardware, hoses, and clamps may only be available from aircraft/engine (OEM).

A. Hardware

(1) One (1) each, Nut, Positive Output (+) terminal, P/N MS35650-3312.

(2) One (1) each, Lockwasher, Positive (+) terminal, P/N MS35338-45. Replace when removed.

(3) One (1) each, Negative Output (-) terminal, P/N 8X-1063

(4) One (1) each, Lockwasher, Negative (-) HET P/N 12X-0199. Replace when removed.

(5) As required, Cupped Nut, Ground stud terminal, HET P/N 40296.

(6) As required, Ground Stud, HET P/N 41038.

(7) As required, Nut, Field terminal, HET P/N 8X-0140.

(8) As required, Lockwasher, Field terminal, HET P/N 12X-0194. Replace when removed.

B. Specific Items

(1) As required, Cover, Output Shaft, HET P/N 41044.

(1) One (1) each, Clamp, V-Band, (alternator to engine) HET P/N 41047.

C. Special Items

(1) One (1) each, O-Ring, Output Shaft, HET P/N M83248/1-111. Replace when removed.

(2) One (1) each, O-Ring, DE Housing, HET P/N M83248/1-131. Replace when removed.

(3) Two (2) each, Brush assembly, HET P/N ALE-13A.

(4) Two (2) each, Screw, Brush Holder, HET P/N 03C44209B15.

(5) One (1) each, Brush Holder assembly, HET P/N ALU-3045BS. (optional)
(Includes holder, brushes, & brush retaining wire.)

(6) As required, Safe-T-Cable™, HET P/N RX-1961. (or 0.032 inch stainless steel safety wire.)

6.10 Applying Safety Wire

A. If applying safety wire, use 0.032 stainless steel per the standards outlined in AC43.13.1b or NASM-33540 of the latest revision. (Safety wire does not maintain fastener torque.)

6.11 Applying Safety Cable

A. If applying an HET P/N RX-1961 Safe-T-Cable™, follow the recommended procedures of the Safe-T-Cable™, manufacturer. Applicable detailed procedures may be found on the Safe-T-Cable™, website: http://www.dmctools.com.

(1) Use of the Safe-T-Cable™ requires the use of special tool kit DMC-1000-4R Tools and Parts Kit for 0.032" Safe-T-Cable™.

6.12 Installation on the Aircraft

To install the alternator on the engine, refer to the applicable engine and/or aircraft service and maintenance manuals. Always follow the OEM instructions.

General Installation

A. Make sure the aircraft battery and any external power has been disconnected.

B. Apply a drop of clean engine oil and install the small rotor shaft O-ring (P/N MS83248/1-111) onto the alternator drive spline and the same with the larger O-ring (P/N MS83248/1-131) to the alternator/engine DE pilot.

C. Position the alternator and install using the following procedure:

(1) Carefully align the drive splines on alternator shaft with the engine pad drive quill. Support the alternator so as to avoid side-loading the shaft during installation.

(2) Slide shaft into accessory drive quill until the mounting flange pilot engages fully with the accessory pad.

(3) While continuing to support the alternator, install the V-Band Clamp, position to center the clamp vee, and tighten the T-bolt nut.

(4) Tighten the T-bolt nut to a torque of 85 in-lbs (9.16 Nm) per Table 6.1. If available, OEM torque for the T-bolt nut shall supersede HET value.

D. Connect the Field wires, positive (+) output, negative (-) output, and ground stud cables on the proper terminals of the alternator. Refer to section 2.4b for locations.

E. Re-connect the cooling air supply and exhaust tubes.

F. Unless otherwise advised by the OEM, connect the positive battery cable to the positive (POS) battery terminal, then connect the aircraft ground cable to the negative (NEG) battery terminal.

G. Check the alternator for security and make a running performance test per the AFM or POH and the engine/aircraft service and maintenance manuals.

6.13 Special Conditions:

NOTE: For engine OEM's Special Condition "Sudden Stoppage", refer to the latest revision of of the engine manufacturers maintenance manual, section 05-50-00.

A. SUDDEN ENGINE STOPPAGE:

(1) If the engine has experienced "sudden stoppage" as defined by the engine manufacturer, the alternator may be impacted by this event. Although the alternator drive system is designed with a shear section which protects the engine from seizure of the rotating components inside the alternator, the drive spline may have been damaged and should be inspected.

(2) If "sudden stoppage" as defined by the engine manufacturer has occurred, the alternator must be removed and overhauled. Refer to the appropriate engine or airframe manuals to remove the alternator. ***Item A(2)a must be performed on any sudden stoppage and is provided for the use of qualified repair or overhaul shops.***

a. If the alternator has been involved in an accident with sudden stoppage, perform magnetic particle inspection (ASTM E 1444) to check the condition of the drive shaft. Fluorescent penetrant inspection (FPI) is required for the remainder of the alternator components. Use of FPI should be done per ASTM E1417 latest revision (supersedes MIL-STD-6866).

(3) If damage is found in step A(2), all supporting bracketry, V-Band Clamp, and hardware associated with the alternator should be inspected in accordance with the appropriate engine or airframe manuals.

(4) Upon completion, assure all steps are taken to properly return the aircraft to service.

B. LIGHTNING STRIKE:

NOTE: For aircraft and engine OEM's Special Condition "Lightning Strike", refer to the latest revision of the applicable manufacturers maintenance manual, section 05-50-00.

(1) Lightning strike is a very unpredictable event both in occurrence and in resultant damage. A lightning bolt entry point may have many exit points or only one. On a well bonded composite aircraft, the lightning bolt will stay on the outer surface throughout the aircraft with little damage to components. The path of the electrical current cannot easily be determined in most cases because while the current may surge through well bonded areas without damage, a gap in any metal contact point or to underlying metal structure will result in an arc, burn, or shattered composite. This is especially true for rotating parts such as gears or shaft splines.

(2) If a report of a potential or actual lightning strike is made, inspect the aircraft for entry and exit points for the lightning bolt to confirm that a strike has occurred. Use the engine and/or aircraft manufacturers maintenance manuals to accomplish these tasks.

(3) If a lightning strike has occurred, (especially if burns appear on the turbine blades or turbine spinner) remove the alternator and inspect for arc marks or burns.

a. Inspect the spline drive teeth, as an arc here may leave raised metal which will cause further damage when running.

b. Inspect the mounting points and bracketry for arc marks or burns at joints and attachments.

c. Inspect the alternator output and field wires. The small gage field wiring can vaporize when exposed to lightning currents.

(4) If evidence of a strike is observed and the alternator is being overhauled or replaced due to this evidence or due to malfunction, it is advised that the entire aircraft electrical system be inspected. Use the appropriate engine and/or aircraft manufacturers maintenance manuals to accomplish the task.

B. LIGHTNING STRIKE: (CONT'D)

(5) If there is no indication of arcing or other damage and a lightning strike cannot be confirmed, reinstall the alternator and check per the applicable airframe and engine manufacturers maintenance manual.

(6) Upon completion, test run the engine per the POH or AFM prior to returning the aircraft or rotorcraft to service. Make an appropriate logbook entry concerning the lightning strike.

6.14 Storage and Shelf Life:

A. STORAGE:

This section addresses the storing of new, overhauled or repaired alternators.

(1) Short term storage is up to but not exceeding twenty-four (24) calendar months.

a. Short term on the shelf: requires only that the unit be kept inside in the original packaging.

b. Short term on the aircraft (or unmounted engine): No additional action other than that required for the engine or aircraft is needed.

(2) Long term storage is storage up to but not exceeding twelve (12) calendar years.

a. Long term on the shelf: Requires that the alternator be removed from the box and from the plastic bag as originally packaged:

1 Discard the original bag.

2 Wipe or lightly spray outside with an electrically friendly preservative oil.

3 Place in a new bag that is specifically formulated for corrosion resistance in the storage of metal products. (Ref. Armor Poly VCI, Armor Protective Packaging, Howell, MI USA, www.armorvci.com or an equivalent.)

4 Place back into original shipping container and store in a cool dry environment.

b. Long term on the aircraft (or unmounted engine): If it is anticipated that the aircraft (or unmounted engine) will be in a long term storage situation:

1 As soon as practicable, lightly spray outside with an electrically friendly preservative oil.

2 No additional action other than that required for the engine or aircraft is needed.

B. SHELF LIFE:

(1) This alternator manufactured by HET has a shelf life of up to, but not to exceed, twelve (12) calendar years, regardless of storage or usage. The unit must be overhauled if this shelf life is exceeded. *Shelf life time applies only if storage requirements are observed.*