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COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR 23080 SERIES III

List of Part Numbers

23080-013 23080-014
23080-013A 23080-014A
23080-013B

TITLE PAGE

EXCLUSIVE DISTRIBUTORS

1. Contact Information

A. Customer Portal

For access to the Technical Publications Portal, Spares Orders Portal and Customer Support Contact, please visit:

http://www.safran-electrical-power.com/?lang=en and Click on the “Support and Services” link.

HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator 23080 Series III.

Attached to this transmittal letter is Revision No. 6 of the Component Maintenance Manual with IPL (original issue dated March 17, 1998).

REVISION 6, DATED JANUARY 20, 2023

Remove the complete existing manual and replace with this full revision of the manual. Retain the Highlights page(s) in the front of the manual for future reference.

This Component Maintenance Manual has been fully revised to include the latest engineering information and also to include Temporary Revisions and Service Bulletin(s) as listed in the Temporary Revisions and Service Bulletin List in the front of the manual.

Key items included in this revision:

- Copyright information date changed to 2023.
- Changed logo from Safran Power to Safran.
- Changes done in Introduction section:
  - Updated the overhaul practices.
- Changes done in Testing and Fault Isolation section:
  - Corrected the SPD reference from SPD 1000 to SPD 1001.
  - Added stator and housing assembly load sharing fault in the Table 1005- Component Testing Fault Isolation Table.
- Changes done in Disassembly section:
  - Incorporated the TR 24-21 to delete the paragraph 4.L.(3) and the associated Note. Added Note to give reason for not cutting the speed pickup lead wires at the pins.
- Changes done in Check section:
  - Added dampener plate gauge tool (P/N 19-601076) to the Table 5001 -Inspection tools and materials.
  - Updated the Para 8.K to use dampener plate gauge tool (P/N 19-601076) to check the splines of the dampener plate (240).
- Changes done in Repair section:
  - Incorporated the TR 24-23 to delete the website link “hstna.com”.

- Changes done in Fits and Clearances section:
  - Updated the acceptance limits for internal spline diameter of dampener plate.
- Changes done in Special Tools, Fixtures, And Equipment section:
  - Incorporated the SIL 23032-1910-24-01 Rev 1 to add Dampener plate gauge tool.
- Changes done in Illustrated Parts List section:
  - Incorporated the TR 24-24 to delete the website link “hstna.com” in vendor list.
  - Incorporated the TR 24-24 to replace the identification plate P/N 06-209284 (item 10001-30) for the effect codes A, D, E.
  - Updated the part list for figure 10001.
- Changes done in Storage section:
  - Incorporated the TR 24-22 to add Desiccant in the Table 15001 - Packaging Material.

The technical changes in this revision are individually identified with revision bars.

RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	Mar 17/98	Mar 17/98	SP
1	Dec 30/00	Dec 30/00	SP
2	Jun 30/01	Jun 30/01	SP
3	Feb 14/02	Feb 14/02	SP
4	Feb 26/08	Feb 26/08	SP
5	Oct 14/14	Oct 14/14	SP
6	Jan 20/23	Jan 20/23	SP

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RECORD OF TEMPORARY REVISIONS

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24-01	Various	Aug 5/02	Aug 5/02	SP	Apr 26/07	SP
24-02	Various	Nov 8/05	Nov 8/05	SP	Apr 26/07	SP
24-03	Various	Oct 25/06	Oct 25/06	SP	Apr 26/07	SP
24-04	10008	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-05	10009	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-06	10010	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-07	10012	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-08	5002	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-09	5017	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-10	5022	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-11	8001	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-12	8002 and 8003	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-13	1027	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-14	7003	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-15	9010	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-16	1008	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-17	1009	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-18	5025	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-19	5029	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-20	6019	Mar 28/14	Mar 28/14	SP	Oct 14/14	SP
24-21	3012	Feb 23/15	Feb 23/15	SP	Jan 20/23	SP
24-22	15001	Aug 12/19	Aug 12/19	SP	Jan 20/23	SP
24-23	6002	Oct 1/19	Oct 1/19	SP	Jan 20/23	SP

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials
24-24	10004	Oct 1/19	Oct 1/19	SP	Jan 20/23	SP
24-25	10007	Oct 25/19	Oct 25/19	SP	Jan 20/23	SP

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SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
23080-01X-24-01	Superseded	-	Oct 2/90				
23080-013-24-01	Incorporated	-	May 10/91				
23080-01X-24-02	Superseded	1	Apr 29/94				
23080-01X-24-03	Incorporated	-	Aug 16/94				
23080-01X-24-04	Incorporated	1	Oct 24/95				
23080-01X-24-05	Incorporated	1	Sep 12/97				
23080-01X-24-06	Incorporated	-	Apr 11/96				
23080-01X-24-07	Incorporated	1	Feb 14/97				
23080-XXX-24-01	Incorporated	3	Jan 24/97				
23080-XXX-24-04	Incorporated	-	May 26/95				
23080-XXX-24-05	Incorporated	1	Jun 27/97				
23080-360-24-01	Incorporated	-	Oct 11/05				
23080-3055-24-01	Incorporated	-	May 08/09				
23080-013A-24-02	Incorporated	-	Apr 16/10				

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23080-013-01	Invalid	1	Aug 03/92	23032-1910-24-01	Incorporated	1	Feb 14/22
23080-013-02	Limited Dist	-	Oct 10/94				
23080-013-03	Limited Dist	1	Aug 31/00				
23080-3110-01	Incorporated	-	Mar 15/94				
02-5600-04	Incorporated	4	Jul 07/15				
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23072-1400-01	Incorporated	1	Feb 07/94				
23075-120X-01	Superseded	1	May 22/90				
23075-1230-01	Superseded	-	Feb 13/92				
23701	Incorporated	1	Jun 19/00				
23703	Incorporated	-	Jan 24/97				
23704	Cancelled	-	Aug 24/01				
23080-013-04	Limited Dist	1	Sep 13/00				
23080-013-05	Limited Dist	-	Aug 31/00				
23080-013-06	Limited Dist	-	Aug 31/00				
23080-013A-24-07	Limited Dist	1	Jun 10/04				
GSIL 2006-01	Valid	0	Sep26/06				
GSIL 2006-02	Valid	1	Feb 10/09				
GSIL 2006-03	Valid	0	Sep 15/06				
GSIL 2008-01	Valid	0	Feb 29/08				
GSIL 2011-01	Valid	0	Dec 16/11				
3CPE0-24-003	Valid	0	Mar 24/14				
GSIL 2020-01	Valid	1	Apr 16/21				
GIL K4358-24-003	Valid	1	Jan 10/17				

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for overhaul and service repair of the 23080 Series III DC Starter-Generators. Line maintenance is supported by Maintenance Manual (MM) 23700. A DC Starter-Generator overhaul includes:

- Replacement of non-reusable parts such as bearings, brushes and miscellaneous hardware.
- Cleaning of subassemblies.
- Detailed inspection of parts, electrical check of all electromagnetic parts (including; insulation integrity check), Non-Destructive Test (NDT) inspections, and complete acceptance testing.

  NOTE: Magnetic particle inspection of the parts as specified in the CHECK section is only required when an overhaul of the generator assembly is being done.

- Check of brush holder alignment.
- Commutator refinishing and check balance.
- Reconditioning of surface finishes as required.
- Repair/rework of parts as required.
- Re-certification including final assembly, records, and release tags.

Only an overhaul and an acceptance test authorize assignment of zero operating hours time since overhaul (TSO) to a DC Starter-Generator. Repairs performed that are partial of an overhaul do not affect TSO and equipment is released on a continue time basis.

An illustrated parts list is included at the back of this CMM for component identification and ordering of approved replacement parts. The structure and content of this manual is in general accordance with requirements established by the Air Transport Association of America (ATA) for aircraft CMMs. This manual is formatted to conform to ATA Specification No. 100.

Give careful attention to applicable warnings and cautions. Before starting any overhaul procedure, become thoroughly familiar with the capabilities and limitations of the equipment. Make sure all necessary safety equipment, test equipment, repair materials, special tools, and fixtures are on hand.

If errors, omissions, or other technical discrepancies exist in CMM, fill out a Technical Publication Comment Form. Send a copy of form to: Technical Publications Supervisor, Safran Power USA or provide information to Technical Publications e-mail at lps.twn.techpubs@safrangroup.com.

Publications can be obtained by going to the Technical Publications Web Portal. Go to https://techpubsdistribution.safran-electrical-power.com.

2. User Qualification and Certification Requirements

The information contained in this manual is intended for persons authorized to perform maintenance, preventative maintenance, rebuilding, and alterations in accordance with Federal Aviation Regulation (FAR), Part-43.3.

3. Quality Assurance Requirements

The repair stations quality assurance activity is responsible for the correct performance of all tests and inspections specified in this manual. The quality assurance activity will also be responsible for maintaining all necessary test, inspection, and maintenance records for each unit received for service.

All instrumentation and inspection equipment must be calibrated and controlled in accordance with International Standards Organization (ISO) standard 10012, with all standards traceable to the National Bureau of Standards or an equivalent standards regulatory authority.

The quality assurance activity will be responsible for certifying that personnel, skills, and materials meet the requirements of the work to be performed. Components of the DC Starter-Generator undergoing overhaul that are recovered as products of disassembly must be examined 100% to determine serviceability.

The quality assurance activity must maintain documented evidence that specifications applicable to special processes such as soldering, nondestructive testing (NDT), plating, etc. have been complied with during repair and/or overhaul of the DC Starter-Generator.

4. Safety Advisory

This manual describes physical and chemical processes that require the use of chemicals or other commercially available materials that require precautionary attention.

The user of this manual should obtain Material Safety Data Sheets and Occupational Safety and Health Act (OSHA) Form 20 or equivalent from the manufacturers or suppliers of materials to be used. The user must become thoroughly familiar with and follow all manufacturer/supplier procedures, recommendations, warnings, and cautions for the safe use, handling, storage, and disposal of materials that require precautionary attention. Users of this manual are also advised to refer to the applicable safety information contained in the “NIOSH Occupational Guideline for Chemical Hazards” published by the United States Department of Labor.

WARNING: **ALERTS OPERATING AND MAINTENANCE PERSONNEL TO POTENTIAL HAZARDS THAT COULD RESULT IN PERSONAL INJURY; WARNINGS DO NOT REPLACE THE MANUFACTURER’S RECOMMENDATIONS.**

CAUTION: ALERTS OPERATING AND MAINTENANCE PERSONNEL TO CONDITIONS THAT COULD RESULT IN EQUIPMENT DAMAGE.

5. Materials List

The materials listed in this section are necessary for processes throughout this manual. A warning and/or caution will precede the use of materials listed in Table Intro 1.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH MANUFACTURER OR SUPPLIER RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Material	Used in
Acrylic Coating	ASSEMBLY
Chemical Film Solution	REPAIR
Corrosion Preventative	CLEANING
Detergent	CLEANING
Epoxy Bonding Cement	ASSEMBLY
Isopropyl Alcohol	CLEANING, ASSEMBLY, DISASSEMBLY, CHECK
Loctite Grades A, D, E, N	ASSEMBLY
Lubricating and Assembly Paste	ASSEMBLY
Red Insulating Enamel	ASSEMBLY, REPAIR
Thread Sealing Compound	ASSEMBLY
Wash Primer	REPAIR
Zinc Chromate Primer	REPAIR
Zinc Phosphate Coating	REPAIR

Table Intro 1 - Material Table

6. Non-Safran Power Authorized Components and Processes Policy

Safran Power authorizes the use of Safran Power spare parts which meet stringent engineering design specifications and quality standards, and have traceability to having been procured and certified to design specifications by Safran Power Quality Assurance incoming and in process inspection systems. Other than the type certification holder (airframe manufacturer), Safran Power Equipment Service Centers are the only authorized distributors of Safran Power replacement parts and complete units.

It is the obligation of all repair and service facilities to provide the FAA, or any other in-country air authority, with proper traceability documentation indicating approval of all spare parts, materials, and processes to ensure configuration compliance and continued air worthiness.

The use of any non-Safran Power authorized parts, or any parts not having been submitted to Safran Power Quality Assurance inspection system will invalidate any and all factory warranties. All Safran Power warranties are automatically voided on any Safran Power designed unit that has been modified by the installation of any unauthorized parts, materials, or unapproved processes supplied by other outside services. The repair station's quality assurance activity will assume product liability for all units that have been modified in this fashion.

Damage resulting from the use of non-Safran Power replacement parts, materials, or processes is not covered by the Safran Power warranty or service policy for any product or application.

7. Abbreviations

The following abbreviations are used in this manual:

ADE	- anti-drive end
DE	- drive end
GCU	- Generator Control Unit
H_2O	- Water
IAW	- in accordance with
in.	- inch(es)
IVD	- Ion vapor deposited
kPa	- kilopascal(s)
lbf.ft	- pound force foot
lbf.in	- pound force inch
µF	- micro Farad
NDT	- Non-Destructive Test
N·m	- Newton meter
PSIG	- pounds per square inch gage
QAD	- Quick Attach/Detach
rms	- root mean square
rpm	- Revolutions Per Minute
SP	- Safran Power
SPD	- Standard Practice Document
TSO	- time since overhaul

DESCRIPTION AND OPERATION

1. Introduction

NOTE: The term “Series III” does not refer to the equipment covered in this manual. The term “Series III” distinguishes this manual from other Component Maintenance Manuals covering similar equipment.

The 23080 Series III DC Starter-Generator (See Figure 1) operates as a motor to provide torque for engine starting and as a generator to provide DC electrical power after engine starting is complete. Refer to Paragraph 2. of this section for performance and equipment characteristics.

The starter-generator consists of an armature that is enclosed by, and rotates within a stator and housing assembly. The armature is supported by two bearings. At the drive end (DE) of the armature, a bearing is supported by a drive end bearing support assembly. At the anti-drive end (ADE) of the starter-generator, the second bearing is supported by the bearing and brush support assembly. Models covered in this manual incorporate optional bearing preload configuration which improves bearing wear characteristics.

The starter-generator’s drive shaft is installed in the armature shaft which is hollow. The armature shaft and drive shaft have mating splines that engage at the anti-drive end of the starter-generator. At the drive end, a dampener assembly absorbs torsional vibration generated by changes in engine gearbox speed and electrical load conditions. The dampener assembly is made up of a dampener backplate, a friction ring and a dampener plate. Also, at the drive end of the starter-generator is a speed pickup that provides a signal to the generator control unit (GCU) for starter cutoff.

A fan is attached to the anti-drive end of the drive shaft. The fan supplies forced air cooling for on-ground operation. Fins in the bearing and brush support assembly improve cooling by distributing airflow through the generator. In flight, the starter-generator is blast-cooled through the air inlet and the user’s air ducting system in addition to the fan.

A quick-attach-detach (QAD) kit eases starter-generator installation and removal, to and from the aircraft. A QAD kit is comprised of a mounting adapter that attaches to the engine gear box accessory drive pad, and a V-band clamp which secures the starter-generator to the mounting adapter. The 23080 Series III DC Starter-Generators and associated parts are listed in the ILLUSTRATED PARTS LIST section.

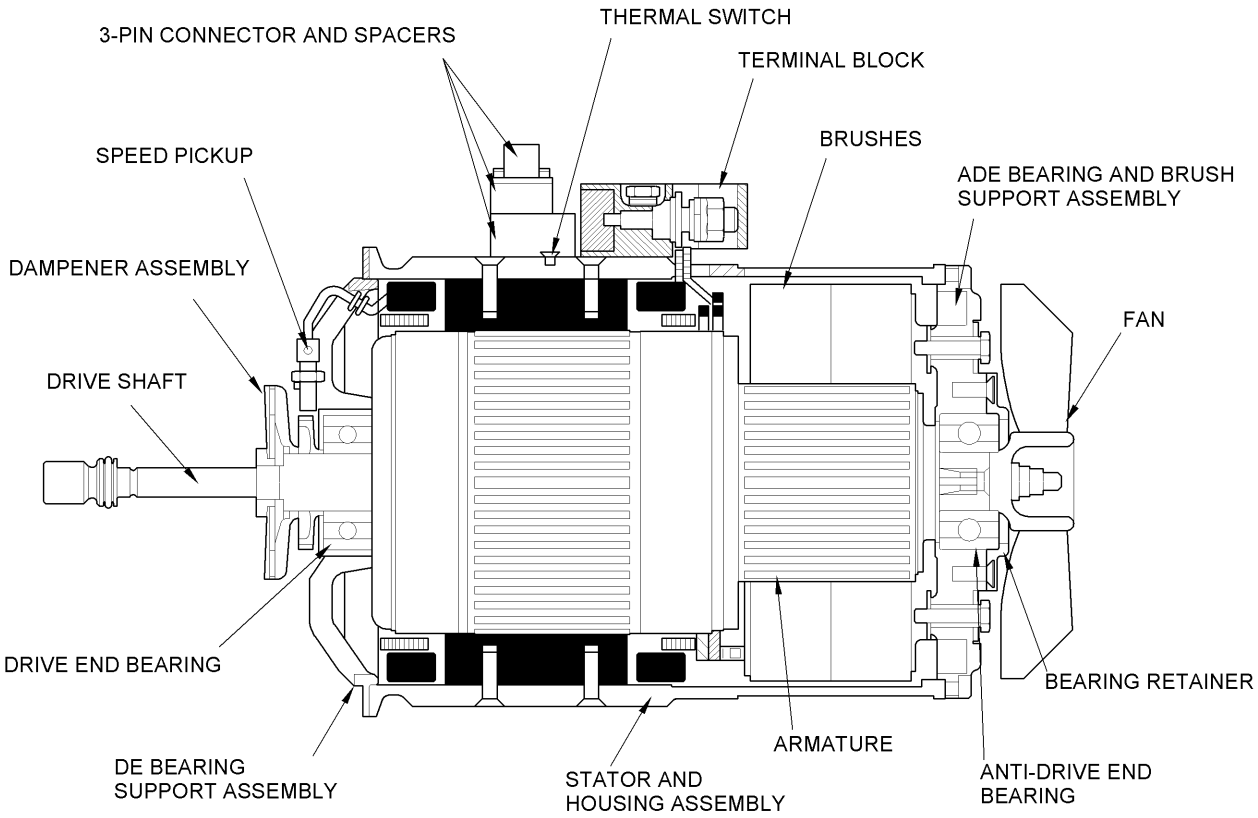

Figure 1 - Typical DC Starter-Generator Features

2. Equipment Specifications

Details of equipment specifications are contained in this section.

Characteristic	Specification
Output Rating	12 Kilowatts
Generator Rating for Continuous Load Within Speed Range	400 Amps at 30 VDC from 6,800 to 12,000 rpm. 27 VDC with 0.5Ω in external field control.
External Starting Power Supply	Self-limiting current load of 2,000 Amps max at 28 VDC, 0.005Ω aircraft circuit resistance.
Cooling	Self cooled with integral fan for ground operation. Combination self-cooled and blast cooled in flight (models 23080-013A and 23080-014 only)
Air Inlet Opening Diameter	3.00 inch (76,2 mm)
Direction of Rotation	Counterclockwise (viewed from drive end)
Drive Spline & Mounting Flange Specification	Drive spline conforms to MS3327-2. Mounting flange modified.
Spline Teeth (Number)	12
Spline Pitch Diameter	0.600 inch (15,24 mm)
Drive Shaft Shear Torque	1,600 lbf.in. (180,80 N·m)
Terminal Designations	Shunt Start B+ Positive E- Negative A+ Shunt Field D Equalizer

Table 1 - Equipment Specifications

Model Number	Start-Generator lbs. (kg)	QAD Kit lbs. (kg)	Overhung Moment lbf.in. (N·m)
23080-013 23080-013A 23080-013B	35.7 (16,19) without air inlet and QAD kit	N/A	N/A
23080-014	38.2 (17,32)	1.97 (0,83)	220 (24,86)
23080-014A	37.7 (17,10)	1.97 (0,83)	215 (24,29)

Table 2 - Overhung Moment and Weight for DC Starter-Generators

3. Equipment Improvements and Modifications

23080 Series III DC Starter-Generator may incorporate one or more modifications. A modification of a particular starter-generator is indicated by a letter in the MOD status box on the identification plate or modification status label. Information regarding modifications of 23080 Series III DC Starter-Generators is detailed in various service bulletins listed in the SERVICE BULLETIN LIST at the front of this CMM and also referenced by model number effectivity in the ILLUSTRATED PARTS LIST section of this CMM.

4. DC Starter-Generator Operation

Electromagnetic interaction between the armature and stator produces output torque during engine starting and DC electrical power during engine operation.

A. Starter Operation

During the engine start cycle the aircraft power bus applies DC voltage across terminals B+ and E-, supplying current to the armature and stator windings. At the same time, a voltage is applied to shunt field terminals A and E- from a Generator Control Unit (GCU). The starting power can be supplied by aircraft batteries or a ground power source. See Figure 2 for a schematic diagram of a typical shunt start DC starter-generator.

During engine start, as the rotational speed of the armature increases, the magnetic flux generated by the shunt field windings creates a back Electromotive Force (EMF) that opposes the voltage supplied from the starting power source. This causes the armature current and the starter output torque to decrease. A feature known as “field weakening” reduces the back EMF, thereby improving starter-generator performance.

Field weakening improves performance by allowing the starter-generator to provide assisting torque at higher speeds. By regulating the shunt field current, field weakening also reduces the possibility of “hot” or “hung” starts by smoothing the transition between start mode and generator mode, achieving more reliable engine starts.

B. Generator Operation

Following starter operation the GCU will “build up” the output voltage from the generator residual voltage. During generator operation, the machine provides a DC output (terminals B+ and E-) regulated by the generator shunt field current (terminal A). By quickly reacting to changes in generator operating conditions such as engine speed or electrical load, the GCU regulates the current level provided to the generator shunt field (terminal A). By regulating the shunt field current the system voltage is maintained at a nominal 30 VDC.

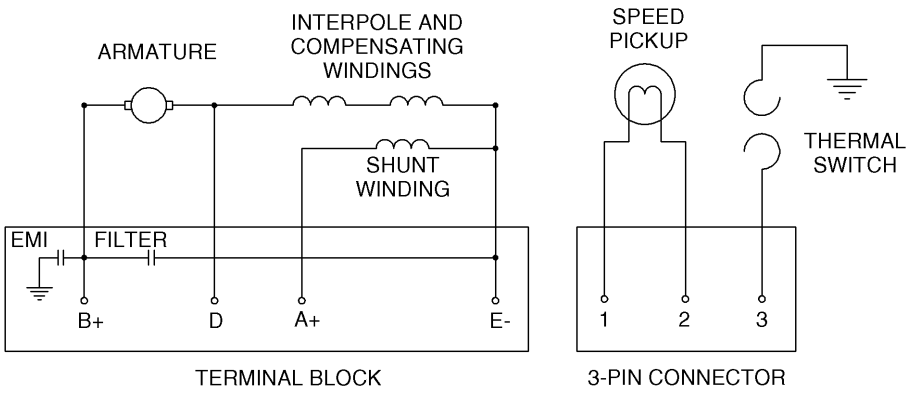

Figure 2 - Shunt Start DC Starter-Generator Schematic

5. Mod Status

See Table 3 for the latest MOD level of each Starter-Generator model:

MOD					Part Number	Description
Model 23080						
-013	-013A	-013B	-014	-014A		
A	-	-	A	A	03-6010-10	BEARINGS DATED COATED 8/87 AND LATER
B	-	-	B	B	03-6010-14	BEARINGS
C	-	-	C	C	03-6010-17	BEARINGS
D	-	D	D	D	03-6010-18	BEARINGS
E	-	E	E	E	23080-360	BEARING AND BRUSH SUPPORT ASSEMBLY
F	-	F	F	F	23080-1902	BRUSH
G	-	G	G	G	23080-370	ARMATURE
H	-	H	H	H	23080-1349	D.E. BEARING SUPPORT ASSEMBLY
J	-	J	J	J	23080-306	STATOR AND HOUSING ASSEMBLY
K	-	-	K	K	23080-1971	BRUSH
L	-	L	L	L	23080-380	D.E. BEARING SUPPORT ASSEMBLY (PRE- LOAD)

Table 3 - MOD Status Chart

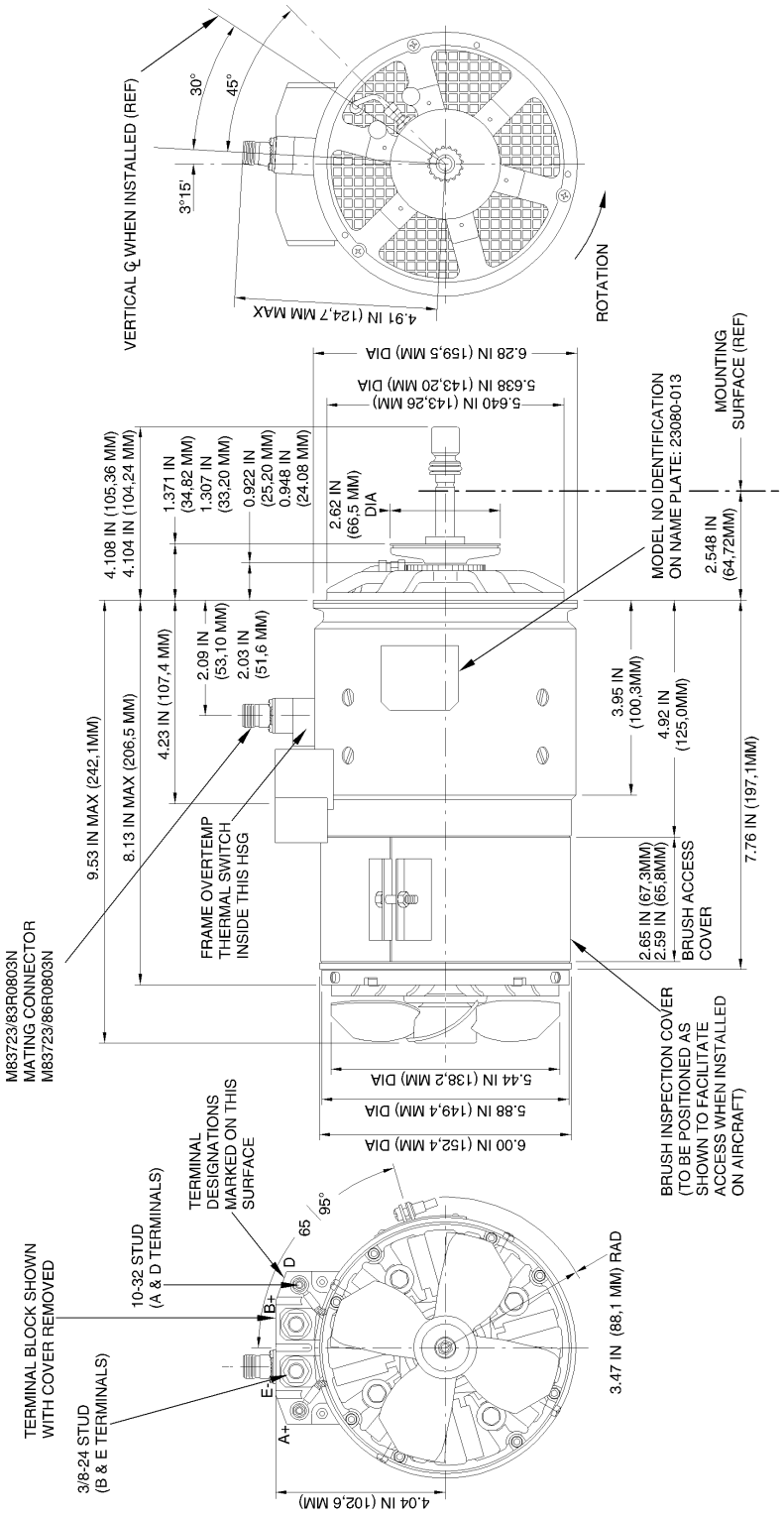

Figure 3 - Outline Drawing

TESTING AND FAULT ISOLATION

1. Introduction

WARNING: THE DC STARTER-GENERATOR CAN PRODUCE HIGH OUTPUT CURRENT CAPABLE OF CAUSING SEVERE SHOCK OR DEATH. MAKE SURE ALL POWER IS SHUT OFF TO GENERATOR BEFORE REMOVING OR REPLACING TEST EQUIPMENT, INSTRUMENTS, OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE CIRCUIT" TESTS AND FAULT ISOLATION PROCEDURES.

Prior to performing any testing, confirm that starter-generator is clean per CLEANING. Inspect for good mechanical condition per CHECK.

The section describes performance tests which are classified as either verification or acceptance tests. Verification testing assists in fault isolation or to confirm the cause for removal, before repair or overhaul of a starter-generator takes place. An acceptance test constitutes a complete functional check-out and is conducted after overhaul. Record all test results on a copy of data sheet provided at the end of acceptance testing procedures.

Verification Testing – For confirmation of cause for removal or to qualify the unit for continued service, the starter-generator must be examined in accordance with CHECK section before testing. A starter-generator that passes initial inspection may be tested in accordance with this section to determine performance or isolate a fault. When a fault is identified, refer to Fault Isolation tables in this section to determine probable cause.

Acceptance Testing - A starter-generator that has been overhauled or repaired and is ready to be returned to service must be tested in accordance with this section to verify performance standards. Only when an acceptance test is fully completed, in the order given, and the unit has passed all tests, can zero operating hours time since overhaul (TSO) be assigned to an overhauled starter-generator.

2. Test Conditions

Refer to Table 1001 for a list of performance test conditions.

Parameter	Operating Condition
Ambient Temperature	77° ± 27° F (25° ± 15° C)
Barometric Pressure	Ambient atmospheric at sea level up to 1,500 ft (457,2 m).
Brush Seating Procedures	Refer to Safran Power Standard Practice Document (SPD) 1006 for brush installation, seating, and run-in procedures.

Table 1001 - Performance Test Conditions

Parameter	Operating Condition
Forced Cooling Air	Air pressure equal to 6 inch (15 cm) H_2O, measured 12 inch (30,5 cm) upstream of starter-generator air inlet.
	For model 23080-014: Cooling air is supplied through a straight air inlet duct 3 inch dia. x 36 inch long (7,6 cm dia. x 91,4 cm long).
	For models 23080-013, -013A, -013B and -014A: A suitable adapter is used to connect the unit to a straight cooling air inlet duct, 3 inch dia. x 36 inch long (7,6 cm dia. x 91,4 cm long).
Physical Mounting	Drive shaft must be in horizontal position.

Table 1001 - Performance Test Conditions

3. Test Equipment

Refer to Table 1002 for a list of special tools, fixtures, and equipment needed for testing and fault isolation. Equivalent substitutes may be used for items listed.

NOTE: Airflow meters and pressure gauges used in the testing of this unit should be certified and calibrated in accordance with ISO10012-1 or should have current calibration traceable to a National Bureau of Standards (NBS) standard. If properly calibrated equipment is not available, the Unit Under Test (UUT) should be sent to an authorized Safran Power repair facility for all the procedures in this manual.

Equipment	Range and Accuracy or Equipment Rating	Ref. Des.
Commutation Viewing Adapter	SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section	(Figure 9003)
DC Ammeter	Range: 0 to 10 A Accuracy: ±1% of reading	A_1
DC Variable Power Supply	Range: 0 to 30 VDC	Power Supply
DC Voltage Regulator	Range: 0 to 30 VDC	Voltage Regulator
DC Voltmeter (2 req'd)	Range: 0 to 50 VDC Accuracy: ±1% of reading	V_2, V_3
DC Voltmeter (Generator)	Range: 0 to 50 mVDC Accuracy: ±1% of reading.	V_1
DC Voltmeter (Starter)	Range: 0 to 100 mVDC Accuracy: ±1% of reading.	V_1
DC Voltmeter	Range: 0 to 10 VDC Accuracy: ±1% of reading	V_4

Table 1002 - Test Equipment

Equipment	Range and Accuracy or Equipment Rating	Ref. Des.
Generator Drive Stand	Range: 4,000 to 20,000 rpm Accuracy: ±5 rpm of reading	Not illustrated
Generator Load Switch	Rating: 30 VDC, 500 A	SW_1
High Potential Tester	Rating: 250 VAC RMS, commercial frequency	Not illustrated
Manometer	Range: 0 - 10 inch (0 to 254 mm) H_2O Accuracy: ±5% of reading	Not illustrated
Oscilloscope	Digital: Band width of 100 MHz Sampling rate of 100 MS/s Analog: Bandwidth of 60 to 100 MHz	Not illustrated
Precision Shunt (Generator)	Rating: 500 A; 50 mVDC	SH_1
Precision Shunt (Starter)	Rating: 1000 A; 100 mVDC	SH_1
Shunt Field Switch	Rating: 30 VDC, 10 A	SW_3
Dummy Terminal Block	Use dummy terminal block during testing to avoid damage to filter capacitors.	Not illustrated
Thermometer (or other temperature measuring device)	Range: 32° to 260° F (0° to 127° C) Accuracy: ±1° F (0,5° C)	Not illustrated
Variable Load Bank	Rating: 30 VDC, 0 to 400 A	Variable Load Bank
Voltage Regulator Switch	Rating: 30 VDC, 10 A	SW_2

Table 1002 - Test Equipment (Continued)

4. Generator Thermal Stabilization

Stabilization is reached when either of the following conditions is met:

- Temperature of shunt field winding (A-E), as determined by its resistance, rises no more than 2° F (1.1° C) in five minutes.
- Frame temperature measured on side opposite terminal block, does not rise more than 2° F (1.1° C) in five minutes.

5. Test Condition Setpoint Tolerances

Test condition setpoint must be set within tolerances indicated in Table 1003, exclusive of measurement accuracy.

Parameter	Test Condition Setpoint Tolerance
Speed (rpm)	±20 rpm
DC Voltage	±0.1 VDC
DC Current	±2.5 A
Cooling Air Pressure	±0.2 inch (5,1 mm) - water
Torque	±1.0 lbf.ft (±1,37 N·m)

Table 1003 - Setpoint Tolerances

6. Test Setup

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

A. Perform initial inspection.

(1) Examine starter-generator in a brightly lit work area. Refer to procedures in CHECK section. Inspection results determine whether disassembly and repair are required before testing.

B. Check brush seating.

NOTE: In a starter-generator being prepared for verification testing, installed brushes may or may not require brush seating.

CAUTION: THE STARTER-GENERATOR MUST BE SUPPORTED AT ALL TIMES DURING INSTALLATION OR REMOVAL. DO NOT ALLOW UNIT TO HANG UNSUPPORTED.

(1) Make sure all brushes (160) are correctly seated according to procedures in SPD 1006.

C. Clean the starter-generator.

NOTE: Make sure that starter-generator is clean before proceeding with Acceptance Testing.

(1) Refer to CLEANING section for details.

D. Attach dummy terminal block.

NOTE: Make sure that a dummy terminal block is attached to stator and housing assembly before proceeding with Acceptance Testing.

CAUTION: ACCEPTANCE TESTING CAN DAMAGE FILTER CAPACITORS INSIDE UNITS TERMINAL BLOCK.

(1) Refer to DISASSEMBLY section and ASSEMBLY section for details.

E. Attach air inlet (110) to starter-generator.

NOTE: 23080 Series III Starter-Generators (except 23080-014) are not supplied with a QAD kit or air inlet. Air inlets must be ordered separately and used during acceptance testing to supply cooling air to the starter-generator. Refer to the ILLUSTRATED PARTS LIST for QAD kit and air inlet part numbers.

(1) Attach air inlet (110) to starter-generator with four screws (120).

F. Install commutation viewing adapter.

(1) Remove brush access cover (130). Refer to DISASSEMBLY section for details.

WARNING: DURING OPERATION, THE DC STARTER-GENERATOR CAN PRODUCE A HIGH OUTPUT CURRENT CAPABLE OF CAUSING SEVERE SHOCK OR DEATH. MAKE SURE ALL POWER IS OFF TO STARTER-GENERATOR BEFORE REMOVING OR REPLACING TEST EQUIPMENT, INSTRUMENTS, OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE CIRCUIT" TESTS AND FAULT ISOLATION PROCEDURES.

CAUTION: STARTER-GENERATOR MUST BE SUPPORTED AT ALL TIMES DURING INSTALLATION OR REMOVAL. DO NOT ALLOW UNIT TO HANG UNSUPPORTED. EXCESSIVE BENDING LOADS ON DRIVE SHAFT CAN DAMAGE SHEAR SECTION.

(2) Put commutation viewing adapter on stator and housing assembly (500).

CAUTION: DO NOT CENTER BRACKETS DIRECTLY OVER AN OPENING IN STATOR AND HOUSING ASSEMBLY.

(3) Center brackets of commutation viewing adapter over one rib of stator and housing assembly (500).

(4) Insert screw into blind rivet nut on bracket of commutation viewing adapter and tighten screw to a torque of 25 to 35 lbf.in. (2,8 to 4,0 N·m).

G. Install starter-generator on test stand.

NOTE: The starter-generator mounts to the mounting adapter (part of the QAD kit) that is attached to the drive stand. A V-retainer coupling secures the starter-generator to the mounting adapter.

NOTE: Some starter-generators are not supplied with a QAD kit. QAD kits must be ordered separately and used during acceptance testing. Refer to the ILLUSTRATED PARTS LIST for QAD kit part numbers.

CAUTION: THE STARTER-GENERATOR MUST BE SUPPORTED AT ALL TIMES DURING INSTALLATION OR REMOVAL. DO NOT ALLOW UNIT TO HANG UNSUPPORTED. EXCESSIVE BENDING LOADS ON DRIVE SHAFT CAN DAMAGE SHEAR SECTION.

(1) Install mounting adapter on drive stand.

(2) While supporting anti-drive end of starter-generator, align and install drive end to mounting adapter plate.

(3) Make sure that drive stand and starter-generator mating splines are properly engaged.

(4) Install V-retainer coupling (10005-10) on mounting adapter and starter-generator. To secure, tighten nut to a torque of 70 lbf.in. (7,9 N·m).

H. Connect starter-generator to electrical test circuit.

(1) Turn all power OFF at drive stand.

(2) Connect generator to test circuit. See Figure 1001 for details.

(3) Assemble terminal block hardware to dummy terminal block. Refer to ASSEMBLY section for details.

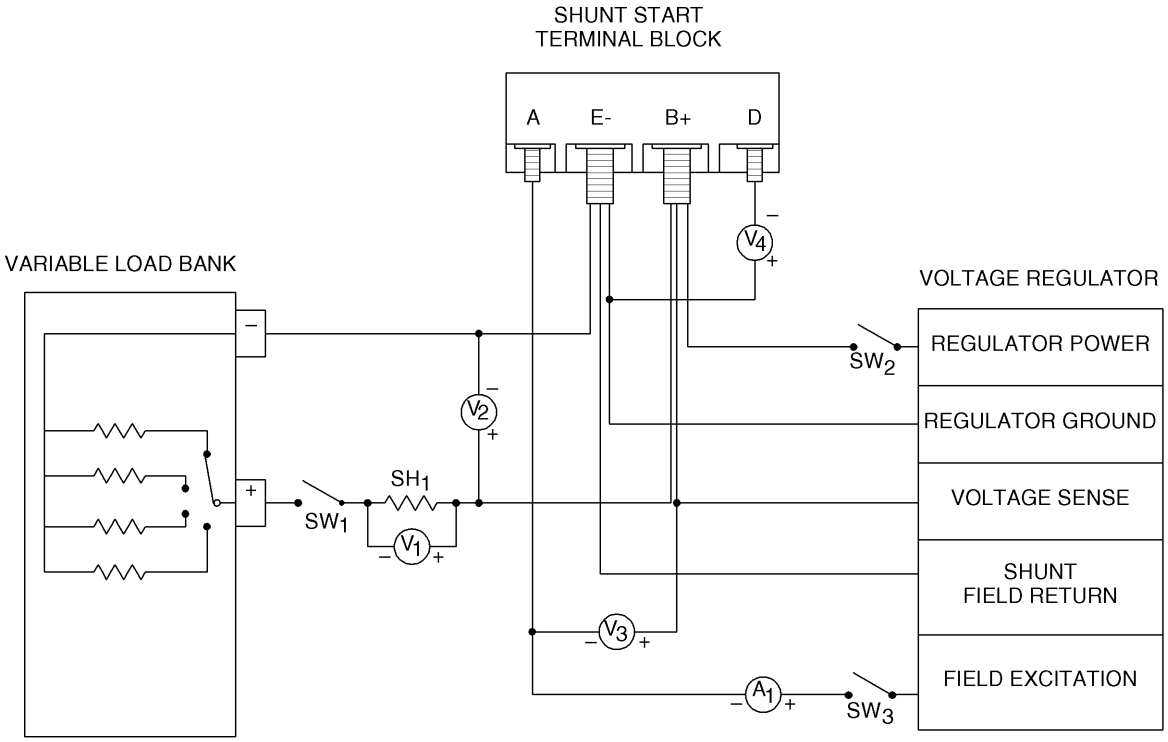

Figure 1001 - DC Starter-Generator Test Connection Diagram

7. Test Procedures

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

CAUTION: IF AN ACCEPTANCE LIMIT IS EXCEEDED BY EVEN A SMALL MARGIN, DO NOT CONTINUE TESTING. CONTINUED TESTING CAN DAMAGE STARTER-GENERATOR.

Tests must be performed in the following sequence.

WARNING: MAKE SURE THAT ALL POWER IS SHUT OFF TO THE STARTER-GENERATOR BEFORE REMOVING OR REPLACING COMPONENTS OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE" CIRCUIT TESTS AND TROUBLESHOOTING PROCEDURES. DURING OPERATION, THE STARTER-GENERATOR PRODUCES A VERY HIGH AMPERAGE OUTPUT THAT CAN CAUSE SEVERE SHOCK OR DEATH.

A. Continuous operating speed and equalizing voltage.

(1) Install thermocouple on the outside of the stator and housing assembly (500) in an area adjacent to a stator main pole.

(2) Install a second thermocouple in the air inlet opening.

(3) Operate starter-generator at 12,000 rpm, 30 VDC (V_2), 400 A (V_1/SH_1), until stabilized. Refer to Paragraph 4.

(4) Measure and record inlet air temperature.

(5) Measure and record winding or frame temperature.

(6) Measure and record the voltage between terminals D and E (V_4). Measured equalizing voltage (V_4) must fall in the range shown in Figure 1002.

NOTE: For starter-generator 23080-013A and those identified with modification status "J", the measured equalizing voltage between terminals D and E must be multiplied by a correction factor of 0.94.

(7) While the generator is still hot, immediately proceed to minimum speed for regulation test.

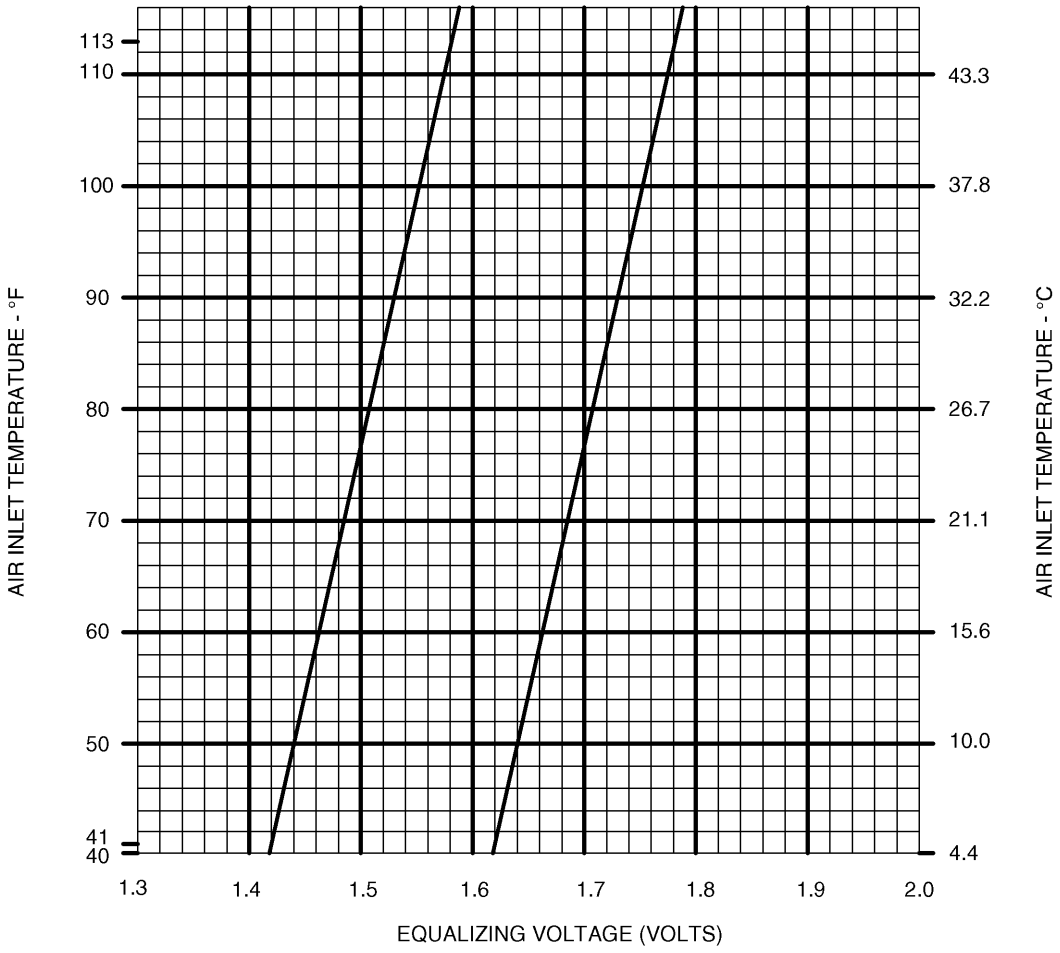

Figure 1002 - Equalizing Voltage Acceptance Limits

B. Minimum speed for regulation test:

(1) Operate starter-generator at the minimum speed for regulation; 6,600 rpm, 29.5 VDC (V_2), and 250 A (V_1/SH_1). Stabilization not required.

(2) Measure and record voltage between terminals B and A (V_3).

(3) Measure and record field current (A_1).

(4) Calculate and record external field circuit resistance between terminals B and A by dividing the B to A voltage (V_3) by the field current (A_1).

(5) Acceptance Limits:

(a) The field current must not be more than 10 A.

(b) The calculated external field circuit resistance must be 0.5 Ω or more.

C. Minimum speed test.

(1) Operate Starter-Generator at 5,520 rpm, 27.0 VDC (V_2) and 150 A. Stabilization is not required.

(2) Measure and record voltage between terminals B and A (V_3).

(3) Measure and record field current (A_1).

(4) Calculate and record external field circuit resistance between terminals B and A by dividing the B to A voltage (V_3) by the field current (A_1).

(5) Acceptance limits:

(a) The field current must not be more than 10 A.

(b) The calculated external field resistance must be 0.4 Ω or more.

D. Overspeed test.

(1) With starter-generator still hot as a result of testing, increase speed to 14,000 rpm (with field switch open) for 5 minutes.

(2) Acceptance Limits:

(a) No indication of failure (throwing of varnish, solder, noise, vibration, loosening of parts).

E. Commutation voltage.

(1) Operate the starter-generator at 12,000 rpm, 30 VDC (V_2), 200 and 400 A (V_1/SH_1).

(2) Visually examine the condition of commutation.

NOTE: The proper angle for viewing commutation is approximately 30 to 45 degrees from the brush box as shown in Figure 1003.

(3) Acceptance Limits:

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush (160) and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush (160).

(b) Unacceptable (pin point) commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush (160).

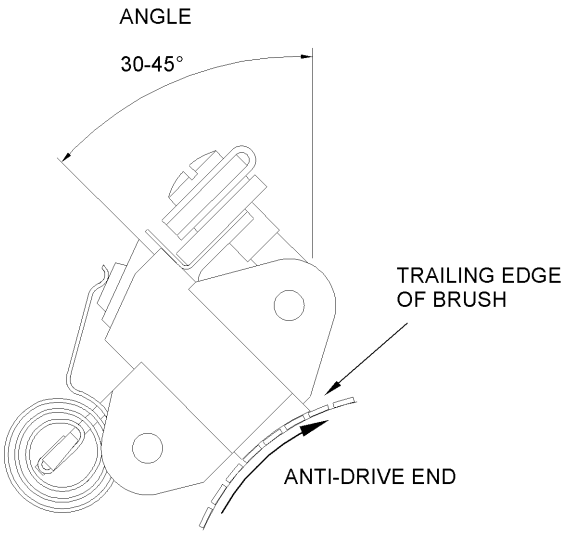

Figure 1003 - Correct Viewing Angles

F. Speed pickup test.

(1) Connect a 20 kΩ ± 10% load across pins 1 and 2 of connector (330). See Figure 1004.

(2) Connect oscilloscope, set at 0.5 v/cm and 5 millisecond time sweep, across pins 1 and 2 of connector (330).

(3) With field switch (SW_3) open, adjust starter-generator speed to 6,000 rpm.

(4) Adjust oscilloscope for display of 2 or 3 cycles.

(5) Measure and record peak-to-peak voltage of speed pickup output voltage.

(6) Observe speed pickup output voltage waveforms.

(7) Acceptance Limits:

(a) Peak-to-peak voltage: 2.5 V Min. to 4.5 V Max.

(b) Refer to Figure 1005 for acceptable voltage waveform.

(c) The frequency of the signal must be from 4150 to 4250 Hz.

NOTE: If unacceptable results are reached, adjust air gap of speed pickup for correct voltage reading and waveform.

(8) Disconnect and remove load from pins 1 and 2 of connector (330).

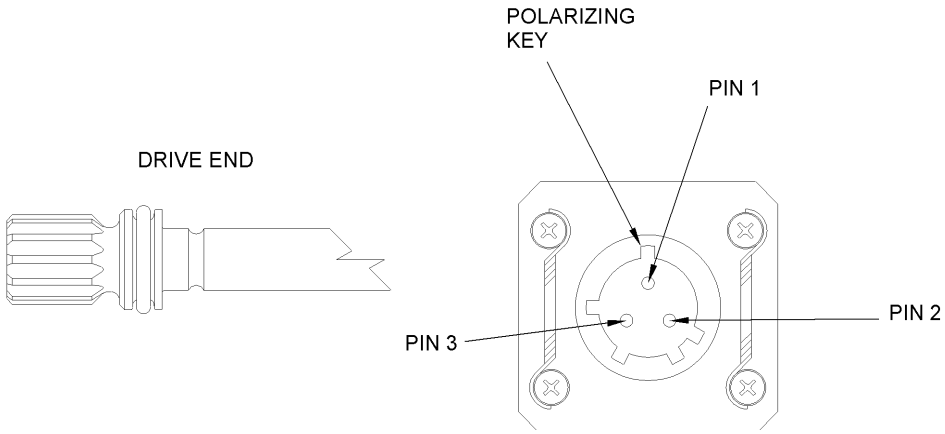

Figure 1004 - 3-Pin Connector

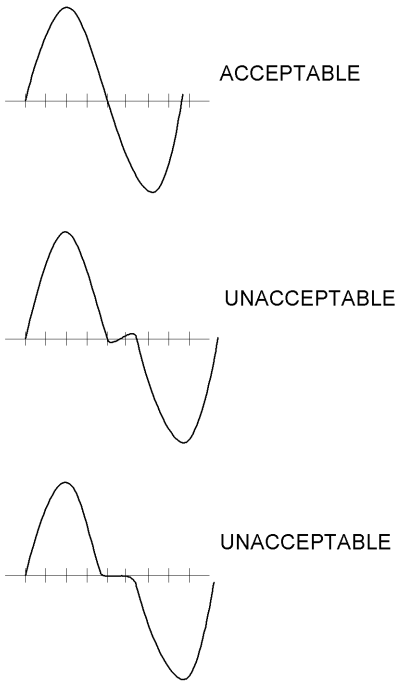

Figure 1005 - Acceptable Voltage Waveform

G. Starter-generator dielectric test.

WARNING: BEFORE YOU USE THE HIGH VOLTAGE TESTER, MAKE SURE THAT THE POWER SWITCH IS IN THE 'OFF' POSITION. MAKE SURE THAT NO PERSON TOUCHES THE EQUIPMENT OR THE PROBES. THIS WILL PREVENT DEATH OR INJURY FROM ELECTRIC SHOCK.

CAUTION: DO NOT DO DIELECTRIC TESTING ON A MACHINE THAT HAS NOT BEEN FULLY CLEANED.

(1) Disconnect starter-generator from test circuit.

(2) Make sure that a dummy terminal block is attached to the starter-generator. Refer to Paragraph 6.D.

(3) Remove commutation viewing adapter.

(4) While machine is still hot as a result of testing, connect all stator terminal leads (A+, B+, D and E-) of dummy terminal block together.

(5) Attach positive (red) lead of high pot tester to connected terminal leads.

(6) Attach negative (black) lead of high pot tester to an unfinished surface of the starter-generator frame.

WARNING: FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL LEADS DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH.

CAUTION: INCREASE OR DECREASE THE TEST VOLTAGES SLOWLY (100 VOLTS PER SECOND, MAXIMUM). INCREASING OR DECREASING THE VOLTAGE TOO QUICKLY CAN CAUSE SERIOUS DAMAGE TO THE STARTER-GENERATOR.

(7) Apply dielectric test voltage of 250 V rms for one minute or 300 V rms for one second (commercial frequency) between the circuit and machine frame.

(8) Slowly decrease voltage to zero.

(9) Turn the power supply OFF.

(10) Disconnect the electrical test leads from the test unit.

(11) Acceptance Limits:

(a) Any arcing as evidenced by flashover (surface discharge), sparkover (air discharge) or breakdown (puncture discharge) will be evidence of damp, dirty, weak or defective components.

H. Speed pickup dielectric test.

WARNING: **BEFORE YOU USE THE HIGH VOLTAGE TESTER, MAKE SURE THAT THE POWER SWITCH IS IN THE 'OFF' POSITION. MAKE SURE THAT NO PERSON TOUCHES THE EQUIPMENT OR THE PROBES. THIS WILL PREVENT DEATH OR INJURY FROM ELECTRIC SHOCK.**

CAUTION: DO NOT DO DIELECTRIC TESTING ON A MACHINE THAT HAS NOT BEEN FULLY CLEANED.

(1) Connect pins 1 and 2 of connector (330) together. See Figure 1004.

(2) Attach positive (red) lead of high pot tester to connected terminal leads.

(3) Attach negative (black) lead of high pot tester to an unfinished surface of the starter-generator frame.

CAUTION: INCREASE OR DECREASE THE TEST VOLTAGES SLOWLY (100 VOLTS PER SECOND, MAXIMUM) INCREASING OR DECREASING THE VOLTAGE TOO QUICKLY CAN CAUSE SERIOUS DAMAGE TO THE STARTER-GENERATOR.

(4) Apply dielectric test voltage of 250 V rms for one minute (commercial frequency) between combined connector pins and machine frame.

(5) Slowly decrease voltage to zero.

(6) Turn the power supply OFF.

(7) Disconnect the electrical test leads from the test unit.

(8) Acceptance Limits:

(a) Any arcing as evidenced by flashover (surface discharge), sparkover (air discharge) or breakdown (puncture discharge) will be evidence of damp, dirty, weak or defective components.

I. Locked rotor test

NOTE: This test is only applicable to starter-generators which have been overhauled and have an armature with a resurfaced commutator. Reference Standards Practice Document 1001.

(1) Rigidly mount starter-generator to test stand by starter-generator mounting flange.

(2) Connect 0.0 Ω jumper between terminals A and B as shown in Figure 1006.

(3) With voltage output set to zero, turn power supply ON.

CAUTION: DO NOT ENERGIZE STARTER-GENERATOR MORE THAN 4 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER IS MORE THAN VOLTAGE AND AMPS OF ACCEPTANCE LIMITS.

(4) Increase voltage between terminals B and E (V_2) until output torque is 20.0 lbf.ft (27,1 N·m).

NOTE: If current or voltage exceeds acceptable limits before the required torque is measured, remove power. Rotate armature to a different orientation and repeat test.

(5) Measure and record line current (V_1/SH_1).

(6) Measure and record voltage between terminals B and E (V_2).

(7) Turn the power supply OFF.

(8) Acceptance Limits:

(a) B-E Voltage (V_2): 12.0 VDC Max.

(b) Line Current (V_1/SH_1): 800 A Max.

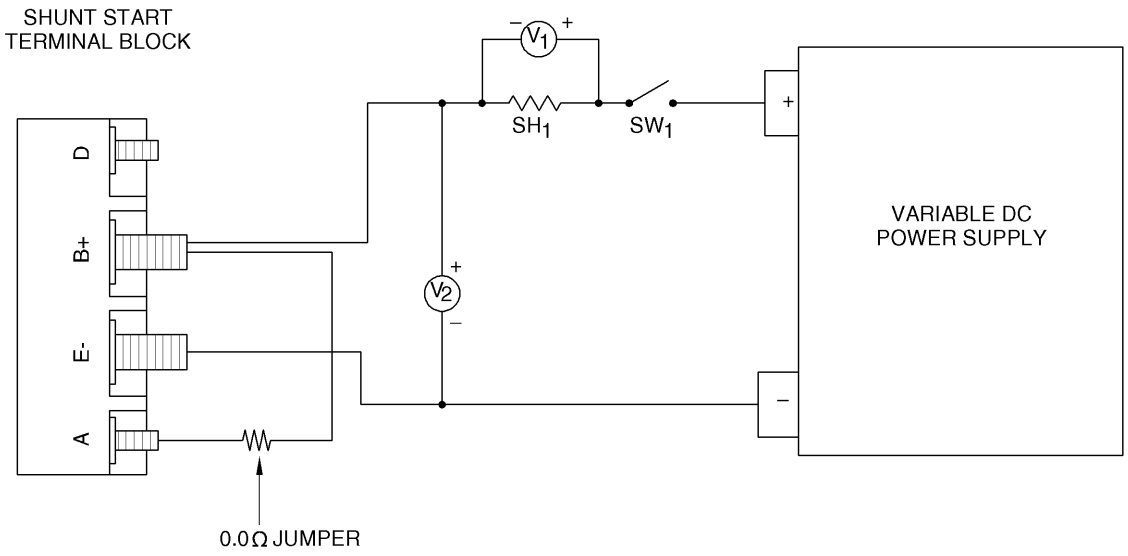

Figure 1006 - Locked Rotor Test Connection Diagram

J. Commutator runout.

CAUTION: DO NOT TOUCH THE POLISHED COMMUTATOR SURFACE WITH BARE HANDS. SKIN ACIDS AND OILS CAN CONTAMINATE CONDUCTING SURFACES, CAUSING CORROSION OR POOR ELECTRICAL CONTACT.

(1) Rotate armature on its own bearings and measure bar-to-bar and total runout.

(2) Acceptance Limits:

(a) Bar-to-Bar Runout: 0.0002 inch (0,005 mm) Max.

(b) Total Runout: 0.0008 inch (0,020 mm) Max.

8. Final Assembly After Acceptance Testing

After starter-generator has successfully completed and passed acceptance testing, refer to the ASSEMBLY section for final assembly instructions.

9. Fault Isolation Tables

The following tables list faults that may occur during acceptance testing, performance testing, or when starter-generator is in service. For each fault, probable causes are listed along with related corrective actions. When a fault is detected, perform the corrective actions necessary to return the starter-generator to a serviceable condition. A complete acceptance test is required after corrective action is accomplished.

Fault	Probable Cause	Corrective Action
A. Continuous Operating Speed and Equalizing Voltage		
High Equalizing Voltage (V_4).	Cooling air flow is low.	Check air flow path for obstructions. Clear all obstructions.
	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	Loose brush lead(s).	Inspect all brush leads for loose connections. If loose brush lead is found and no evidence of arcing is present, secure brush lead to complete brush holder. If loose brush is found and evidence of arcing is present, replace brush.

Table 1004 - Fault Isolation Table

Fault	Probable Cause	Corrective Action
High Equalizing Voltage (V_4). (Continued)	Brush circuit(s) open.	Inspect all brush leads for an open circuit. If open circuit found, overhaul or repair starter-generator as necessary.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
B. Minimum Speed For Regulation Test		
Field current (A_1) limit is exceeded.	Excessive load applied during testing.	Check and adjust applied load at load bank, as necessary.
Low external field resistance.	Cooling air flow is low.	Check air flow path for obstructions. Clear all obstructions.
	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	Brushes hung up in complete brush holder.	Inspect for proper positioning.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Low external field resistance. (Continued)	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Perform brush run-in procedure. Refer to SPD 1006.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
C. Overspeed Test		
Noisy operation during overspeed test.	Cooling fan blades rubbing or fan is out of balance.	NOTE: There are no authorized repair procedures to balance cooling fans. Check fan blades and air inlet for damage. Replace cooling fan if damaged. Repair or replace air inlet if damaged.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Noisy operation during overspeed test. (Continued)	Bearings are defective and/or installed incorrectly.	Visually inspect bearings. Disassemble starter-generator and replace bearings as necessary.
	Armature is striking against the stator and housing assembly.	Check armature and stator and housing for physical damage. Repair or replace damaged part(s) as necessary.
	The spline of the drive shaft is worn	Disassemble the starter-generator to the extent necessary to the remove the drive shaft. Check the drive shaft. Replace the drive shaft if the spline is worn.
Starter-Generator vibrates during overspeed test.	Bearings are defective and/or installed incorrectly.	Visually inspect bearings. Disassemble starter-generator and replace bearings as necessary.
	Armature is out of balance.	Check armature balance. Refer to SPD 1001. Repair or replace armature as necessary.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
D. Commutation Test		
Excessive sparking with no load.	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	One or more complete brush holders are loose.	Check attaching hardware. If damage is found, repair and assemble bearing and brush support assembly as necessary. Perform dielectric test on bearing and brush support assembly according to procedure in CHECK section. Perform brush run-in procedure. Refer to SPD 1006.
	Brush spring pressure below limit.	Check brush spring pressure. Refer to SPD 1006. Replace brush springs that do not meet limits in FITS & CLEARANCES section.
	An armature winding is partially or completely open.	Replace armature.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Excessive sparking with no load. (Continued)	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Perform brush run-in procedure. Refer to SPD 1006.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
	Armature is out of balance.	Check armature balance. Refer to SPD 1001. Repair or replace armature as necessary.
E. Speed Pickup Test		
No output voltage.	Speed pickup leads are shorted to starter-generator frame.	Check for continuity between starter-generator frame and speed pickup leads. Replace speed pickup if continuity is found.
	Speed pickup coil or lead wires are open.	Check speed pickup for continuity between speed pickup leads. Replace speed pickup if continuity is not found.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Output voltage not within limits.	Incorrect air gap between speed pickup and spur gear.	CAUTION: DO NOT ADJUST THE AIR GAP WHILE THE STARTER-GENERATOR IS OPERATING. ADJUSTING THE AIR GAP DURING OPERATION CAN DAMAGE THE EQUIPMENT. Adjust air gap to be within following limits: 0.006 to 0.008 inch (0,15 to 0,20 mm).
	Low output.	Reduce air gap. See Caution.
	High output.	Increase air gap. See Caution.
Speed pickup waveform is incorrect.	Incorrect air gap between speed pickup and spur gear.	Adjust air gap to be within following limits: 0.006 to 0.008 inch (0,15 to 0,20 mm). See Caution.
	Speed pickup spur gear is damaged.	Replace speed pickup spur gear.
	Speed pickup is damaged.	Replace speed pickup.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
F. Starter-Generator Dielectric Test		
Starter-Generator insulation breakdown.	Bearing and brush support assembly is grounded.	Disassemble the starter-generator. Clean bearing and brush support assembly. Refer to CLEANING section. Perform dielectric test on bearing and brush support assembly according to procedure in CHECK section. If bearing and brush support assembly fails dielectric test, replace insulating sleeves and washers, according to the procedures in the disassembly and assembly section.
	Armature is grounded.	Disassemble the starter-generator. Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
G. Speed Pickup Dielectric Test		
Speed pickup insulation breakdown.	Lead wires are grounded to stator and housing assembly or speed pickup has short to ground.	Check for continuity between starter-generator frame and speed pickup leads. Replace speed pickup if continuity is found.
H. Locked Rotor Test		
Low or no torque.	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Brushes incorrectly seated or installed.	Remove the brush cover. Using a wire hook tool, pull brush sets away from commutator surface. CHECK commutator surface for damage. REPAIR, if limits are not exceeded in FITS & CLEARANCES. Perform brush run-in procedure. Refer to SPD 1006. Re-test starter-generator.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Low or no torque. (Continued)	Open brush circuit.	Remove the brush cover. Inspect all brush leads for an open circuit. If an open circuit is found, replace brush (new brush only). Perform brush run-in procedure. Refer to SPD 1006. Re-test starter-generator.
Line current (V_1/SH_1) or voltage between terminals B and E (V_2) exceeded.	Stator and housing assembly is shorted or grounded.	Disassemble the starter-generator. Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
	Armature is shorted or grounded.	Disassemble the starter-generator. Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
I. Commutator Runout Check		
Bar-to-bar runout or total indicated runout exceeded.	Shifted commutator bars.	REPAIR commutator surface. REPLACE armature if not repairable.

Table 1004 - Fault Isolation Table (Continued)

10. Component Testing Fault Isolation Table

Wherever possible in the component testing fault isolation procedures, repairs are made. When repair is not possible, replace components.

Fault	Probable Cause	Corrective Action
A. Stator and Housing Assembly Dielectric Test		
Insulation breakdown	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
B. Armature Dielectric Test		
Insulation breakdown	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, clean armature. Refer to CLEANING section. Repeat dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests after a second cleaning, repeat test between commutator bars and retaining bands.

Table 1005 - Component Testing Fault Isolation Table

Fault	Probable Cause	Corrective Action
C. Armature Dielectric Test, Between Commutator Bars and Retaining Bands		
Insulation breakdown	Grounded armature	Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, clean armature. Refer to CLEANING section. Repeat dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests after a second cleaning, replace armature.
D. Bearing and Brush Support Assembly Dielectric Test		
Insulation breakdown	Grounded armature.	Clean bearing and brush support assembly. Refer to CLEANING section. Note: Leads for filter capacitor should be disconnected. Perform dielectric test on bearing and brush support assembly according to procedure in CHECK section. If bearing and brush support assembly fails dielectric test, clean bearing and brush support assembly. Refer to CLEANING section. Replace insulating sleeves and washers. Repeat dielectric test on bearing and brush support assembly according to procedure in CHECK section. If bearing and brush support assembly fails dielectric tests after a second cleaning, replace bearing and brush support assembly.

Table 1005 - Component Testing Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
E. Stator and Housing Assembly Load Sharing (For Model P/N 23080-13A)		
Repeated unconfirmed faults for not sharing load equally with one of the main generators (causes main generator to “dash out”)	Intermittent or high resistance connection in the stator housing assembly.	Shunt leads (A-D) - Check for loose terminal lug crimps or damaged wire strands at the terminals or exposed bare wires from damaged lead insulation.
		Replace terminal lugs or Replace stator and housing assembly.

Table 1005 - Component Testing Fault Isolation Table (Continued)

23080 SERIES III VERIFICATION / FINAL ACCEPTANCE DATA SHEET

Model Number:__23080-_____ Inspected by:_____

Serial Number:_____ Date:_____

Modification Level:_____

Inspection/Test	Requirements/Limits	Measurements	Accept	Reject
Visual inspection	Check for physical damage			
Continuous Operating Speed, and Equalizing Voltage	Inlet air temperature	° F (° C)		
	Winding or frame temperature	° F(° C)		
	Measured equalizing voltage D to E (V_4)	VDC		
Minimum Speed for Regulation Test	Voltage between terminals B and A (V_3)	VDC		
	Field current (A_1) (10 A Max)	A		
	Calculated external field circuit resistance (0.5 Ω Min)	Ω		
Minimum Speed Test	Field current (A_1) (10 A Max)	A		
	Voltage between terminals B and A (V_3)	VDC		
	Calculated external field circuit resistance (0.4 Ω Min)	Ω		
Overspeed Test	No sign of electrical or mechanical failure			
Commutation Test	Not to exceed pinpoints			
Speed Pickup Test	Peak-to-peak voltage (2.5 to 4.5 VDC)	VDC		
	Voltage waveform			
	Frequency signal (4150 to 4250 Hz)	Hz		
Starter-Generator Dielectric Test	No indication of insulation breakdown			
Speed Pickup Dielectric Test	No indication of insulation breakdown			

Inspection/Test	Requirements/Limits	Measurements	Accept	Reject
Locked Rotor Test and Residual Voltage Test	Line Current (V_1/SH_1) (800 A Max)	A		
	B to E voltage (V_2) (12.0 VDC Max)	VDC		
Commutator Runout Test	Bar-to-bar runout (0.0002 inch (0,005 mm) Max)	inch (mm)		
	Total indicated runout (0.0008 inch (0,020 mm) Max)	inch (mm)		

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SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

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DISASSEMBLY

1. Introduction

This section provides disassembly instructions for 23080 Series III DC Starter-Generators. Disassemble only to the extent required to replace defective parts, unless complete overhaul is required. Additional disassembly of major components is not necessary unless specifically instructed in the CHECK or TESTING AND FAULT ISOLATION sections. Before disassembly, wipe exterior surfaces with a clean cloth to remove dust, dirt, or other foreign materials.

Do not remove threaded inserts. Refer to CHECK section for details.

Do not disassemble riveted parts. Refer to REPAIR section to determine whether part(s) can be replaced.

Do not open or desolder permanent connections unless replacement of worn, damaged, or defective parts is necessary.Tag electrical wires before removal. All soldering and desoldering procedures must be done to ANSI/IPC J-STD-001.

During overhaul, replace bearings, brushes and o-rings. Parts that have been removed during disassembly, such as, insulating parts, retaining rings, screws, self-locking nuts and lock washers, must be discarded regardless of their condition. The screws that attach the brush leads to the brush holder do not need to be replaced unless damaged.

NOTE: When a starter-generator is removed for service, the QAD kit usually stays on the aircraft.

2. Disassembly Tools

In addition to standard shop tools, those special tools, fixtures, and equipment listed in Table 3001 are required for disassembly.

Tools Description	Source/Figure Reference
Anti-Drive End Armature Shaft Adapter	Figure 9001
Anti-Drive End Hub Support	Figure 9014
Arbor Press	Commercially Available
Bearing and Brush Support Assembly Support	Figure 9013
Bearing Puller (Snap-On A78 or Equivalent)	Commercially Available
Dampener Hub Driver	Figure 9006
Drive End Armature Shaft Adapter	Figure 9002
Drive End Outboard Hub Support	Figure 9015
External Snap Ring Pliers	Commercially Available
Foam Cushion	Commercially Available

Table 3001 - Disassembly Tools

Tools Description	Source/Figure Reference
Horizontal Stator Support	Figure 9016
Inner Race Bearing Driver	Figure 9004
Pin Insertion/Extraction Tool	Commercially Available
Plastic or Leather Mallet	Commercially Available
Spline Wrench	Figure 9019
Torque Wrench	Commercially Available
Tweezers	Commercially Available
Wire Hook Tool	Commercially Available

Table 3001 - Disassembly Tools (Continued)

3. Disassembly Materials

Materials necessary for starter-generator Disassembly are listed in Table 3002.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source (CAGE Code)
Isopropyl Alcohol See **WARNING** before using this material.	TT-I-735, Grade A Flash Point: 53° F (12° C), FLAMMABLE. Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information.	Commercially Available
Masking Tape	N/A	Commercially Available

Table 3002 - Disassembly Materials

4. Disassembly of DC Starter-Generator

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

A. Remove QAD mounting kit from starter-generator, if present.

NOTE: When a starter-generator is removed for service, the QAD kit normally remains on the aircraft.

(1) Loosen self-locking nut (10005-20) and remove V-retainer coupling (10005-10) from the starter-generator.

(2) Remove QAD and mounting adapter (10005-40) from starter-generator. See Figure 3001.

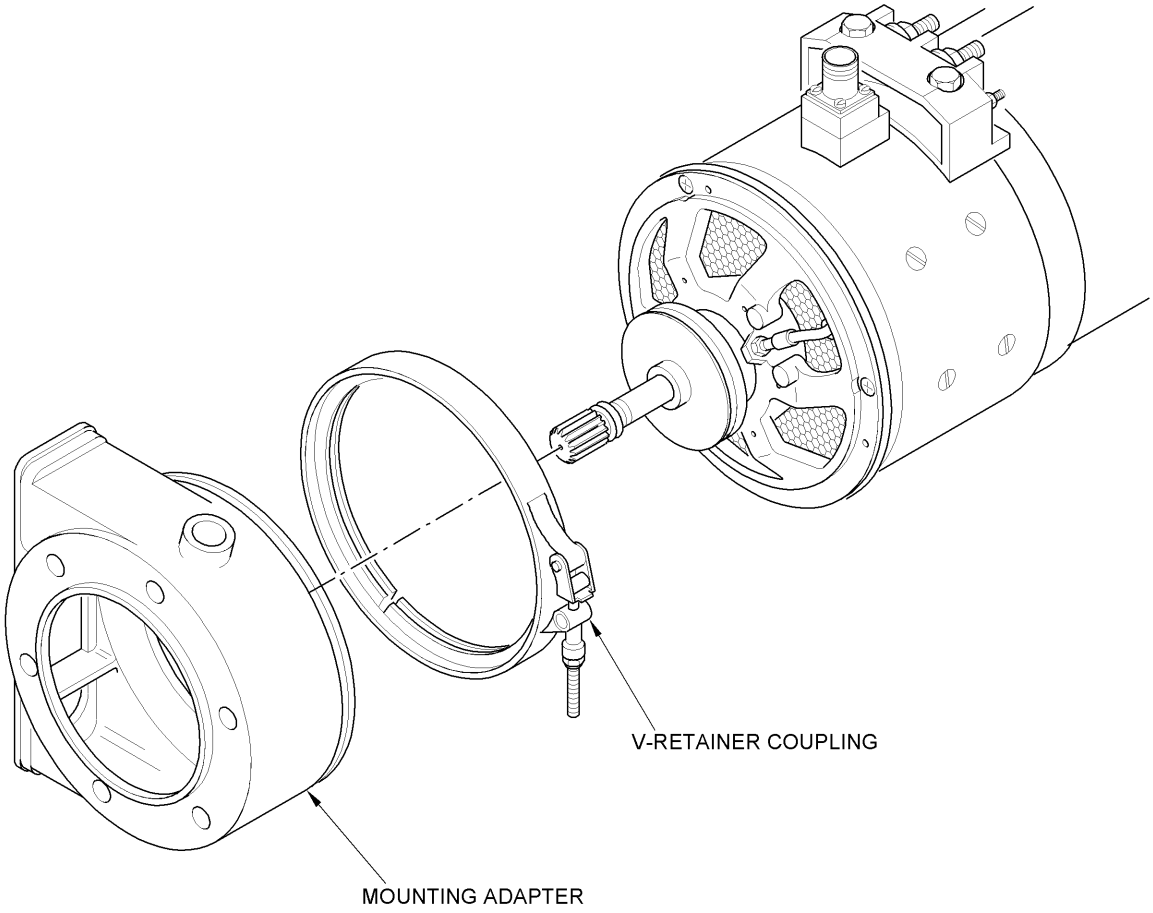

Figure 3001 - Removing the QAD Kit

B. Remove the identification plate (-30), modification status label (-50), caution decal (-60), patent label (-70) and TSO label (-80) from stator and housing assembly (500).

NOTE: Do not remove these items unless they are damaged or unreadable.

NOTE: Minor scratches and superficial damage that do not affect the legibility are not reason to replace the ID plate.

(1) Use a smooth, flat tool that will not scratch the stator housing to wedge under the edge of the identification plate and pry up on the corners of the plate near the four drive screws that hold it in place to dislodge the plate from the housing.

NOTE: This will tear the corners of the light metal identification plate.

(2) Remove the remaining metal from under the head of each drive screw.

(3) Use a small pair of sidecutters with the flat face to the housing to wedge in under the head of each drive screw to hold the shank of the screw and turn out counterclockwise.

(4) Discard the four drive screws (-40) from the stator and housing assembly (500).

(5) Keep the identification plate for reference when transferring the information to a replacement identification plate (-30).

WARNING: HANDLE THE TOOL CAREFULLY. WEAR EYE PROTECTION.

(6) If applicable, remove and discard the modification status label (-50) from the stator and housing assembly (500).

NOTE: The starter-generator may not have a modification status label (-50).

(a) Lift the corner of the modification status label with a sharp tool.

(b) Peel off the modification status label from the starter-generator. Keep it for reference when transferring information to the replacement identification plate.

WARNING: ISOPROPYL ALCOHOL CAN BE DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(c) Use isopropyl alcohol to remove adhesive residue.

(d) Wipe dry with a soft dry cloth.

(7) Remove and discard the caution decal (-60), patent label (-70) and TSO label (-80) from stator and housing assembly (500).

NOTE: The starter-generator may not have a TSO label (-80).

(a) Lift the corner of the caution decal, patent label and TSO label with a sharp tool.

(b) Peel off and discard the caution decal, patent label, and TSO label from the starter-generator.

WARNING: ISOPROPYL ALCOHOL CAN BE DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(c) Use isopropyl alcohol to remove adhesive residue.

(d) Wipe dry with a soft dry cloth.

C. Remove terminal block cover (-90) from terminal block.

(1) Remove the two screws (-100) that attach the terminal block cover (-90) to the terminal block. See Figure 3002.

(2) Remove the terminal block cover.

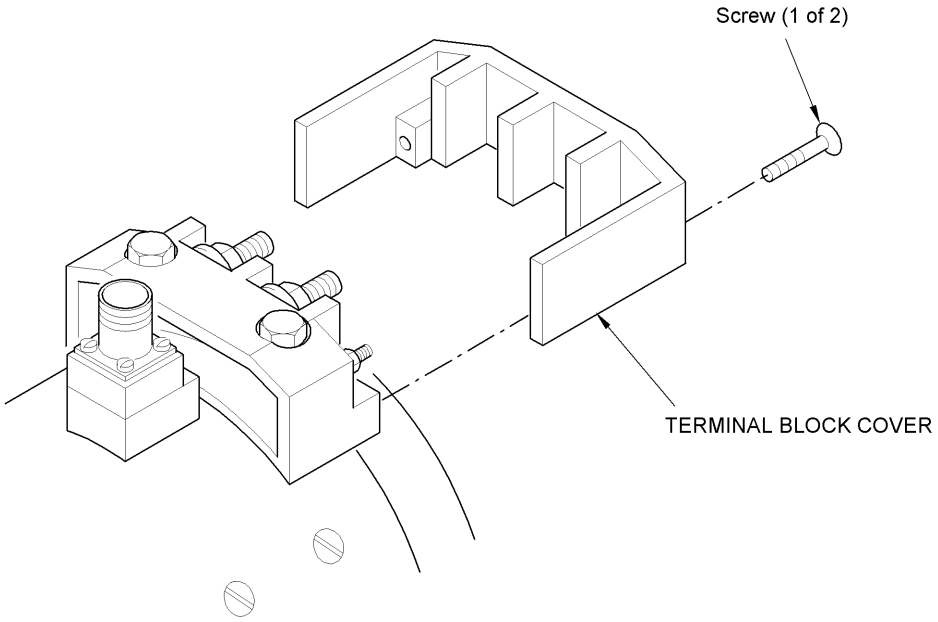

Figure 3002 - Removing the Terminal Block Cover

D. Remove air inlet (110) from bearing and brush support assembly (290).

(1) If required, remove lockwire from attaching screws of air inlet (110), discard lockwire.

(2) Remove four screws (120) that attach air inlet (110) to the bearing and brush support assembly (290). See Figure 3003.

(3) Remove air inlet (110).

E. Remove brush access cover (130) from stator and housing assembly (500).

(1) Remove screw (140) from self-locking blind rivet nut (150) that secures brush access cover around the stator and housing assembly. See Figure 3004.

(2) Remove brush access cover (130) from the stator and housing assembly.

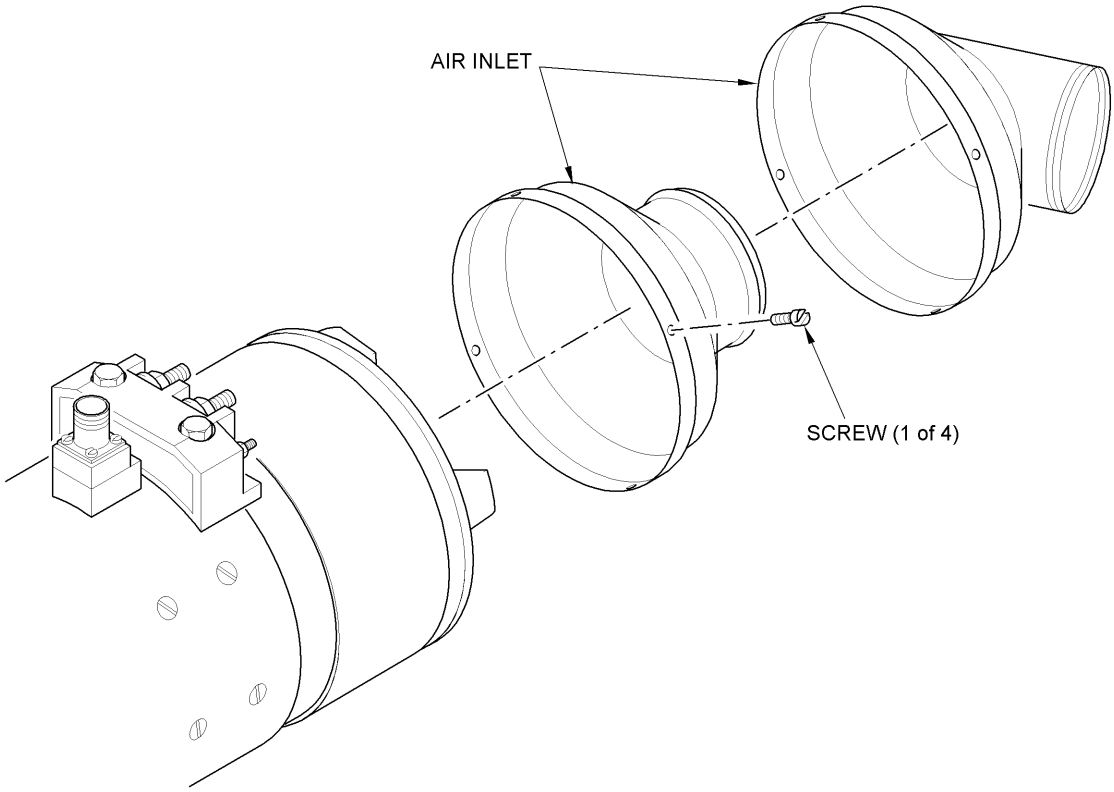

Figure 3003 - Removing the Air Inlet

F. Remove brushes (160) from bearing and brush support assembly (290). See Figure 3005.

NOTE: If brushes (160) are to be reused, identify the brushes (160) and complete brush holders (10002-30) with the numbers 1 through 4.

(1) Remove four screws (170) that attach brushes (160) shunt leads to complete brush holders (10002-30).

CAUTION: RAISE AND LOWER BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO REMOVE BRUSHES FROM EACH COMPLETE BRUSH HOLDER.

(2) Use a wire hook tool to lift two brush springs (10002-130) away from brush (160). Remove brush (160) from complete brush holder (10002-30).

(3) Slowly return brush springs (10002-130) to a resting position on complete brush holder (10002-30).

(4) Identify brush (160) with the number on complete brush holder (10002-30) from which it was removed.

(5) Repeat Paragraph 4.F.(1) through Paragraph 4.F.(4) for each remaining brush (160).

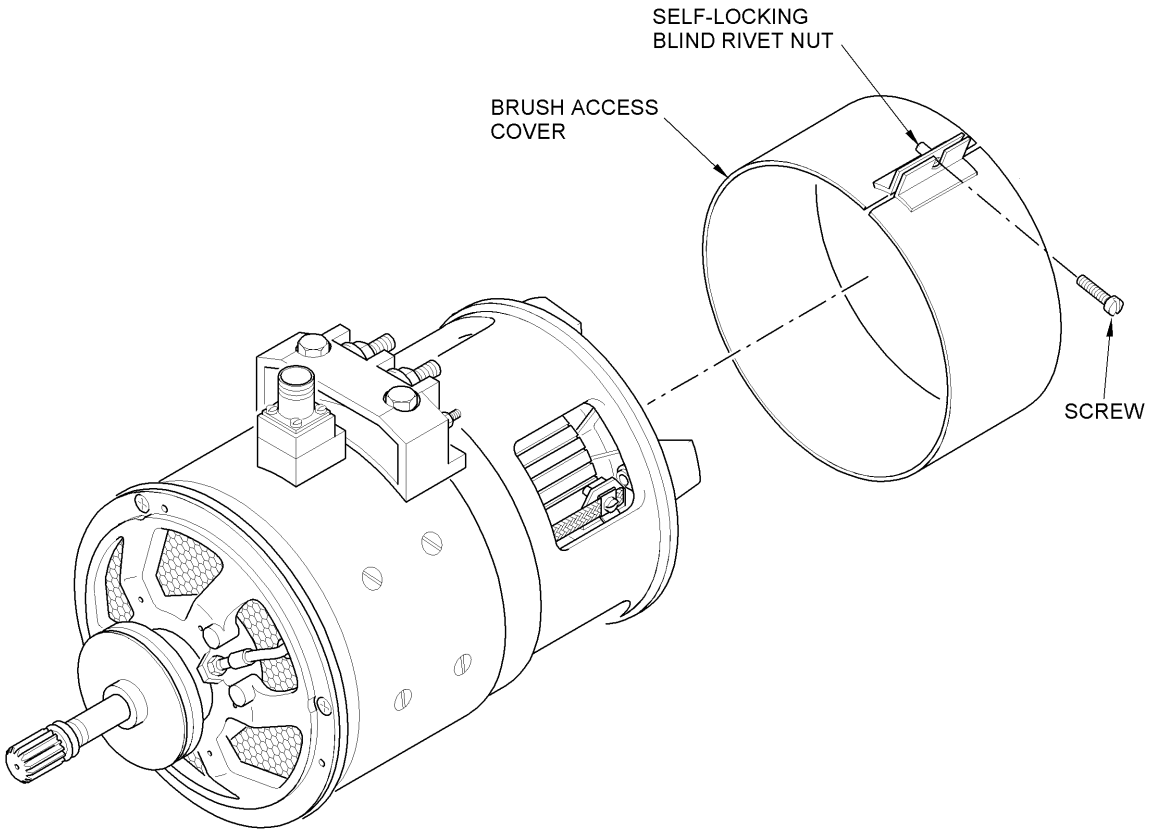

Figure 3004 - Removing the Brush Access Cover

G. Remove fan (180) from drive shaft (210).

(1) Put a spline wrench on the drive spline to prevent the drive shaft (210) from turning while removing the self-locking nut (190).

(2) Remove self-locking nut (190) and flat washer (200) from drive shaft (210). See Figure 3006.

(3) Slide fan (180) off of the drive shaft (210).

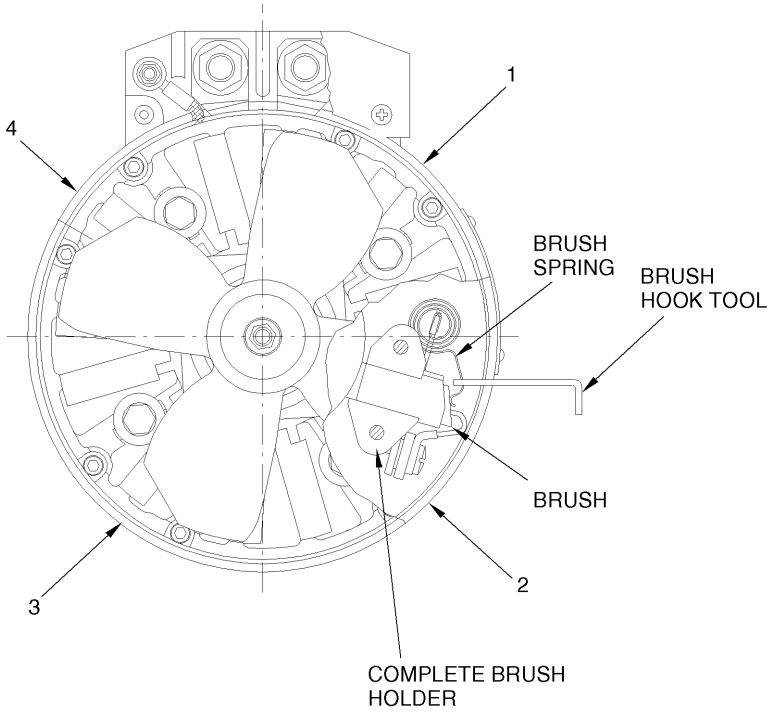

Figure 3005 - Numbering the Brush Holder Assemblies

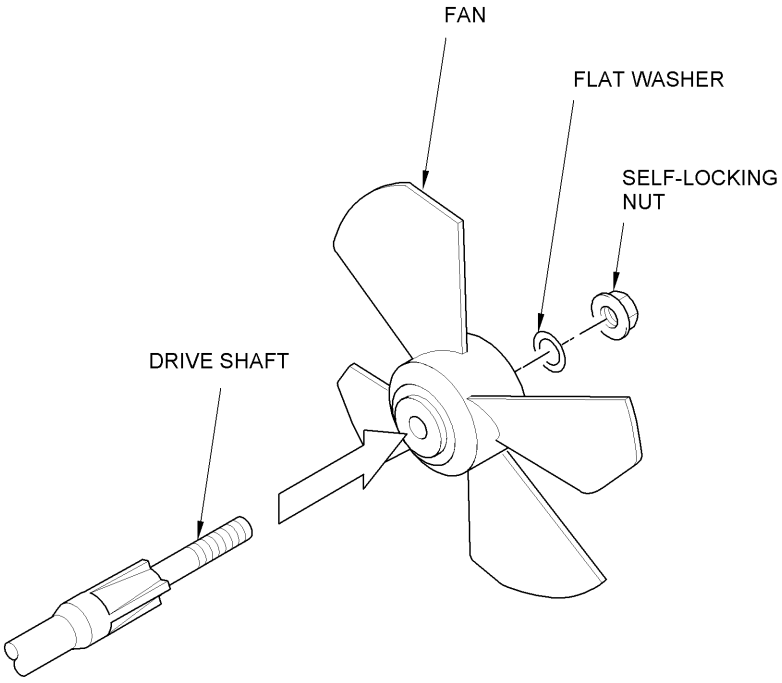

Figure 3006 - Removing the Fan from the Drive Shaft

H. Remove drive shaft (210) with the attached O-ring (220), dampener hub (250), dampener plate (240) and friction ring (230) from armature (460) shaft.

CAUTION: DO NOT USE A HIGH AMOUNT OF FORCE WHEN YOU TAP THE DRIVE SHAFT. HIGH FORCE CAN DAMAGE THE DRIVE SHAFT THREAD.

(1) Lightly tap the anti-drive end of drive shaft (210) with a plastic or leather mallet to disengage it from armature (460) shaft.

(2) Pull drive shaft (210) out of the drive end of the starter-generator. See Figure 3007.

WARNING: DO NOT CUT, RIP, OR SAND ASBESTOS-CONTAINING MATERIALS. LEAVE UNDAMAGED MATERIALS ALONE AND, TO THE EXTENT POSSIBLE, PREVENT THEM FROM BEING DAMAGED, DISTURBED, OR TOUCHED. DISCARD MATERIAL BY FIRST CHECKING WITH LOCAL HEALTH, ENVIRONMENTAL, OR OTHER APPROPRIATE OFFICIALS TO FIND OUT ABOUT PROPER HANDLING AND DISPOSAL PROCEDURES.

(3) Remove friction ring (230) from drive shaft (210). If friction ring (230) is Part No. 02-5600-05, it must be discarded because it contains asbestos.

(4) Remove dampener plate (240) from dampener hub (250) on drive shaft (210).

(5) If present, remove and discard O-ring (220) from drive shaft (210).

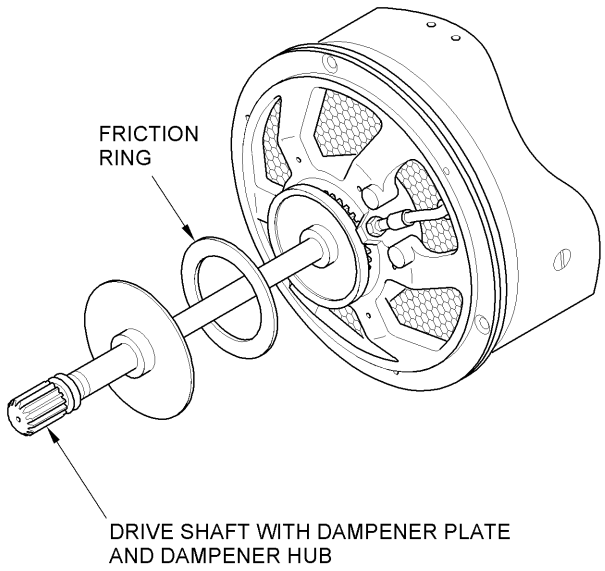

Figure 3007 - Removing The Drive Shaft, Friction Ring and Dampener Plate

I. Remove dampener hub (250) from drive shaft (210). See Figure 3008.

NOTE: Do not remove dampener hub from drive shaft unless hub or drive shaft are damaged.

CAUTION: PUT A FOAM CUSHION UNDER DRIVE SHAFT TO PREVENT IT FROM BEING DAMAGED.

(1) Set a foam cushion and a hub support on an arbor press table.

(2) Set a dampener hub driver on the drive shaft (210) on the flat side of dampener hub (250).

(3) Insert drive shaft (210) through the center of the hub support until dampener hub driver is seated on the hub support.

(4) Slowly press drive shaft (210) down into the hub support until dampener hub (250) disengages from draft shaft (210).

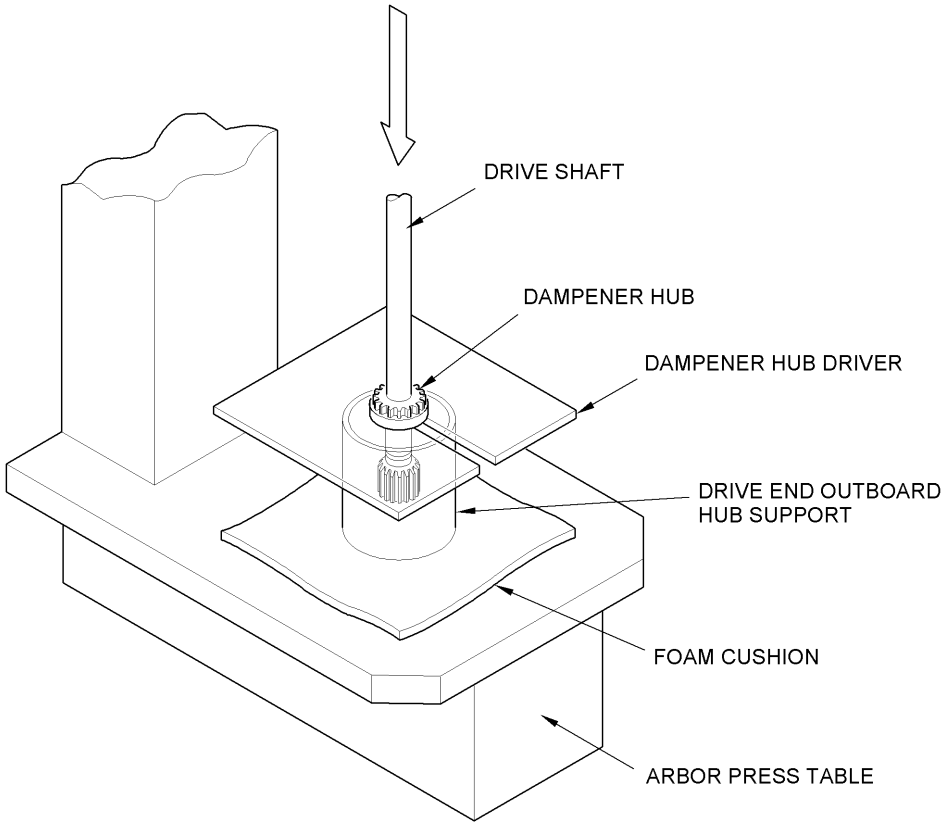

Figure 3008 - Remove the Dampener Hub from the Drive Shaft

J. Remove dampener backplate (260), retaining ring (270), and speed pickup spur gear (280) from armature (460) shaft. See Figure 3009.

CAUTION: FAILURE TO USE THE DRIVE END ARMATURE SHAFT ADAPTER WHEN REMOVING THE DAMPENER BACKPLATE AND SPUR GEAR CAN CAUSE PERMANENT DAMAGE TO THE ARMATURE SHAFT.

(1) Put drive end armature shaft adapter into the drive end of armature (460) shaft.

CAUTION: TAPE THE JAWS OF THE BEARING PULLER TO PREVENT DAMAGE TO THE DAMPENER BACKPLATE DURING REMOVAL.

(2) Remove dampener backplate (260) from armature (460) shaft using a suitable bearing puller.

(3) Use external snap ring pliers to remove and discard retaining ring (270).

(4) Remove speed pickup spur gear (280) using a suitable bearing puller and the shaft adapter.

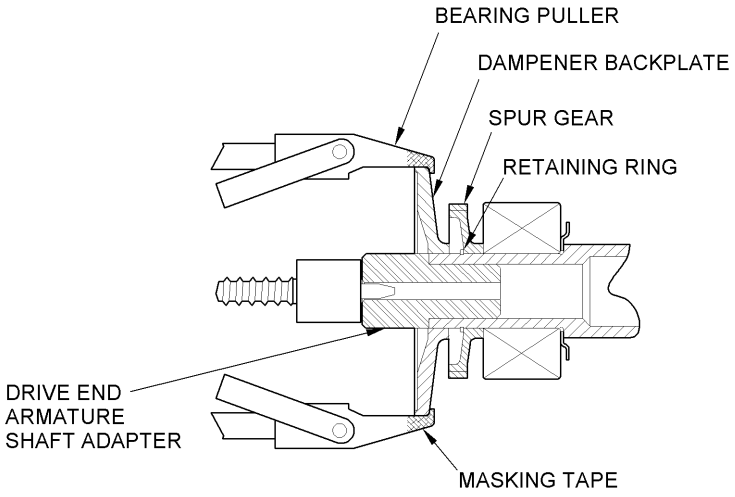

Figure 3009 - Removing the Dampener Backplate and Speed Pickup Spur Gear

K. Remove bearing and brush support assembly (290) and attached armature (460) from stator and housing assembly (500) See Figure 3010

NOTE: For bearing pre-load models (MOD L), the drive end bearing (420) will remain in the drive end bearing support assembly when removing the armature. The baffle disc or spacer (320) will release when the armature with attached bearing and brush support assembly is removed. Make sure this part is not lost when the bearing and brush support assembly (290) and attached armature (460) are removed. For non-preload models refer to Paragraph 4.Q. for removal of the drive end bearing (420).

(1) Set the starter-generator on a horizontal stator support.

CAUTION: FAILURE TO USE A DRIVE END ARMATURE SHAFT ADAPTER WHILE REMOVING THE BEARING AND BRUSH SUPPORT ASSEMBLY CAN CAUSE PERMANENT DAMAGE TO THE ARMATURE SHAFT.

(2) Remove eight self-locking screws (300) and eight flat washers (310) that attach the bearing and brush support assembly (290) to stator and housing assembly (500).

(3) Insert the drive end armature shaft adapter into the drive end of the armature (460) shaft.

(4) Gently tap on the drive end armature shaft adapter with a plastic or leather mallet until the bearing and brush support assembly (290) separates from the stator and housing assembly (500).

(5) Carefully remove the bearing and brush support assembly (290) and attached armature (460) from the stator and housing assembly (500).

(6) For bearing pre-load models, remove and retain the spacer (320) from the armature (460) shaft.

L. Remove the 3-pin connector (330) and spacer (340 and 350) from stator and housing assembly (500). See Figure 3011

(1) Remove and discard the lockwire from four screws (360) that attach the 3-pin connector (330) and spacers (340, 350) to stator and housing assembly (500).

(2) Remove four screws (360) and pull the connector (330) from stator and housing assembly (500) to length of electrical wire.

(3) DELETED.

NOTE: DELETED.

(4) Remove pins 1, 2 and 3 from connector using pin extraction tool. Set 3-pin connector and spacers aside.

NOTE: Do not cut the lead wires to the speed pickup and thermal switch. This will cause the lead wires to be too short and require replacement of the speed pickup or thermal switch assembly.

(5) Remove connector (330) and spacers (340, 350) from stator and housing assembly (500).

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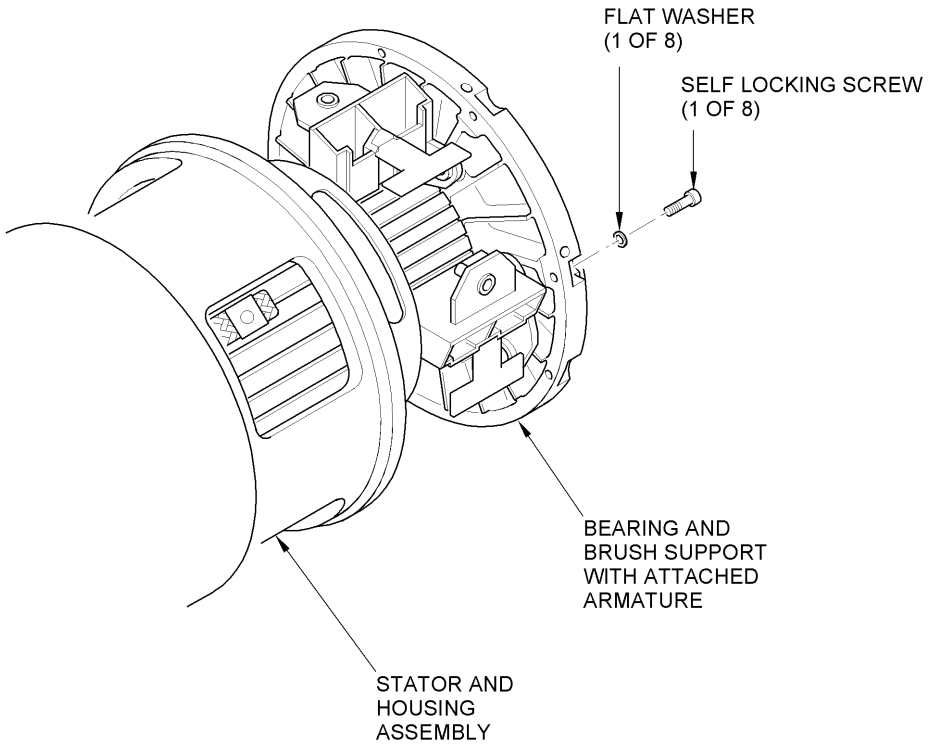

Figure 3010 - Remove the Bearing and Brush Support Assembly with Attached Armature

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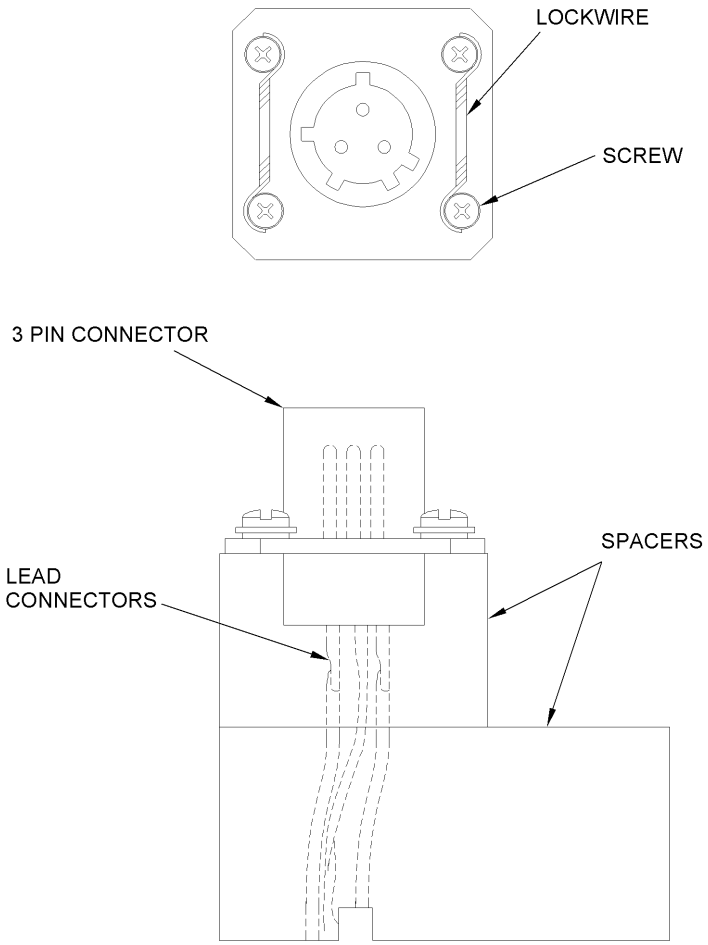

Figure 3011 - Remove Connector and Spacers from Stator and Housing Assembly

M. Remove thermal switch (370)

NOTE: Do not remove this item unless it is damaged.

(1) Unthread the thermal switch (370) from the stator and housing assembly (500) and discard.

N. Remove drive end bearing support assembly (380) from stator and housing assembly (500). See Figure 3012.

(1) Remove three screws (390) from stator and housing assembly (500).

CAUTION: DO NOT USE HIGH FORCE WHEN TAPPING DRIVE END BEARING SUPPORT ASSEMBLY OR YOU CAN DAMAGE THE MATING FLANGE OF THE STATOR AND HOUSING ASSEMBLY.

(2) Lightly tap the outer diameter of the drive end bearing support assembly (380) with a plastic or leather mallet to loosen it from the stator and housing assembly (500).

NOTE: Do not disassemble the stator and housing assembly (500).

(3) Remove drive end bearing support assembly (380) from stator and housing assembly (500) while pulling speed pickup (400) leads through the stator and housing assembly (500).

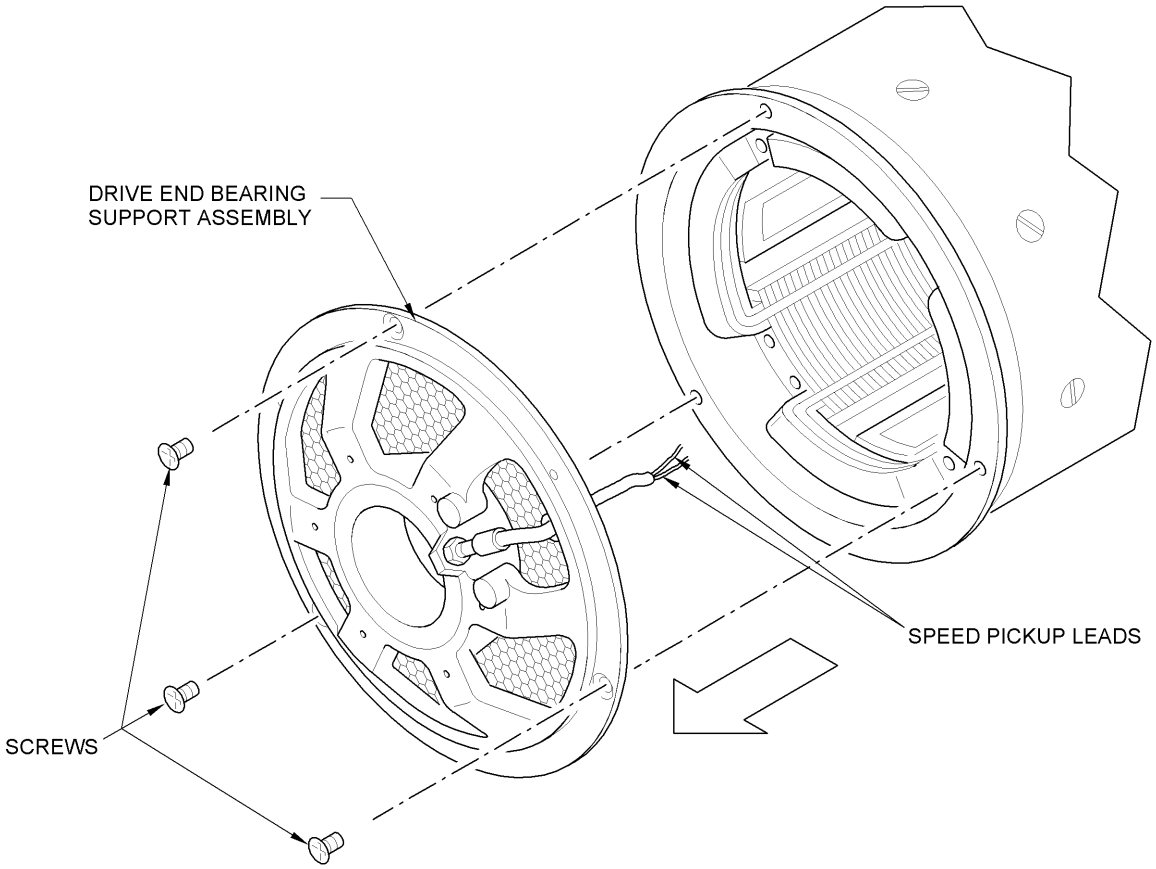

Figure 3012 - Removing the Drive End Bearing Support Assembly

O. Remove speed pickup (400) and grommet (410) from the drive end bearing support assembly (380). See Figure 3013.

(1) Pull speed pickup (400) leads through grommet (410).

NOTE: Do not disassemble the drive end bearing support assembly (380) unless damaged.

(2) Loosen speed pickup (400) jam nut and back it away from drive end bearing support assembly (380).

(3) Remove speed pickup (400) from drive end bearing support assembly (380).

(4) Remove and discard grommet (410) from drive end bearing support assembly (380).

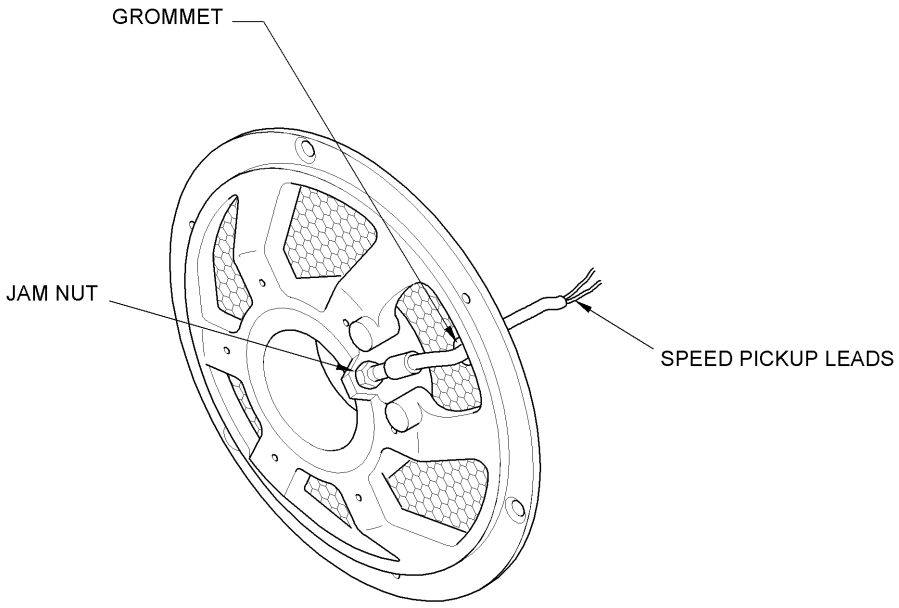

Figure 3013 - Removing the Speed Pickup

P. For bearing pre-load models, remove drive end bearing (420), spring wave washer (430) and shims (440, 450) (if present) from the drive end bearing support assembly (380).

NOTE: This instruction applies to starter-generators that have the bearing pre-load feature (MOD L). For non-preload models refer to Paragraph 4.Q. See Figure 3014.

CAUTION: FAILURE TO USE A DRIVE END OUTBOARD BEARING HUB SUPPORT CAN CAUSE PERMANENT DAMAGE TO ASSEMBLY.

(1) Position an outboard hub support on the table of an arbor press.

(2) Position drive end bearing support assembly (380) on the outboard hub support.

(3) Set the inner race bearing driver on drive end bearing (420) in drive end bearing support assembly (380).

(4) Press drive end bearing (420) out of the bearing liner of drive end bearing support assembly (380).

(5) Remove drive end bearing (420) from inside of the outboard hub support. Discard bearing (420).

(6) Remove spring wave washer (430) and shim(s) (440, 450) (if present) from the bearing liner of drive end bearing support assembly (380).

NOTE: The spring wave washer (430) can be reused if it passes the inspection criteria given in the CHECK section.

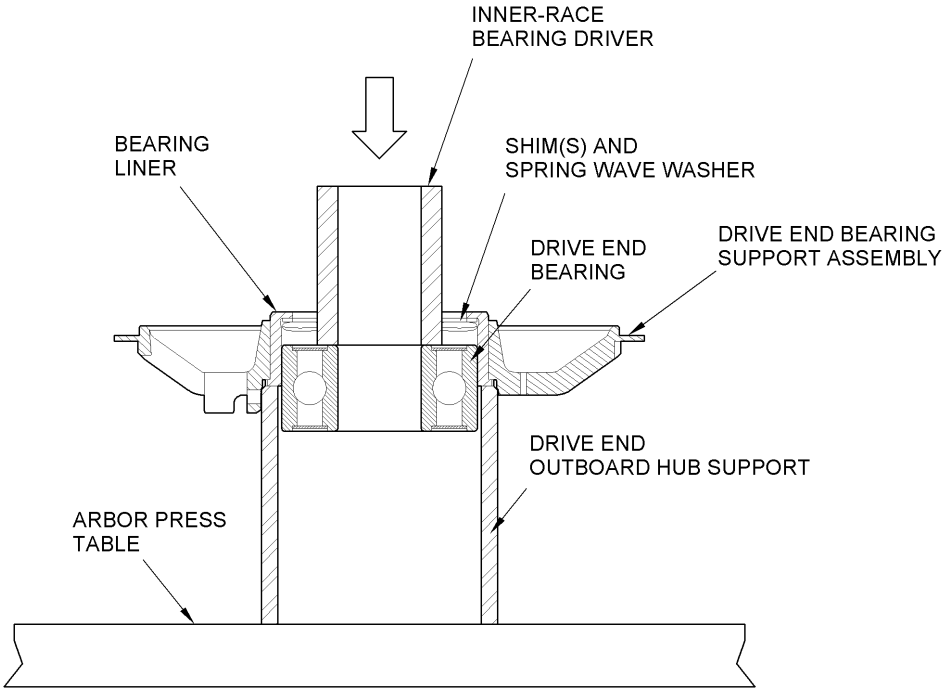

Figure 3014 - Removing the Bearing from the Drive End Bearing Support Assembly (Pre-Load)

Q. For bearing non-preload models, remove drive end bearing (420) and baffle disc (320) from armature (460) shaft. See Figure 3015.

NOTE: This instruction applies to starter-generators that have the bearing non-preload feature.

CAUTION: FAILURE TO USE A DRIVE END ARMATURE SHAFT ADAPTER CAN CAUSE PERMANENT DAMAGE TO ASSEMBLY.

(1) Put drive end armature shaft adapter into armature (460) shaft.

(2) Using a suitable bearing puller, remove drive end bearing (420) from armature (460) shaft and discard bearing.

(3) Remove and retain baffle disc (320).

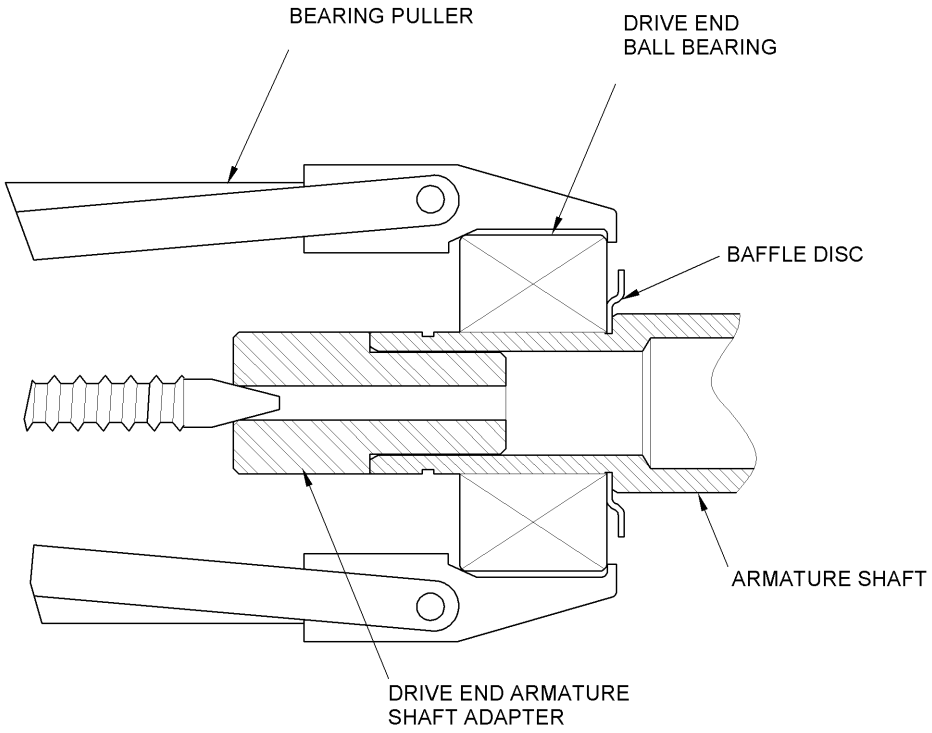

Figure 3015 - Remove Drive End Bearing and Baffle Disc (Non-Preload)

R. Remove the armature (460) from the bearing and brush support assembly (290). See Figure 3016.

CAUTION: TO PREVENT DAMAGE TO THE ARMATURE SHAFT, PUT A FOAM CUSHION AT THE BASE OF THE ANTI-DRIVE END BELL ASSEMBLY SUPPORT.

(1) Put a foam cushion and bearing and brush support assembly support on an arbor press table.

(2) Put the bearing and brush support assembly (290), with the attached armature (460), onto the bearing and brush support assembly support.

CAUTION: FAILURE TO USE THE ANTI-DRIVE END ARMATURE SHAFT ADAPTER WHEN PRESSING THE ARMATURE FROM THE BEARING AND BRUSH SUPPORT ASSEMBLY CAN CAUSE PERMANENT DAMAGE TO THE ARMATURE SHAFT.

(3) Insert an anti-drive end armature shaft adapter into the end of the armature (460) shaft.

CAUTION: TO PREVENT DAMAGE TO THE ARMATURE SHAFT, HOLD IT SECURELY WHEN IT IS PRESSED OUT OF THE BEARING AND BRUSH SUPPORT ASSEMBLY.

(4) Carefully press the armature (460) shaft down and away from the bearing and brush support assembly (290).

(5) Carefully remove armature (460) from inside the bearing and brush support assembly support.

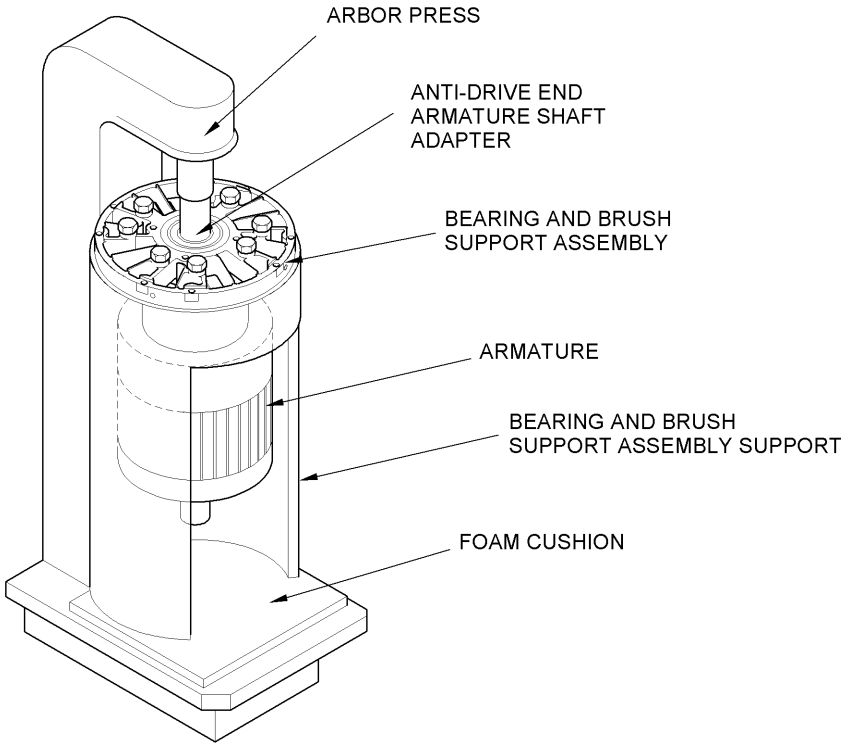

Figure 3016 - Remove the Armature from the Bearing and Brush Support Assembly

S. Remove the bearing retainer (470) and bearing (490) from the bearing and brush support assembly (290). See Figure 3017.

CAUTION: FAILURE TO USE AN ANTI-DRIVE END HUB SUPPORT WHEN BEARING IS PRESSED FROM THE ADE BEARING AND BRUSH SUPPORT ASSEMBLY CAN CAUSE PERMANENT DAMAGE TO THE ADE BEARING AND BRUSH SUPPORT ASSEMBLY.

(1) Remove four screws (480) and bearing retainer (470) from bearing and brush support assembly (290).

(2) Set an anti-drive end hub support on the table of an arbor press.

(3) Set the bearing and brush support assembly (290) on the anti-drive end hub support with the inboard side facing up.

(4) Set an inner race bearing driver on the inner race of anti-drive end bearing (490).

(5) Slowly press anti-drive end bearing (490) from bearing and brush support assembly (290) using an inner race bearing driver.

(6) Remove anti-drive end bearing (490) from inside the anti-drive end hub support. Discard anti-drive end bearing (490).

NOTE: Do not disassembly the bearing and brush support assembly (290) unless damage is found.

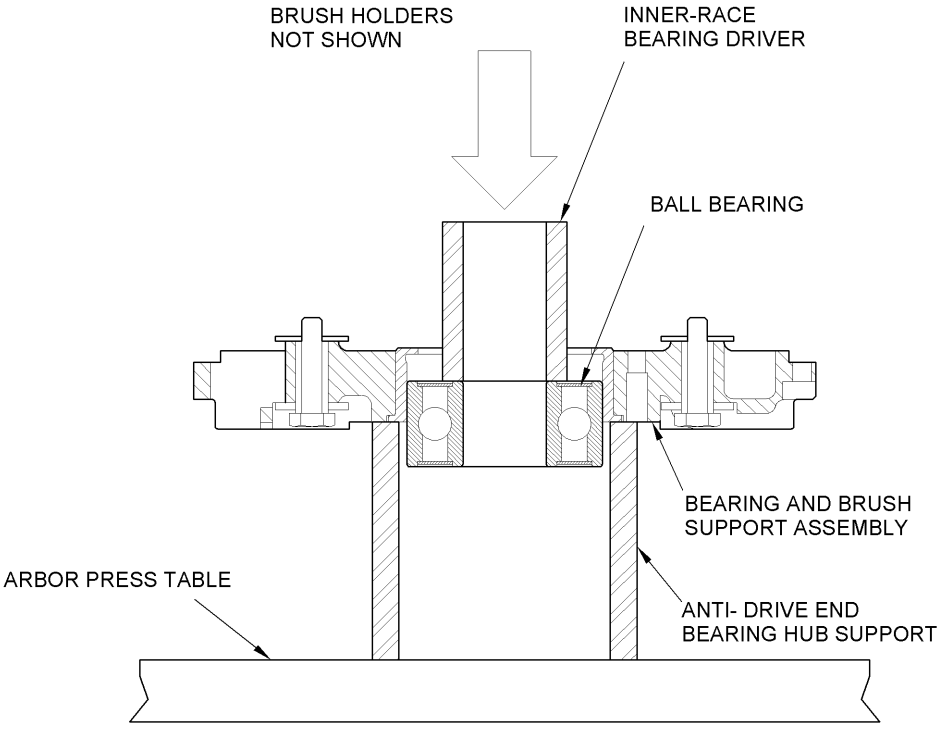

Figure 3017 - Removing the Anti-Drive End Ball Bearing

5. Disassembly of Bearing and Brush Support Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10002 of ILLUSTRATED PARTS LIST.

A. Remove complete brush holder (30) assemblies from anti-drive end end bell (10).

NOTE: Do not disassemble bearing and brush support assembly unless necessary.

(1) Remove two bolts (40), two nonmetallic washers (50), two flat washers (60), complete brush holder (30) and insulating board (80) from anti-drive end end bell (10).

(2) Remove two insulation sleeves (70) from mounting holes in anti-drive end end bell (10).

(3) Discard non-metallic washers (50) and insulation sleeves (70). Retain the insulating board (80).

(4) Remove two brush springs (130) from complete brush holder (30).

(5) Repeat Paragraph 5.A.(1) through Paragraph 5.A.(4) as required for remaining complete brush holders (30).

B. Disassemble each complete brush holder (30) assembly.

NOTE: Do not disassemble complete brush holders unless necessary.

(1) Refer to the REPAIR section for complete brush holder assembly (30).

6. Disassembly of the Drive End Bearing Support Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10003 of ILLUSTRATED PARTS LIST.

A. Remove the screen (30) from the drive end end bell (10).

NOTE: Do not remove the screen from the drive end end bell unless it is damaged.

(1) Remove and discard the attaching six drive screws (40) and six flat washers (50) from drive end end bell (10).

(2) Remove and discard screen (30) from drive end end bell (10).

7. Disassembly of the Stator and Housing Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10004 of ILLUSTRATED PARTS LIST.

NOTE: Do not disassemble the stator and housing assembly further than the removal of the terminal block to examine, repair, or replace parts determined to be unserviceable.

A. Remove attaching hardware from the terminal block (50). See Figure 3018.

(1) From Terminals B and E remove two nuts (10) and two flat washers (20). Discard flat washers (20).

(2) From Terminals A and D remove two nuts (30) and two flat washers (40). Discard flat washers (40).

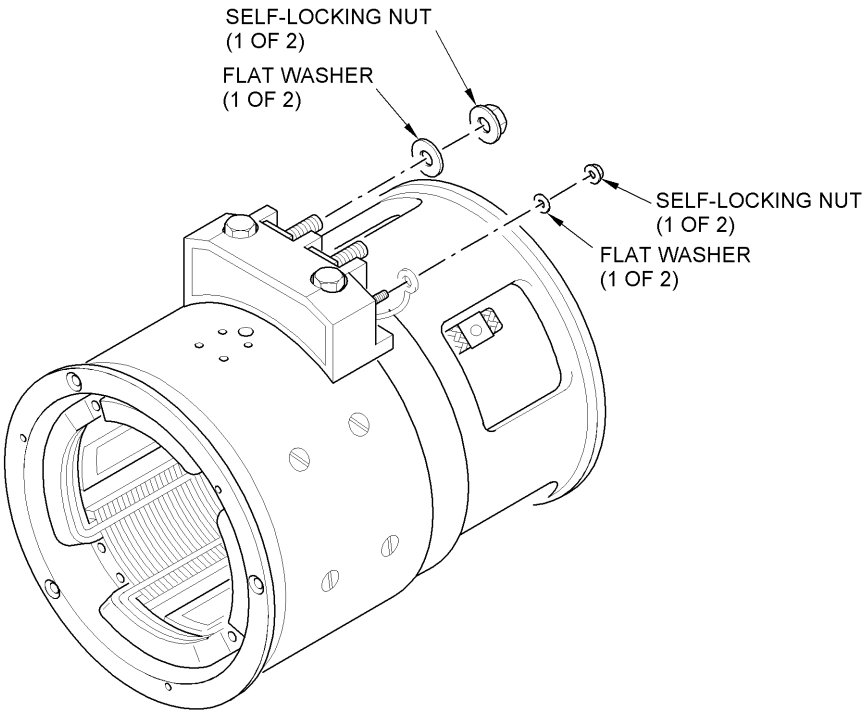

Figure 3018 - Removing Terminal Block Hardware

B. Remove terminal block (50) from the housing. See Figure 3019**.**

(1) Remove the two bolts (60), two lock washers (70) and two flat washers (80) from terminal block (50). Discard lock washers (70) and flat washers (80).

(2) Remove the wires from terminals A and D.

(3) Carefully remove the terminal block (50) from the stator leads.

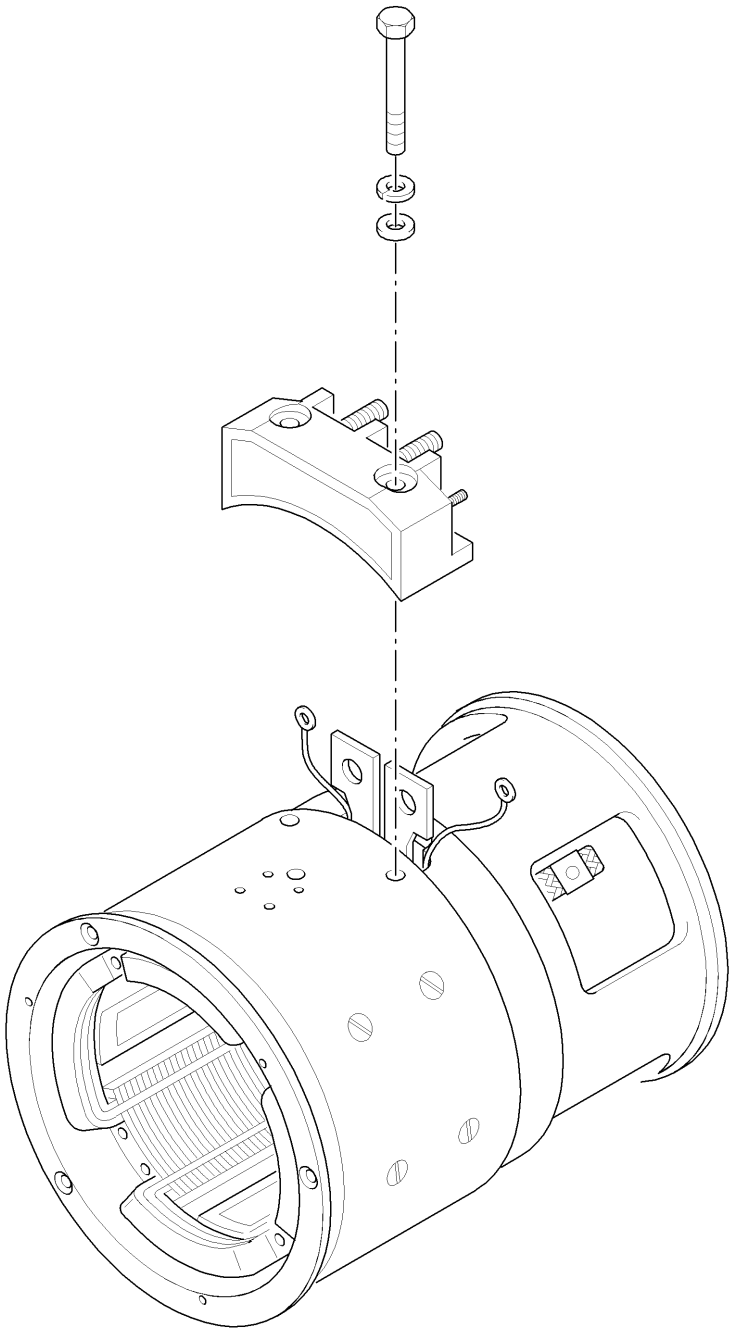

Figure 3019 - Removing the Terminal Block from the Housing

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CLEANING

1. Introduction

This section contains the cleaning procedures for 23080 Series III DC Starter-Generators.

2. Cleaning Materials

Table 4001 lists equipment and materials required to perform the cleaning of assemblies, subassemblies and components.

WARNING: YOU MUST OBEY THE TOOL/EQUIPMENT MANUFACTURERS WARNINGS AND CAUTIONS SHOWN ON PACKAGING, CONTAINERS AND/OR INSTRUCTION LEAFLETS. IF YOU DO NOT, YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY.

WARNING: ISOPROPYL ALCOHOL IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

Material	Description/Specification	Source/CAGE Code
Bag, Polyethylene	Size that will easily enclose parts being washed.	Commercially Available
Brush	Nonmetallic, soft bristle	Commercially Available
Cleaning Pads/Wiping Cloths	Lint-free, soft fabric	Commercially Available
Corrosion Preventive	Cold application, water displacing soft film MIL-C-16173, Grade 3.	Commercially Available
De-ionized Water	For fresh water, Ion Exchange process to a resistivity not less than 750 kΩ/cm @ 77° F (25° C) min., when measured in accordance with ASTM D1125-95, Method A. For rinse water that is to be reused, check that the resistivity does not fall below 500 kΩ/cm @ 77° F (25° C) min., measured in accordance with ASTM D1125-95, Method A.	Commercially Available

Table 4001 - Cleaning Materials and Equipment

Material	Description/Specification	Source/CAGE Code
Desiccant	MIL-D-3464E Type II, Kraft bag, 4 unit bag size Englehard Corporation Desiccate 25 or equivalent	Commercially Available
Detergent Refer to material technical data sheet for recommended dilution of water and detergent, and solution temperature. Equivalent detergents can be used to clean parts and assemblies. Detergents must not be destructive to the finish or material of part. Use only detergents specified in this table to clean IVD coated parts.	Formula 815 GD Applications: Hot tanks - aluminum safe Steam Cleaning Pressure Sprayers Ultrasonic Cleaning Formula 1990 GD Application: Spray Wash Cleaning	Brulin and Company, Inc. 2920 Dr. Andrew J Brown Ave. Indianapolis, Indiana 46205-4066 USA Phone:(1) 317/923-3211 FAX: (1) 317/925-4596 www.brulin.com (V94058)
Isopropyl Alcohol	TT-I-735, Grade A See **WARNING** before using this material. Flash Point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available

Table 4001 - Cleaning Materials and Equipment (Continued)

3. Cleaning Procedures

Before you do procedures given in CHECK, REPAIR, ASSEMBLY, TESTING AND FAULT ISOLATION, and final inspection, the components must be cleaned, rinsed, and dried. All signs of moisture, oil, and other contamination must be removed from the internal structure of the generator to make sure all parts and circuits function correctly. Clean the starter-generator as follows:

A. Blow out dirt particles.

(1) Put the parts into a ventilated air spray booth.

WARNING: **COMPRESSED AIR USED FOR CLEANING MUST BE FREE OF OIL AND WATER. WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, CONTROL PRESSURE TO 29 PSIG (200 KPA) OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES. TAKE PRECAUTIONS TO AVOID INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR USED TO CLEAN/DRY THE COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(2) Blow away all loose dirt with clean, dry, compressed air.

B. Clean the parts.

WARNING: **DETERGENT CAN BE DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.**

Wash the parts with one or more of the approved cleaning procedures given in Table 4002.

Procedure	Instructions
Spray	Put the parts into a high pressure spray wash booth using detergent Brulin 1990 GD.
	CAUTION: LIMIT THE PRESSURE TO CLEAN PARTS. HIGH PRESSURE CAN REMOVE OR DAMAGE SURFACE COATINGS, CONNECTIONS AND INSULATION.
	Spray the parts with a solution of detergent and de-ionized water. Refer to the manufacturers specification for the recommended dilution of water and detergent and solution temperature.
Ultrasonic	**CAUTION:** ULTRASONIC CLEANING CAN DAMAGE PLATING, BLACK OXIDE COATINGS, AND, IN ALUMINUM PARTS, DIMENSIONAL TOLERANCES.
	Put the parts into the ultrasonic cleaning tank using detergent Formula 815 GD and de-ionized water. Refer to the manufacturers specification for the recommended dilution of water and detergent and solution temperature.
	Let the parts to soak for 15 to 20 minutes maximum.
	Remove all evidence of dirt with a soft bristle brush or cleaning rag.

Table 4002 - Cleaning Procedures

Procedure	Instructions
Agitation	Put all parts into an agitation tank and clean using detergent Brulin 1990 GD and de-ionized water. Refer to the manufacturers specification for the recommended dilution of water and detergent and solution temperature.
	Agitate the parts until all evidence of dirt can be removed with a soft bristle brush or cleaning rag.
Soak	Put all parts into a soaking tank and clean using detergent Formula 815 GD or Brulin 1990 GD and de-ionized water. Refer to the manufacturers specification for the recommended dilution of water and detergent and solution temperature.
	Soak the parts until all evidence of dirt can be removed with a soft bristle brush or cleaning rag.

Table 4002 - Cleaning Procedures (Continued)

C. Rinse the parts.

(1) Rinse the part(s) with de-ionized water.

D. Do the applicable cleaning procedure again until the parts are clean and free of dirt and carbon residue.

E. Dry the parts.

(1) Remove any moisture that remains on the parts with a dry lint-free cloth.

WARNING: WEAR INSULATED GLOVES AND OBSERVE ALL SAFETY PRECAUTIONS WHEN HANDLING HEATED PARTS TO AVOID PERSONAL INJURY.

(2) Put the cleaned parts in an oven at a temperature of 200° to 250° F (93,3° to 121° C) for 2 to 3 hours.

WARNING: ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA

(3) Examine each part for carbon particles by wiping with isopropyl alcohol on a clean lint-free cloth.

4. Corrosion Preventive

NOTE: If the drive shaft is not expected to be re-installed into a starter-generator immediately after cleaning, apply a corrosion preventive compound to its black oxide coating (identified by a very dark finish).

WARNING: THE CORROSION PREVENTIVE COMPOUND IS FLAMMABLE AND TOXIC. EXTENDED EXPOSURE CAN CAUSE SKIN IRRITATION, DIZZINESS, AND HEADACHE. WHEN EXTENDED EXPOSURE IS NECESSARY, USE RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING.

(1) Apply a layer of MIL-C-16173, grade 3, corrosion preventive compound to the drive shaft.

NOTE: The drive shaft must be completely dry before you apply the corrosion preventive compound.

(2) Let the coating air dry for four hours. The coating will remain soft after drying.

5. Cleaning After Liquid Penetrant Inspection

A. Description

This specifies the procedure for cleaning part(s) after liquid penetrant inspection. Cleaning is necessary to remove residual penetrant or developer that could cause interference in processing or service requirements. Rinse parts fully with water and fully dry to make sure there is no interference in processing or service requirements.

B. Procedure

(1) Rinse the part(s) immediately after liquid penetrant inspection:

(a) The parts must be fully rinsed using water by manual or automated spray to remove the liquid penetrant.

1 Fully rinse the part(s) and aggressively agitate the part while it is immersed.

2 Pour the rinse water out from the part(s). Hold the part(s) vertical, open end down, for approximately one minute to drain.

(b) The part(s) surfaces must be visually examined under a black light after rinsing to make sure all the liquid penetrant has been removed.

1 Part(s) which show remaining liquid penetrant after rinsing must be fully cleaned and examined again.

(2) Drying of part(s) after rinsing:

CAUTION: REMAINING WATER USED FROM THE RINSING PROCEDURE MUST BE REMOVED. FAILURE TO OBEY DRYING INSTRUCTIONS CAN RESULT IN CORROSION OF THE MATERIAL.

(a) Remove the rinse water from the part(s) with a dry lint-free cloth.

WARNING: **WHEN YOU USE COMPRESSED AIR, ADJUST THE PRESSURE TO 29 PSI (200 KPA) MAXIMUM. PUT ON EYE PROTECTION TO PREVENT INJURY.**

CAUTION: MAKE SURE THAT COMPRESSED AIR FOR USE TO CLEAN/DRY THE COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(b) Use compressed air to remove rinse water.

WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HOT MATERIALS CAN CAUSE SEVERE BURNS TO SKIN. WEAR THERMAL PROTECTIVE CLOTHING WHEN HANDLING HEATED PARTS.**

(c) Immediately put the washed and rinsed part(s) in a vented 250° ± 10° F (121,1° ± 5,6° C) oven for a minimum of 2 hours.

1 The part(s) is to be positioned horizontally on a rack or on a block that will hold it in position.

(d) After the part(s) is fully dried and has cooled.

1 Check for indications of possible corrosion caused by the liquid penetrant.

a Reject the part(s) if corrosion is found.

2 If no corrosion is found, put the part(s) in a polyethylene bag with a bag of desiccant and seal it with tape, twist tie or rubber band.

3 The part(s) must be kept in a bag with desiccant until just before assembled on the starter-generator.

CHECK

1. Introduction

This section provides initial and detailed component inspection procedures for starter-generators returning from service for scheduled and unscheduled maintenance. Complete an initial inspection of the starter-generator before beginning any testing or disassembly. The results of this inspection will determine if a starter-generator is in satisfactory condition for a verification test or if it will need further disassembly, inspection, and/or replacement of parts.

This section provides the information that is needed to perform a satisfactory inspection of the starter-generator components. During an overhaul of the starter-generator, all primary components must be examined to determine if they are serviceable.

Reject a part if wear or damage is outside the acceptance limits or is not serviceable.

2. Necessary Tools and Materials

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH MANUFACTURER'S OR SUPPLIER'S RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

In addition to normal shop tools, specific tools and materials for inspection of the starter-generator are listed in Table 5001.

Tool Description	Reference
Alcohol, Isopropyl	Table 4001
Brush, non-metallic, soft bristle	Commercially Available
Cleaning pads/wiping cloths, lint-free, soft fabric	Commercially Available
Compression digital hand tester	Commercially Available
Dial Indicators	Commercially Available
Dynamic Balancer	Safran Power Standard Practice Document (SPD) 1001
Gauge Blocks	Commercially Available
Growler	Commercially Available
Dielectric (Hi-Pot) Tester	Table 1002
Magnifier, 7X to 10X	Commercially Available
Ohmmeter	Commercially Available
Surface Plate	Commercially Available

Table 5001 - Inspection Tools and Materials

Tool Description	Reference
Tensiometer	Commercially Available
V-blocks	Commercially Available
Dampener Plate Gauge Tool, P/N 19-601076	Figure 9021

Table 5001 - Inspection Tools and Materials (Continued)

A. Use of Growler

A growler is required to check for shorted armature windings. When an alternating current is passed through a growler, the current sets up a magnetic flux in the windings of the armature. As the flux passes through the windings, a potential is induced causing current to flow if the winding is short-circuited. The current flow is then detected by an iron feeler, such as a hacksaw blade.

The most common way of using a growler is the ‘feeler method’ in which the growler spans a slot containing a winding. The feeler of iron is held about 0.25 inch (6,4 mm) above the slot containing the other side of the same winding. If the winding is shorted, the feeler will be pulled down to the slot and will stick and vibrate. The feeler can also be used on the same side of the winding that is spanned by the growler.

3. General Information

Check Acceptance Limit Measurements for individual components are found in the FITS AND CLEARANCES section of this CMM. If part does not meet acceptance limits, discard. Use the following procedures for all inspections.

A. Examine the starter-generator and its components visually for:

- signs of corrosion
- chipped-off enamel
- nicks, cracks, dents, scratches
- gouging, scoring or glazing mating surfaces
- fretting corrosion on mating surfaces
- loose or defective attaching parts
- distortion
- discoloration
- crossed or stripped threads
- condensation at drain holes
- torn or cracked seals

- galling or glazing of friction lining residue
- bent or distorted springs
- rounding, stripping or uneven wear on gear teeth

B. Examine electrical components visually for:

- loose or defective attaching parts
- damage caused by excessive heat
- electrical arcing paths
- corroded contacts or terminals
- loose or defective electrical connector, contacts or terminals
- corroded electrical pins or connector
- bent connector pins
- loose, broken or shorted terminations

4. Initial Inspection

NOTE: If damage is found during inspection, stop the inspection immediately and begin further disassembly of the starter-generator using the instructions in the DISASSEMBLY section.

A. Visually examine the starter-generator in a brightly lit work area in accordance with (IAW) Paragraph 3.A.

(1) If shipping or handling damage exists, stop the inspection and notify your supervisor.

(2) If operational damage exists, write down the components that need to be replaced or repaired and continue the inspection.

B. Clean the exterior of the starter-generator.

WARNING: ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA.

(1) Clean the surface of the starter-generator using a lint-free cleaning cloth moistened with isopropyl alcohol.

(2) If needed, loosen any dust particles or grease with a soft bristle brush.

C. Examine the starter-generator in a brightly lit work area IAW Paragraph 3.B.

D. Examine the seating between the housing and both end bells. Make sure that all attaching hardware is in place.

5. Non-Destructive Test (NDT) Inspections

A. Unless otherwise specified, do magnetic particle inspections IAW ASTM-E1444. Unless otherwise specified, acceptance criteria must be IAW MIL-STD-1907 Table 1, Grade A.

B. Unless otherwise specified, do liquid penetrant inspections IAW ASTM-E1417 type 1 Method A or B, sensitivity 2 or higher. Unless otherwise specified, acceptance criteria must be IAW MIL-STD-1907 Table II, Grade C.

6. Replace Service Parts and Common Hardware

A. Overhaul

During overhaul, replace bearings, brushes and o-rings. Parts that have been removed during disassembly, such as, insulating parts, retaining rings, screws, self-locking nuts and lock washers, must be discarded regardless of their condition. The screws that attach the brush leads to the brush holder do not need to be replaced unless damaged.

B. Service repair

During repair, inspection or servicing, replace all exposed hardware and flat washers that are damaged, deformed, corroded, or have other apparent defects. Always replace bearings, retaining rings, lock washers, and self-locking nuts regardless of their condition if removed during disassembly.

7. Inspection Guidelines

A. Repair or service inspection

Examine only those components that have been disassembled for repair or service. Do not disassemble any component for inspections unless given instructions to do so in this section or in the TESTING AND FAULT ISOLATION section.

B. The following terms are referenced in this section:

- DISCARD -

  If damage to the part is found or the part is outside of the acceptance limits in the FITS AND CLEARANCES section, the part must be removed and replaced with a new one.

- REPAIR -

  If damage to the part is found or the part is outside of the acceptance limits in the FITS AND CLEARANCES section, the part can be repaired by a procedure found in the REPAIR section.

- DISASSEMBLE -

  If damage to the part is found to a part in an assembly, or part of the assembly is outside of the acceptance limits in the FITS AND CLEARANCES section, you can disassemble the part from the assembly and repair or replace the damaged part(s).

- REPLACE -

  If damage occurs that causes a part to be outside of the acceptance limits in the FITS AND CLEARANCES section or there is no repair procedure for that part, replace the part. Retain the following parts to submit for remanufacture: armature and stator and housing assembly.

C. Dimensions and Points

Letters (i.e., A,B,C,D, etc.) used in an illustration in this section indicate dimensions or points.

D. Surfaces

Numbers (i.e., 1,2,3,4, etc.) used in an illustration indicate surfaces.

8. Inspection of Parts and Assemblies

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

NOTE: In cases where a repair is authorized but the repair does not work, discard and replace the item in question regardless of whether or not it is so spelled out in this manual.

A. V-Retainer coupling (10005-10) and T-bolt (10005-30).

(1) Examine V-retainer coupling (10005-10) IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if damage or corrosion exists.

(b) DISCARD the part if corroded or spot welds are damaged.

(2) Examine the T-bolt (10005-30) IAW the procedures found in Paragraph 3.A.

(a) REPAIR the part if two or less threads are damaged.

(b) DISCARD the part if more than two threads are damaged.

B. Mounting adapter (10005-40). See Figure 5001.

(1) Examine mounting adapter (10005-40) IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks or major damage exists.

(b) REPAIR the part if minor surface damage exists.

(2) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(3) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW section 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

(4) Examine mounting adapter (10005-40) for damaged or missing guide pin(s) (10005-70).

(a) REPAIR pin(s) (10005-70) if damage exists or they are not within limits of the FITS AND CLEARANCES section.

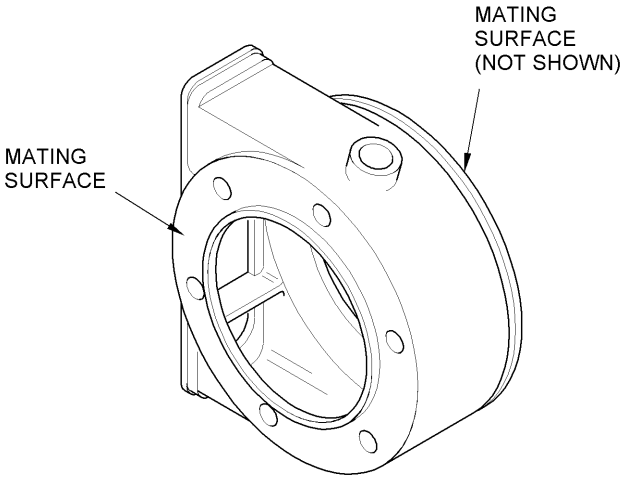

Figure 5001 - Mounting Adapter

C. Identification plate. See Figure 5002.

NOTE: ID plates with superficial nicks, dents and scratches, that do not interfere with the legibility of the identification nameplate, can be reused providing they are sealed with acrylic coating.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

If damage exists or the information is faded or unreadable:

(a) Retain the original identification plate.

(b) Transfer the information from the original identification plate to a replacement identification plate (-30).

(c) DISCARD the original identification plate.

(2) Make sure that the drive screws (-40) are tight and in place.

(a) DISCARD loose drive screws (-40).

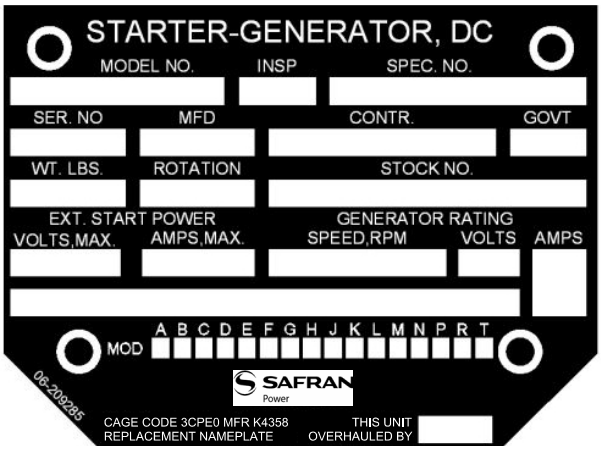

Figure 5002 - Replacement Identification Plate

D. Terminal block cover (-180).

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(2) DISCARD the part if damage exists.

E. Air inlet (110). See Figure 5003.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(2) DISCARD the part if cracks, major damage or fretting corrosion on either the inlet or mounting flange exists.

(3) REPAIR the part if minor surface damage exists.

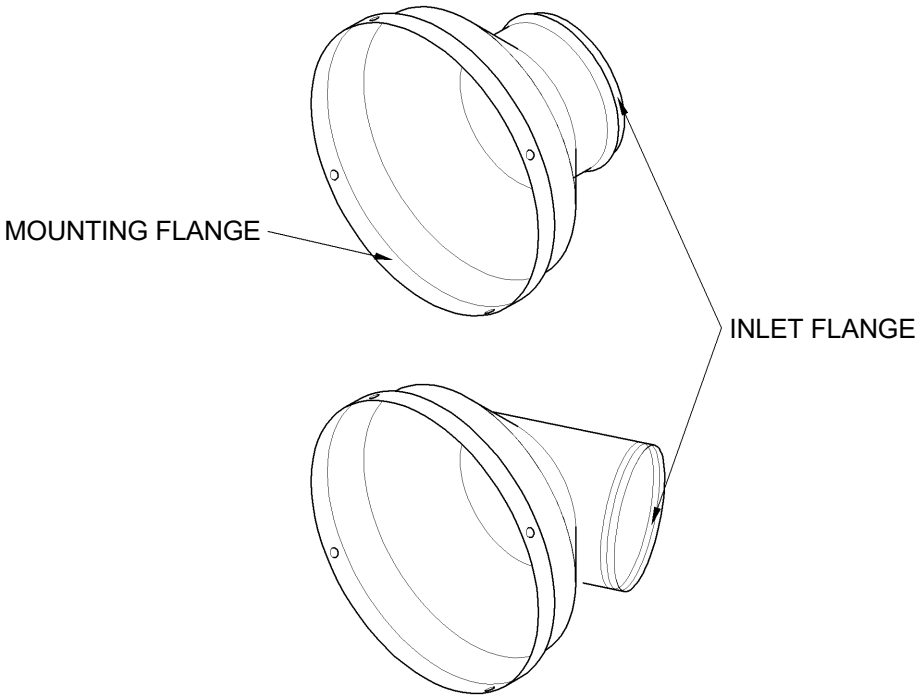

Figure 5003 - Air Inlets

F. Brush access cover. See Figure 5004**.**

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks or major damage exists.

(b) REPAIR the part if minor surface damage exists.

(2) Examine the insulating tape for tears or loose edges.

(a) REPAIR the insulating tape if it is loose or worn.

(3) Examine the screw (140) threads IAW the procedures found in Paragraph 3.A.

(a) REPAIR the part if two or less threads are damaged.

(b) DISCARD the part if more than two threads are damaged.

(4) Ensure that the blind rivet nut (150) on the bracket is tightly attached.

(a) REPAIR the part if the nut is loose or missing.

(5) Examine the blind rivet nut (150) threads IAW the procedures found in Paragraph 3.A.

(a) REPAIR the part if two or less threads are damaged.

(b) DISCARD the part if more than two threads are damaged.

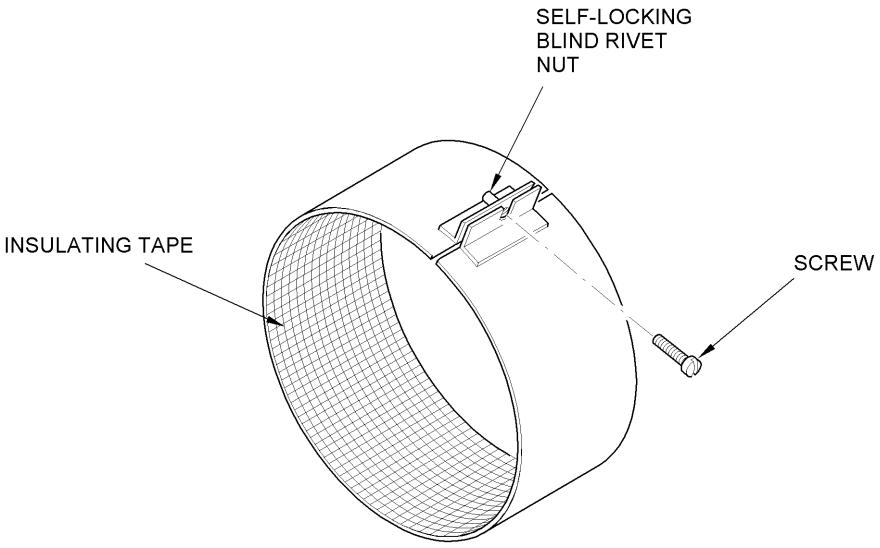

Figure 5004 - Brush Access Cover

G. Brushes (160). See Figure 5005

NOTE: For repair only. Brushes must be replaced at each overhaul.

(1) Visually examine brushes for cracks, chips, frayed leads, and loose rivets or loose connections.

(a) DISCARD brushes if damaged.

(2) Visually examine wear indicator for remaining allowable wear.

(a) REPLACE brushes if remaining allowable wear will be exceeded before the next overhaul. Seat new brushes in accordance with instructions in SPD 1006.

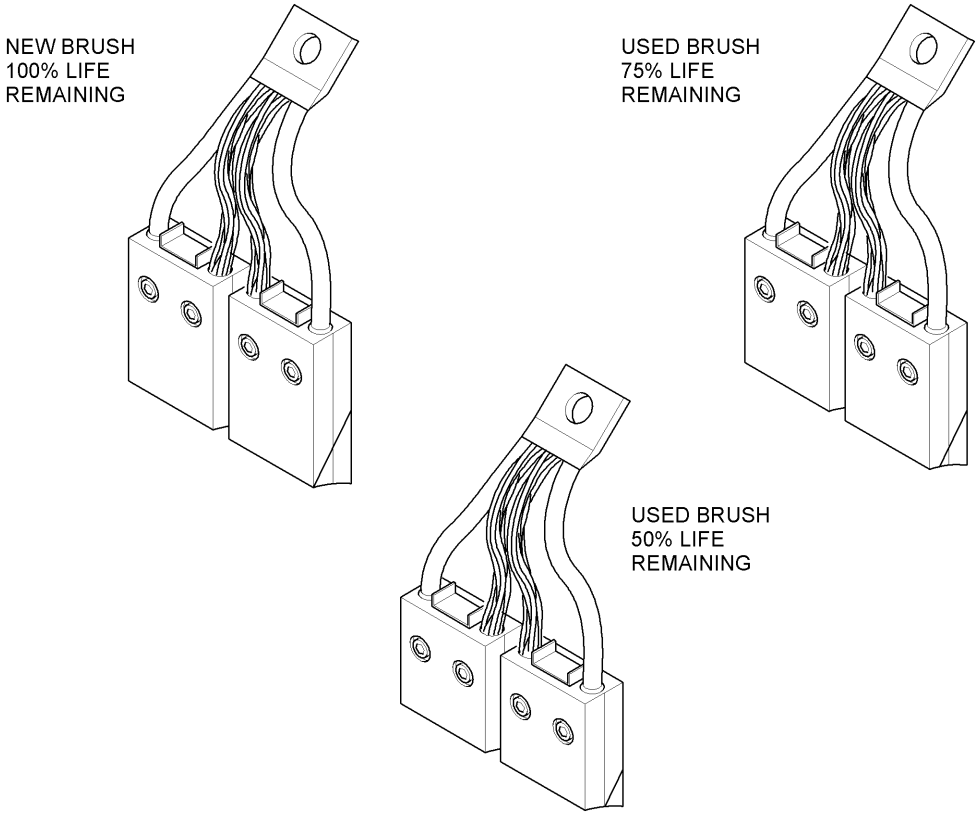

Figure 5005 - Brush Wear

H. Fan (180). Figure 5006

(1) Examine the part IAW the procedures found in Paragraph 3.A.

NOTE: Pay particular attention to the blade edges and surfaces and shaft mating surface.

(a) DISCARD the part if cracks, scoring-gouging-glazing on mating surfaces, or major damage exists.

(b) REPAIR the fan if minor surface damage is found.

(2) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(3) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW section 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

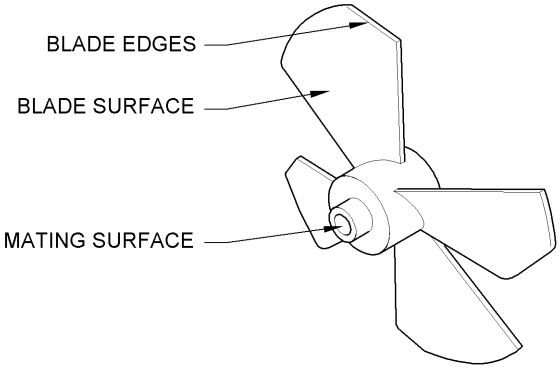

Figure 5006 - Fan

I. Drive Shaft (210) and dampener hub (250). See Figure 5007.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISASSEMBLE the drive shaft (210) and dampener hub (250) if cracks or thread damage beyond two threads exist.

(b) REPAIR the drive shaft (210) and dampeners hub (250) if dents, nicks and scratches exist.

(2) Examine armature mating spline, drive spline, and dampener hub spline for rounding, stripping, or uneven wear.

(a) DISASSEMBLE drive shaft (210) and dampener hub (250) if damaged

(b) DISCARD the damaged part.

(3) Measure the drive spline diameter over two gage pins.

(a) DISASSEMBLE the drive shaft (210) and dampener hub (250) if the diameter is not within the limits in the FITS AND CLEARANCES section.

(b) DISCARD the out of specification part.

(4) Perform a magnetic particle inspection IAW procedures found in Paragraph 5.A.

(a) DISCARD the drive shaft (210) and dampener hub (250) if damage is found.

NOTE: Examine drive shaft and dampener hub mating surfaces only if dampener hub was removed from drive shaft.

(5) Visually examine mating surfaces for gouging, scoring, or glazing.

(a) REPAIR damaged surface(s) if minor damage is found.

(b) DISCARD part(s) if part(s) fail visual inspection.

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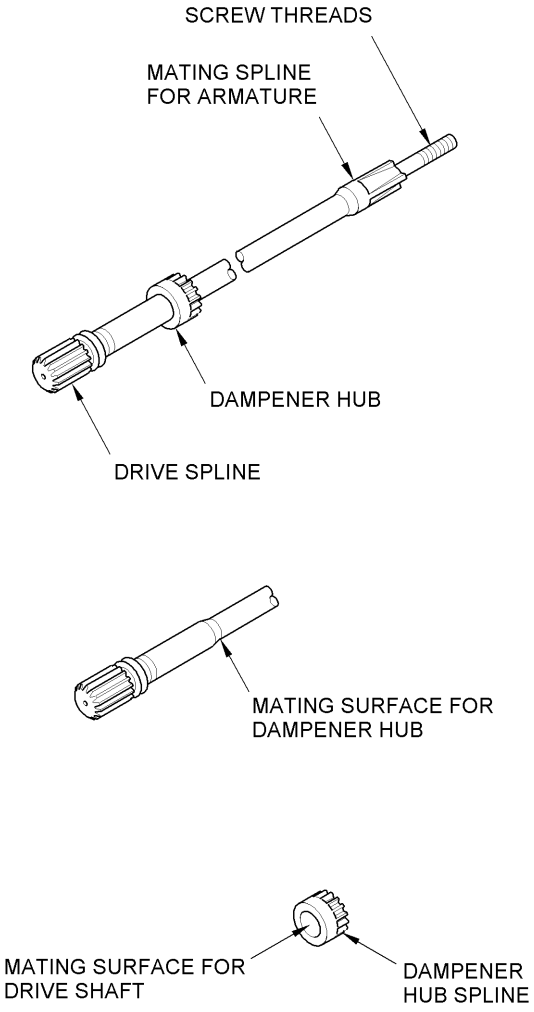


Figure 5007 - Drive Shaft and Dampener Hub.

J. Friction ring (230). See Figure 5008.

WARNING: DO NOT CUT, RIP, OR SAND ASBESTOS-CONTAINING MATERIALS. LEAVE UNDAMAGED MATERIALS ALONE AND, TO THE EXTENT POSSIBLE, PREVENT THEM FROM BEING DAMAGED, DISTURBED, OR TOUCHED. DISCARD MATERIAL BY FIRST CHECKING WITH LOCAL HEALTH, ENVIRONMENTAL, OR OTHER APPROPRIATE OFFICIALS TO FIND OUT ABOUT PROPER HANDLING AND DISPOSAL PROCEDURES.

(1) If friction ring is Part No. 02-5600-05, it must be discarded because it contains asbestos.

(2) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if damage is found.

(3) Measure the friction ring (230) thickness.

(a) DISCARD the part if thickness is not within limits in the FITS AND CLEARANCES section.

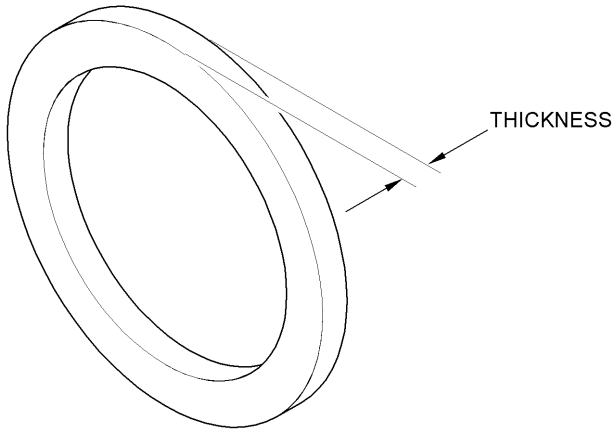


Figure 5008 - Friction Ring

K. Dampener plate (240). See Figure 5009.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks exist.

(b) REPAIR if minor nicks, scratches, gouging, scoring, or glazing is found.

(2) Examine the spline teeth for rounding, stripping, or uneven wear.

(a) DISCARD the part if damaged.

(3) Measure the dampener plate (240) thickness.

(a) DISCARD if thickness is below the acceptance limit in the FITS AND CLEARANCES section.

(4) Use the dampener plate gauge (19-601076) (See Figure 9021) to check the splines of the dampener plate (240), or measure the distance between pins of the spline teeth.

(a) The dampener plate (240) is acceptable if the plate has a tight fit on the dampener plate gauge or does not fit.

(b) The dampener plate must be discarded if the plate fits easily on the dampener plate gauge or is loose.

(c) If measuring the distance between spline teeth, DISCARD if distance is above the acceptance limit in the FITS AND CLEARANCES section.

(5) Perform a magnetic particle inspection IAW the procedures found in Paragraph 5.A.

(a) DISCARD the part if damaged.

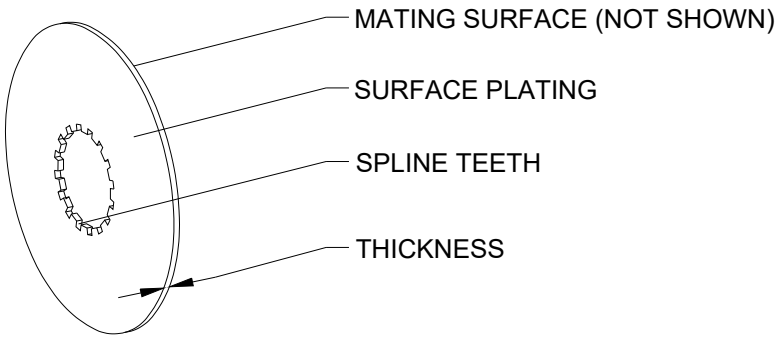


Figure 5009 - Dampener Plate

L. Dampener back plate (260). See Figure 5010.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks exist.

(b) REPAIR if minor nicks or scratches exist.

(c) DISCARD if gouging, scoring, or glazing exists on mating surfaces.

(2) Perform a magnetic particle inspection IAW the procedures found in Paragraph 5.A.

(a) DISCARD if damage is found.

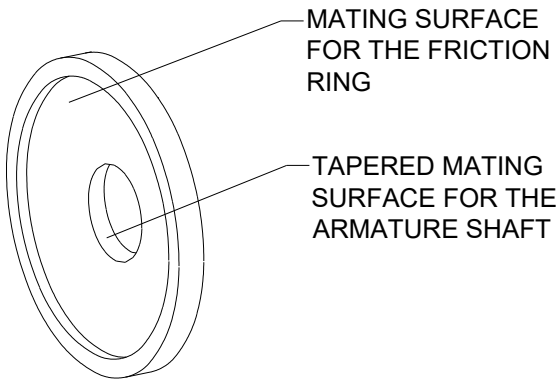


Figure 5010 - Dampener Back Plate

M. Speed pickup gear (280). See Figure 5011

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks are found.

(b) REPAIR if minor nicks, dents or scratches are found.

(2) Visually examine mating surfaces for gouging, scoring or glazing.

(a) DISCARD the part if damaged.

(3) Visually examine teeth for wear (contact with magnetic speed pickup)

(a) DISCARD the part if damaged.

(4) Perform magnetic particle inspection IAW the procedures found in Paragraph 5.A.

(a) DISCARD the part if damaged.

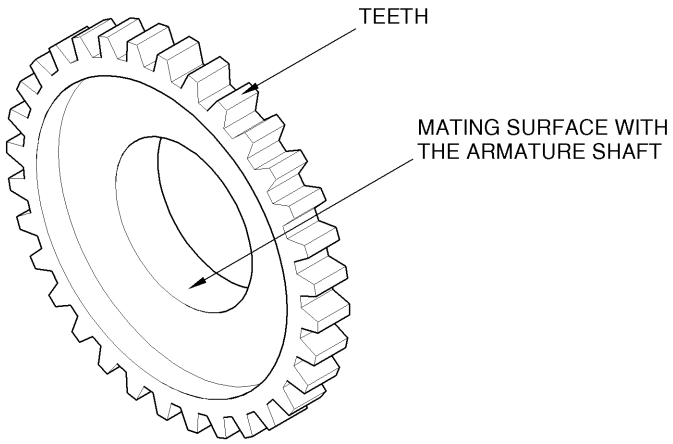


Figure 5011 - Speed Pickup Gear

N. Bearing and brush support assembly (290). See Figure 5012 through Figure 5013.

(1) Examine the part IAW the procedures found in Paragraph 3.A. (PRE SB 23080-3055-24-01)

NOTE: Refer to service bulletin “SB 23080-360-24-01” for the conversion to anti-drive end end bell P/N 23080-3055. This service bulletin specifies the repair of anti-drive end (ADE) end bells that have small crack(s) in the thin wall area between the bearing retainer screw hole and the bearing liner

(a) DISCARD the part if cracks or fretting and/or corrosion on the mating surface are found.

(b) REPAIR if minor dents, scratches and nicks or gouging scoring or glazing on the mating surfaces (marked 1, 2, 3, and 6 on Figure 5012) are found.

(2) Examine the part IAW the procedures found in Paragraph 3.A. (SB 23080-3055-24-01).

(a) DISCARD and REPLACE the part if cracks or fretting and/or corrosion on the mating surface are found (marked 1, 2, 3, and 6 on Figure 5012).

(3) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(4) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW section 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

(5) Measure bearing liner diameter “A.” Using a gage with an accuracy of ± 0.00004 inch (0,0010 mm). See Figure 5012.

(a) DISASSEMBLE the bearing and brush support assembly (290) if damage exists.

(b) REPAIR if bearing liner diameter does not meet the limits in the FITS AND CLEARANCES section.

(6) Examine the helicoil inserts (10002-20) (marked 4 and 5 on Figure 5012) for damage.

(a) REPAIR helicoil if damage is found.

(b) REPAIR any damaged parts.

(7) Hand tighten a machine screw into the blind rivet nut in each complete brush holder (10002-30) to assure that the self-locking feature is functional. The machine screw should bind in the blind rivet nut before it is fully engaged.

(a) REPAIR the complete brush holder (10002-30) if the blind rivet nut is damaged.

(b) REPAIR the complete brush holder (10002-30) if the self-locking feature does not function properly.

(8) Examine the brush holders (10002-90), including the brush spring supports and center supports for cracks, warping, and discoloration caused by electrical arcing.

(a) DISCARD the complete brush holder (10002-30) if damage exists.

(9) Measure brush spring (10002-130) force using tensiometer (pull scale) with harness. See Figure 5013.

NOTE: When measuring brush spring force, readings can vary widely depending on where measuring device touches spring. Measurements must be taken from curved tip of spring at point where spring touches brush.

(a) Take six measurements.

(b) Calculate an average from the measurements.

(c) Discard any brush spring not within limits of FITS AND CLEARANCES.

(10) Perform a dielectric test.

WARNING: **BEFORE YOU USE THE HIGH VOLTAGE ELECTRICAL EQUIPMENT, MAKE SURE THAT THE POWER SWITCH IS IN THE 'OFF' POSITION. MAKE SURE THAT NO PERSON TOUCHES THE EQUIPMENT OR THE PROBES. THIS WILL PREVENT DEATH OR INJURY FROM ELECTRIC SHOCK.**

CAUTION: FAILURE TO TURN OFF HIGH POTENTIAL TESTER POWER BEFORE CONNECTING OR DISCONNECTING HIGH VOLTAGE ELECTRICAL LEADS CAN CAUSE SERIOUS DAMAGE TO BEARING AND BRUSH SUPPORT ASSEMBLY.

CAUTION: BEARING AND BRUSH SUPPORT ASSEMBLY (290) MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

(a) With power OFF, connect positive test lead of high potential tester to metal surface of brush holder.

(b) With power OFF, connect negative test lead to uncoated surface of bearing and brush support.

(c) With high potential tester output voltage at 0, turn power ON.

(d) Slowly adjust output voltage (at a rate not more than 100 V/sec.) to 250 V RMS, commercial frequency. Adjust voltage back to 0.

(e) Turn high potential tester power OFF.

(f) Disconnect test leads from bearing and brush support assembly.

(g) Acceptance Limits:

1 Any arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current that is more than 2 mA is evidence of damp, dirty, weak or defective components and constitutes a failure.

If bearing and brush support assembly (290) fails dielectric test, clean bearing and brush support assembly, and repeat dielectric test.

2 If bearing and brush support assembly fails dielectric test after cleaning, disassemble bearing and brush support assembly, replace all insulating materials (i.e., washers, sleeves, plates), and repeat dielectric test.

If bearing and brush support assembly (290) fails dielectric test, replace bearing and brush support assembly.

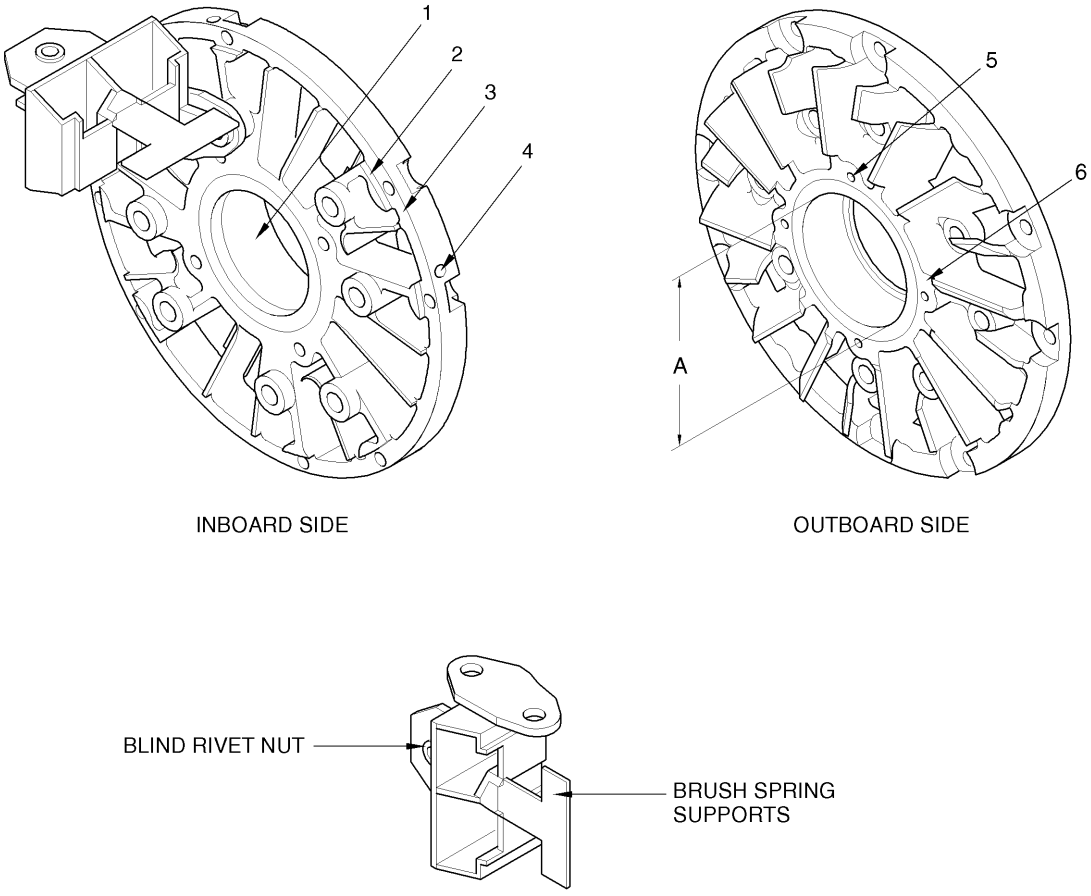


Figure 5012 - Bearing and Brush Support Assembly, Inboard and Outboard Side

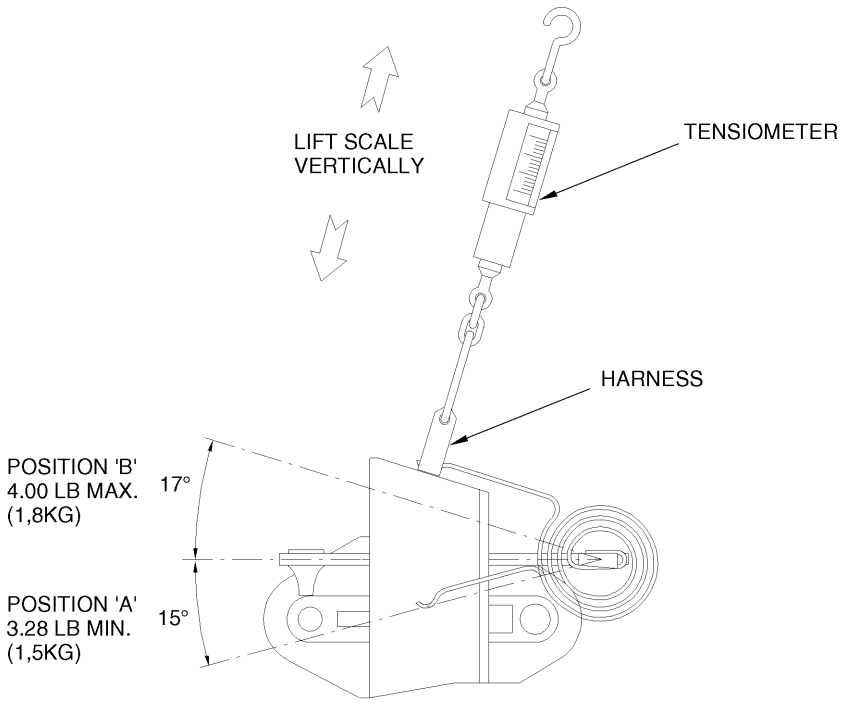


Figure 5013 - Determine Spring Force

O. Baffle Disc or Spacer (320). See Figure 5014

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if damaged.

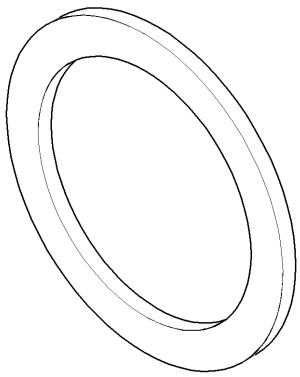


Figure 5014 - Spacer

P. Connector (330) and spacers (340, 350).

(1) Examine the part IAW the procedures found in Paragraph 3.A. and Paragraph 3.B.

(2) Make sure that connector (330) pins are not bent or missing.

(3) DISCARD the connector (330) and/or spacers (340, 350) if damage exists.

Q. Thermal switch (370). See Figure 5015

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) REPLACE thermal switch (370) if damaged.

(2) Examine insulation sleeving for cracks or tears.

(a) REPLACE thermal switch (370) if damaged.

(3) Use an ohmmeter to check for continuity of switch at ambient air temperature

(a) REPLACE thermal switch (370) if continuity is indicated.

WARNING: USE NECESSARY PRECAUTIONS WHEN HANDLING HEATED PARTS TO AVOID INJURY TO PERSONNEL.

(4) Use an oven to heat thermal switch assembly to 340° F (171° C).

(5) Use an ohmmeter to check for continuity of assembly.

(a) REPLACE thermal switch (370) if continuity is not less than 0.1 Ω.

NOTE: Thermal switch is a normally open switch with an operating range of 300° to 350° F (149° to 177° C). The switch closes when temperature rises to 330° F (166° C) and opens when temperature drops to 300° F (149° C).

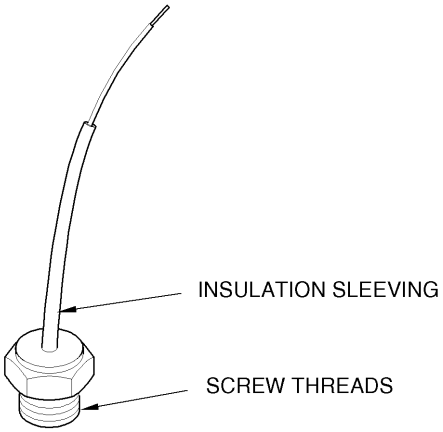


Figure 5015 - Thermal Switch

R. Drive end bearing support assembly (380). See Figure 5016.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks or fretting and/or corrosion on the mating surface are found.

(b) REPAIR if minor dents, scratches and nicks or gouging scoring or glazing on the mating surfaces are found.

(2) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(3) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW section 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

(4) Measure bearing liner diameter “A” using a gage with an accuracy of ± 0.00004 inch (0,0010 mm). See Figure 5016.

(a) REPAIR the bearing liner if the measurements are not within the limits of the FITS AND CLEARANCES section.

(5) Examine the helicoil inserts (10003-20) (marked 1 on Figure 5016) and threaded hole (marked 2 on Figure 5016) for crossed or stripped threads.

(a) REPLACE helicoil inserts (10003-20) if damaged.

(b) DISCARD drive end bearing support assembly (380) if threaded hole damaged.

(6) Examine screen (10003-30) for tears.

(a) DISASSEMBLE drive end bearing support assembly (380) if damage is found.

(b) DISCARD drive screws (10003-40) and damaged screen (10003-30).

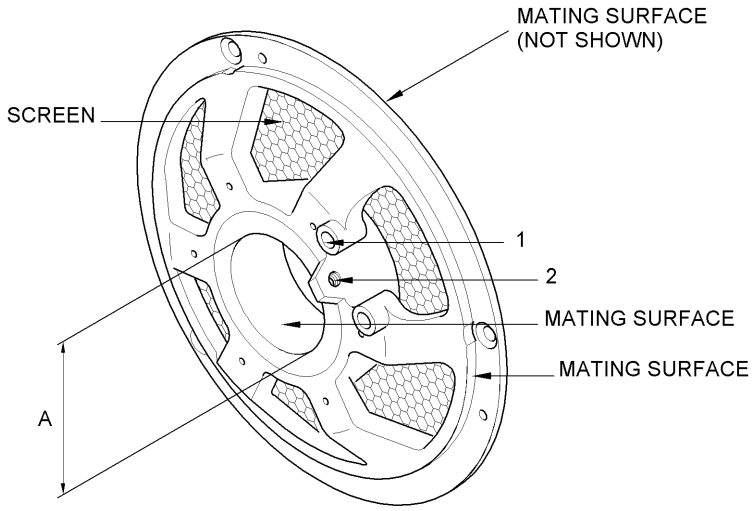


Figure 5016 - Drive End Bearing Support Assembly

S. Speed pickup (400). See Figure 5017.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) REPAIR the part if two or less threads are damaged

(b) DISCARD the part if more than two threads are damaged or other damage exists.

(2) Examine the insulation sleeving for damage.

(a) DISCARD the part if damage exists.

(3) Measure resistance between each speed pickup lead and ground. REPLACE the speed pickup if it does not meet the limit in FITS AND CLEARANCES section.

(4) Measure resistance between the two speed pickup leads. REPLACE the speed pickup if the resistance is not within the limits in FITS AND CLEARANCES section.

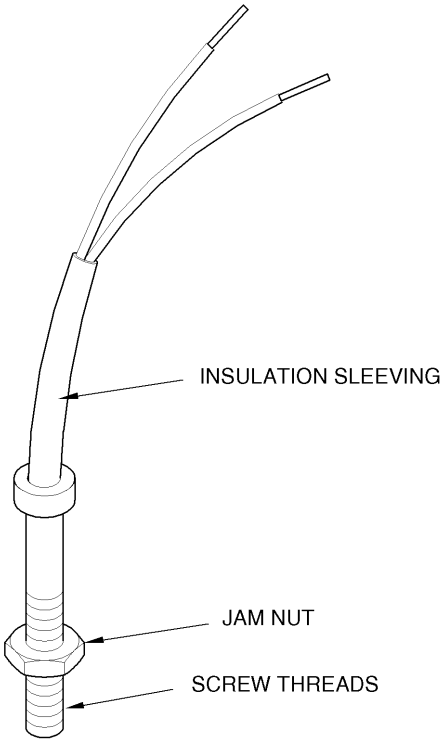


Figure 5017 - Speed Pickup

T. Spring Wave Washer (430). See Figure 5018.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the spring wave washer (430) if damage is found.

(2) Use a Compression Digital Hand Tester, or equivalent, to measure the force required to compress the spring from the free height (H_F) to the compressed height (H_C). See Figure 5018.

(a) DISCARD if the load given in Table 5002 is not met.

Free Height (H_F)	Compressed Height (H_C)	Acceptance Limits
0.125 inch (3,18 mm)	0.062 inch (1,58 mm)	26 to 34 lbs. (11,8 to 15,4 kg)

Table 5002 - Spring Wave Washer Inspection

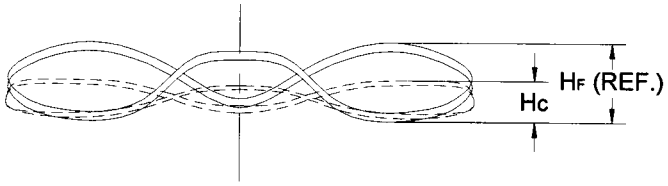


Figure 5018 - Spring Wave Washer Load Inspection

U. Armature (460). See Figure 5019.

CAUTION: INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) IS NOT APPROVED ON THE ARMATURE WINDINGS. THE ARMATURE MUST BE REPLACED IF YOU FIND INSULATION ENAMEL (GLYPTAL OR EQUIVALENT) ON THE ARMATURE WINDINGS.

(1) Before the commutator is refinished, measure commutator bar-to-bar run-out in a full circumference outside the brush paths (area where the brushes do not touch).

(a) REPLACE armature (460) if bar-to-bar run-out is more than the limits of the FITS AND CLEARANCES section before refinishing the armature. NO REPAIR IS PERMITTED.

(2) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if cracks or fretting and/or corrosion on the mating surface are found.

(b) REPAIR if minor dents, scratches and nicks or gouging scoring or glazing on the mating surfaces are found.

(3) Examine bearing journals for gouging, scoring, or glazing.

(a) REPAIR bearing journals if damaged.

(b) REPLACE armature if damage is not repairable.

(4) Measure bearing journal diameters, A and C, as shown in Figure 5019.

(a) REPAIR bearing journals if they do not meet limits in FITS AND CLEARANCES section. Refer to SPD 1000.

(b) REPLACE armature if damage is not repairable.

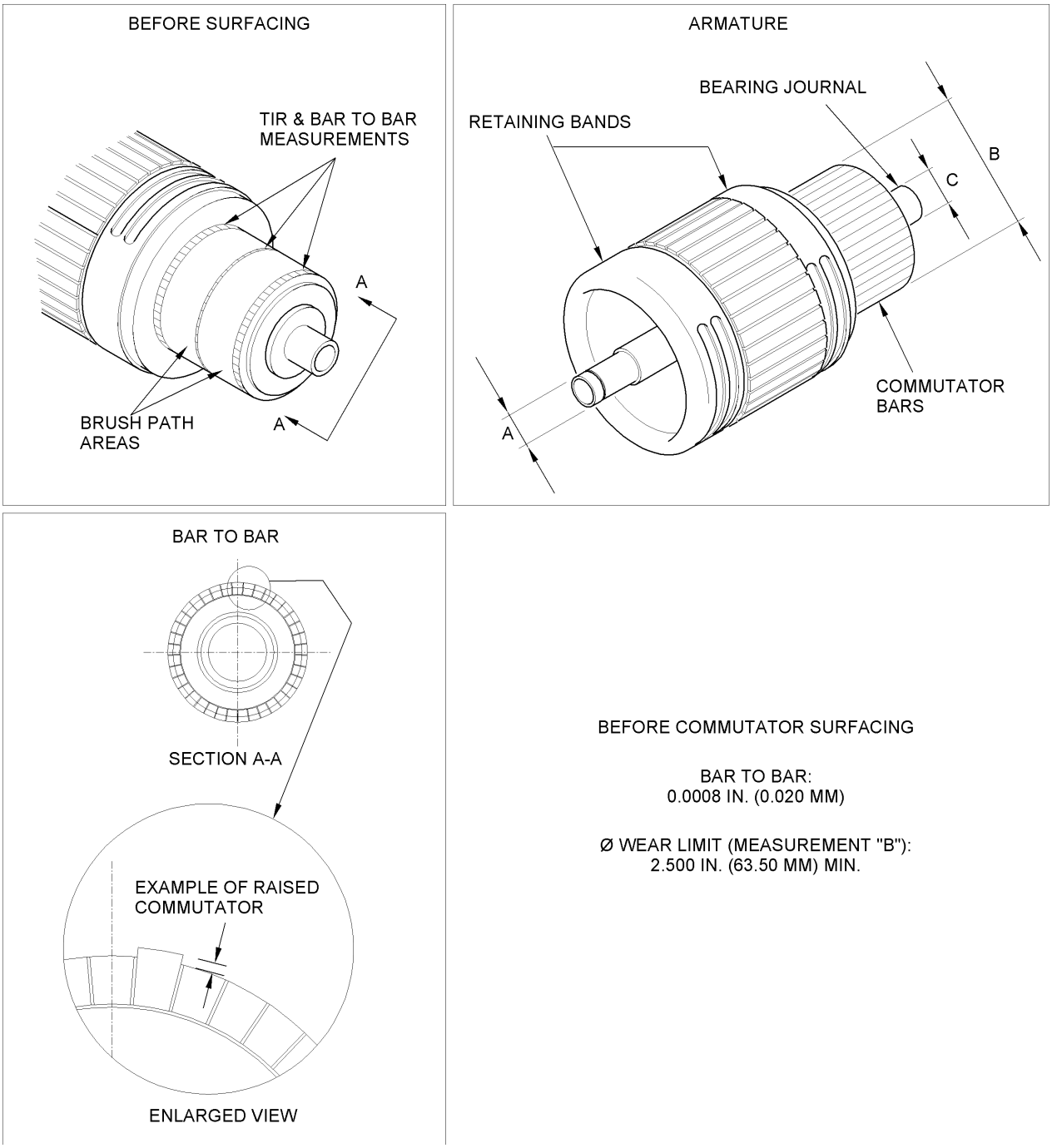


Figure 5019 - Armature Check

(5) Measure commutator diameter B, as shown in Figure 5019.

(a) REPLACE armature if minimum commutator diameter “B” is below limit in FITS AND CLEARANCES section.

(6) Examine internal spline for rounding, stripping, or uneven wear.

(a) Check the drive spline for too much wear by engaging a new drive shaft into the armature internal drive spline. Reject the armature shaft if too much play is found when engaging the drive shaft.

NOTE: An armature spline with too much wear will not engage tightly with a new drive shaft.

(b) Use a bright light to visually examine the internal spline of the armature shaft for gouging or rounding of the spline. Reject the part if damage is found.

NOTE: The armature shaft internal spline cannot be repaired. The armature shaft cannot be removed from the armature for replacement in the field.

(c) REPLACE armature if damaged.

(7) Examine commutator undercut for broken, damaged, or missing mica.

(a) REPLACE armature if damaged.

(8) Examine commutator bars for burning and discoloration.

(a) REPAIR commutator if damaged.

(b) REPLACE armature if damage is not repairable.

(9) Measure commutator undercut.

(a) REPAIR commutator if mica undercut depth is below limits in FITS AND CLEARANCES section.

(b) REPLACE armature if damage is not repairable.

(10) Test armature windings for shorts using a growler and iron feeler. Refer to Paragraph 2.A. of this section for additional information about use of growler during inspection.

(a) REPLACE the armature (460) if a short exists.

(11) Perform a dielectric test.

WARNING: **BEFORE YOU USE THE HIGH VOLTAGE ELECTRICAL EQUIPMENT, MAKE SURE THAT THE POWER SWITCH IS IN THE 'OFF' POSITION. MAKE SURE THAT NO PERSON TOUCHES THE EQUIPMENT OR THE PROBES. THIS WILL PREVENT DEATH OR INJURY FROM ELECTRIC SHOCK.**

CAUTION: FAILURE TO TURN OFF HIGH POTENTIAL TESTER POWER BEFORE CONNECTING OR DISCONNECTING HIGH VOLTAGE ELECTRICAL LEADS CAN CAUSE SERIOUS DAMAGE TO THE ARMATURE.

CAUTION: ARMATURE (460) MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC TEST.

(a) With power OFF, connect positive test lead of high potential tester to armature (460) shaft.

(b) With power OFF, put negative test lead on commutator bar.

(c) With the high potential tester output voltage at 0, turn power ON.

(d) At a rate not to exceed 100 V/sec., slowly adjust output voltage to 250 V RMS, commercial frequency for one minute. Slowly decrease voltage back to 0.

(e) Turn high potential tester power OFF.

(f) Remove negative test lead.

(g) Connect negative lead to retaining band.

(h) Repeat dielectric test between retaining bands and commutator bars.

(i) Acceptance Limits:

1 Any arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current that is more than 2 mA is evidence of damp, dirty, weak or defective components and constitutes a failure.

If armature (460) fails dielectric test, clean armature (460) and repeat dielectric test.

2 If armature (460) fails dielectric test after cleaning, replace armature (460).

V. Bearing retainer (470). See Figure 5020.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if damaged.

(2) Carefully examine mating surfaces 1 and 2 for gouging, scoring, or glazing.

(a) DISCARD the part if damaged.

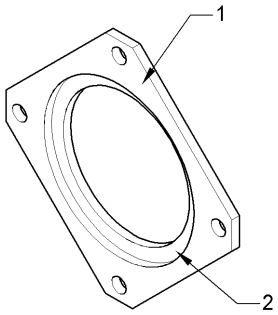


Figure 5020 - Bearing Retainer

W. Stator and housing assembly (500). See Figure 5021.

CAUTION: INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) IS NOT APPROVED ON THE STATOR WINDINGS. THE STATOR MUST BE REPLACED IF YOU FIND INSULATION ENAMEL (GLYPTAL OR EQUIVALENT) ON THE STATOR WINDINGS.

(1) Examine the part IAW the procedures found in Paragraph 3.A. and Paragraph 3.B.

(a) DISCARD the part if cracks or other major damage exists.

(b) REPAIR thread damage of two turns or less.

(c) DISCARD the part if thread damage is more than two turns.

(d) REPAIR the part if other damage exists.

(2) Examine the brush leads and stator leads for damage.

(a) If brush lead damage is more than 5 percent of the brush lead, REPLACE the stator and housing assembly (500).

(b) If stator lead damage is found, REPLACE the stator and housing assembly (500).

(3) Perform a dielectric test.

WARNING: **BEFORE YOU USE THE HIGH VOLTAGE ELECTRICAL EQUIPMENT, MAKE SURE THAT THE POWER SWITCH IS IN THE 'OFF' POSITION. MAKE SURE THAT NO PERSON TOUCHES THE EQUIPMENT OR THE PROBES. THIS WILL PREVENT DEATH OR INJURY FROM ELECTRIC SHOCK.**

CAUTION: FAILURE TO TURN OFF THE HIGH POTENTIAL TESTER POWER BEFORE CONNECTING OR DISCONNECTING HIGH VOLTAGE ELECTRICAL LEADS CAN CAUSE SERIOUS DAMAGE TO THE STATOR AND HOUSING ASSEMBLY.

CAUTION: STATOR AND HOUSING ASSEMBLY (500) MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

(a) Jumper all stator leads together.

(b) With power OFF, connect positive test lead of high potential tester to jumpered stator leads.

(c) With power OFF, connect negative test lead to uncoated surface of housing.

(d) With high potential tester output voltage at 0, turn power ON.

(e) At a rate not to exceed 100 V/sec., slowly adjust output voltage to 250 V RMS, commercial frequency for one minute. Slowly decrease voltage back to 0.

(f) Turn high potential tester power OFF.

(g) Disconnect test leads.

(h) Disconnect jumper from stator leads.

(i) Acceptance Limits:

1 Any arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current that is more than 2mA is evidence of damp, dirty, weak or defective components and constitutes a failure.

If stator and housing assembly (500) fails dielectric test, clean stator and housing assembly and repeat dielectric test.

2 If stator and housing assembly (500) fails dielectric test after cleaning, replace stator and housing assembly.

(4) Use an ohmmeter to check for continuity between terminals A and E.

(a) REPLACE the stator and housing assembly (500) if an open circuit exists.

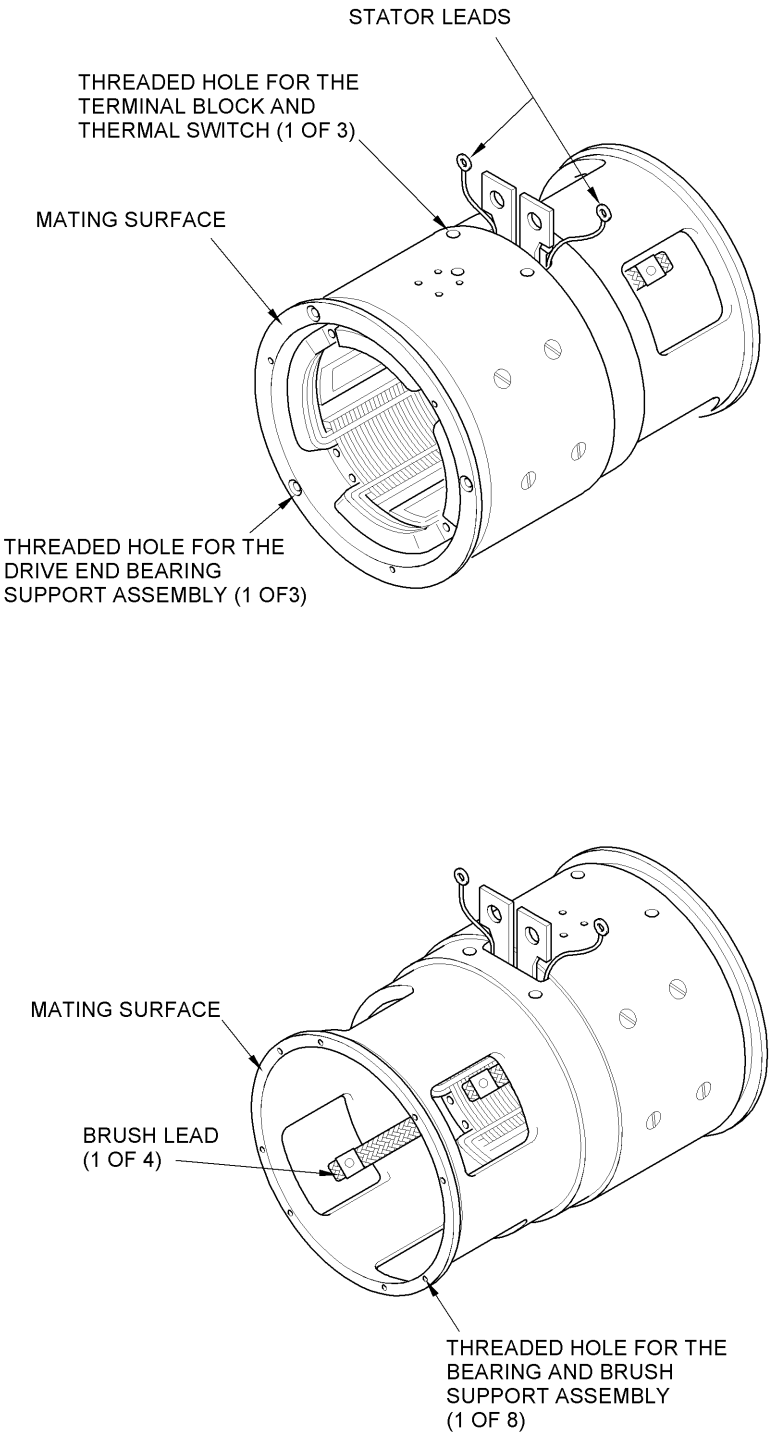


Figure 5021 - Stator and Housing Assembly

X. Terminal block (10004-50). See Figure 5022.

CAUTION: THE USE OF RE-MANUFACTURED TERMINAL BLOCKS IS NOT AUTHORIZED BY SAFRAN POWER. DAMAGED TERMINAL BLOCKS OTHER THAN THOSE WITH REPAIRABLE THREAD DAMAGE) MUST BE DISCARDED.

(1) Examine the part IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if damage, other than thread damage, exists.

(b) REPAIR the part if thread damage of two turns or less exists.

(c) DISCARD the part if thread damage of more than two turns exists.

(2) Measure the capacitance values between Terminals B and E and between B and the ground lead at a frequency of 110 to 130 Hz, 77° F (25° C).

(a) DISCARD the part if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

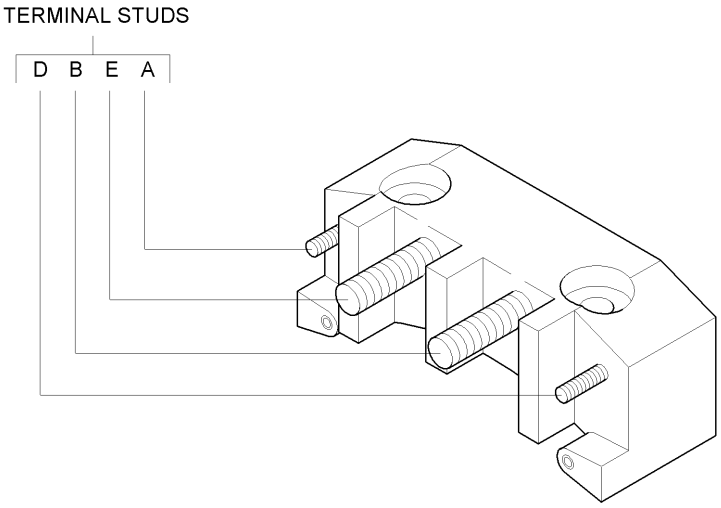


Figure 5022 - Terminal Block

9. Terminology

Table 5003 lists the definitions of terms used to describe damage conditions.

Term	Definition	Probable Cause
Corrosion	The chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.	Environmental condition that causes deterioration.
Crack	A break in material.	Severe stress from overload or shock; possible extension of a scratch.
Dent	A small, smoothly rounded depression.	A sharp blow or excessive pressure.
Fretting	Wear that occurs between tight-fitting surfaces subjected to cyclical relative motion of extremely small amplitude. Usually, fretting is accompanied by corrosion, especially of the very fine wear debris.	Vibration between mating surfaces.
Fretting corrosion	The accelerated deterioration at the interface between contacting surfaces as the result of corrosion and slight oscillatory movement between the two surfaces.	Vibration between mating surfaces.
Galling	Transfer of metal from one surface to another.	Result of localized lubrication break-down between sliding surfaces.
Glazing	Smoothing and creep of a surface.	Result of localized lubrication break-down between sliding surfaces.
Gouging	Removal of surface material, typified by rough and deep depressions.	Protruding objects, incorrectly aligned.
Nick	A sharp bottomed depression that may have rough outer edges.	Dropping, banging.
Rounding	Removal of surface metal at corners or dulling of edges.	Result of abrasion, vibration, or poor mating surfaces.
Scoring	A deep scratch following a path of part travel.	Result of localized lubrication break-down between sliding surfaces.

Table 5003 - Terminology

Term	Definition	Probable Cause
Scratch	A very shallow furrow or irregularity, usually longer than wide.	Movement of a sharp object across the surface.
Short	Evidenced by sparking, arcing, or high current. Electrical condition where two conductors are connected by a path of very low resistance.	The result when two carrying conductors are connected by a path of negligible resistance.
Stripped Thread	Thread of a nut, stud, bolt, or screw damaged by tearing away parts of the thread.	Incorrect installation of threaded mating parts.
Tear	Parting of material.	Excessive tension, caused by external force.
Wear	Slow removal of material. Wear may not be visible to the naked eye.	Result of abrasive substances contacting rolling surfaces and acting as a lapping compound.

Table 5003 - Terminology (Continued)

REPAIR

1. Introduction

CAUTION: ANY USE OF PARTS, MATERIALS, OR PROCESSES NOT AUTHORIZED BY SAFRAN POWER FOR MAINTENANCE OR OVERHAUL OF THE STARTER-GENERATOR CAN AFFECT CONTINUED FLIGHT WORTHINESS OR INVALIDATE CERTIFICATION.

Repairs are limited to:

- repairing damaged surfaces
- repairing damaged threads
- replacing helicoil inserts
- bearing liner and journal restoration
- commutator refinishing
- armature balancing
- restoring surface coatings of parts and assemblies
- correcting output voltage polarity
- replacing brush access cover insulating tape
- replacing brush access cover self-locking blind rivet nut
- repair and replacement of QAD mounting adapter guide pins

Repair operations not outlined or referenced in this manual are not authorized by Safran Power.

In addition to specific repairs authorized by Safran Power in this manual, standard repair procedures for starter-generators are described in the following Safran Power Standard Practice Documents (SPD).

- Selective (Brush Plating), Electrodeposition - Refer to SPD 1000.
- Armature Balancing for DC Starter-Generators - Refer to SPD 1001.
- Surface Repair and Coating - Refer to SPD 1002.
- Plastic Media Blasting - Refer to SPD 1003.
- Brush Holder Alignment Fixtures - Refer to SPD 1004.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Repair Tools

In addition to normal shop tools, specific tools for repair of the starter-generator are listed in Table 6001.

NOTE: Equivalent substitutes may be used for the tools listed in Table 6001.

Tools	Reference
Commutator Turning Fixture	Figure 9008
Drive End Inboard Hub Support	Figure 9015
Drive End Outboard Hub Support	Figure 9015
Bump Switch	Rating: 30 VDC, 10 A
Helicoil Insert Removal and Installation Tool	Commercially Available
India Stone	Commercially Available
PlusNut® Fastener Header P/N C1000-1032	Figure 9020
Rivet Alignment and Press Fixture	Figure 9009
Six Volt Battery or Equivalent DC Power Source	Commercially Available
Thread Chasers	Commercially Available

Table 6001 - Repair Tools

3. Repair Materials

Materials necessary for starter-generator repair are listed in Table 6002.

NOTE: Equivalent substitutes may be used for the materials listed in Table 6002. Repair materials are not available from Safran Power. All items can be purchased commercially.

Item	Description/Material Specification	Source
Chemical Film Solution Alodine 1200	Chemical Film Solution MIL-C-5541, Class 1A or Class 3	Henkel Surface Technology Madison Heights, MI 48071 (V1N6B3)
Coating, Zinc Phosphate	TT-C-490, Type 1	Commercially Available

Table 6002 - Repair Materials

Item	Description/Material Specification	Source
Cleaning Solvent	Ensolve Cleaning Solvent	Enviro Tech International, Inc. Alameda, CA 94501 www.ensolv.com (V0S8S8)
Isopropyl Alcohol	TT-I-735, Grade A See **WARNING** before using this material. Flash Point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available
Oil, Machine	N/A	Commercially Available
Pads, Cleaning	Lint-free cotton	Commercially available
Primer, Zinc Chromate	TT-P-1757 Composition G, Color Yellow.	Commercially Available
Abrasive paper	400/600 grit (non-aluminum oxide only)	Commercially Available
Tape, Insulating	P/N 2713-A6R 8 mil, PTFE coated fiberglass, acrylic adhesive	Saint Gobain New Haven, CT www.saint-gobain.com/us (V1DS07)

Table 6002 - Repair Materials (Continued)

4. Surface Repair

Repair formed metal components that have surface damage or corrosion and qualify for repair.

(1) Remove corrosion, sharp edges, burrs, nicks, or scratches from cast surfaces, machined mating surfaces, and sealing surfaces with india stone or abrasive paper. Remove only sharp edges or burrs that are above surface of part.

(2) Remove minor raised edges, burrs, nicks, or scratches on any polished or load-bearing surface. Remove only material that extends above polished surface. Make sure that dimensional tolerances are within limits.

5. Thread Repair

A. Repair damaged threads as follows:

CAUTION: DO NOT USE THREAD CUTTING DIE, NON-REPAIRABLE DAMAGE CAN RESULT.

(1) Use thread chaser to repair damaged threads.

(2) Use india stone to remove remaining sharp edges or burrs.

(3) To prevent corrosion apply a light coating of machine oil to repaired threads.

6. Helicoil Insert Replacement

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10002 or Figure 10003 of ILLUSTRATED PARTS LIST.

A. Remove and replace damaged helicoil inserts (10002-20, 10003-20) as needed.

(1) Remove damaged helicoil insert with a helicoil insertion/removal tool.

(2) Clean hole for helicoil insert. Refer to the CLEANING section.

WARNING: KEEP ZINC CHROMATE PRIMER AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. ZINC CHROMATE PRIMER IS FLAMMABLE.

WARNING: DO NOT GET ZINC CHROMATE PRIMER ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ZINC CHROMATE PRIMER IS A POISONOUS MATERIAL.

(3) Apply thin coat of zinc chromate primer to outer surface of replacement helicoil insert.

(4) Install helicoil insert to the depth shown in Figure 6001 below part surface while primer is still wet.

(5) Break off helicoil insert installation tang.

WARNING: KEEP CHEMICAL FILM AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. CHEMICAL FILM IS FLAMMABLE.

WARNING: DO NOT GET CHEMICAL FILM ON YOUR SKIN AND DO NOT BREATHE THE FUMES. CHEMICAL FILM IS A POISONOUS MATERIAL.

(6) Apply chemical film solution MIL-C-5541, Class 3 to bare metal.

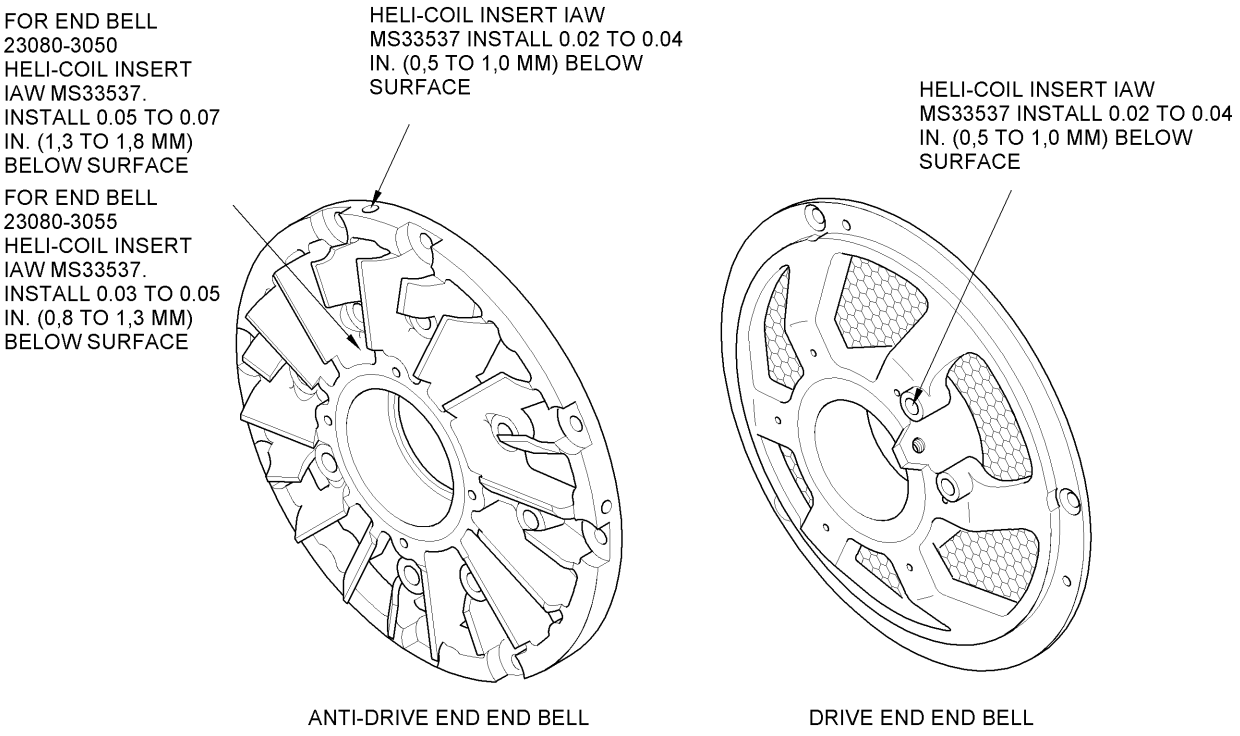


Figure 6001 - Helicoil Insert Replacement

7. Bearing Journal and Liner Restoration

If bearing journals or liners are worn beyond acceptance limits, restoration may still be possible. Refer to SPD 1000 for repair limitations and procedures for Nickel Plating.

NOTE: To modify the drive end end bell to bearing pre-load configuration, see Service Bulletin 23080-01X-24-07.

A. Restoration

Refer to SPD 1000 for detailed instructions. Components not in compliance with the dimensions in Figure 6002, Figure 6003 and Figure 6004 must be reworked, or replaced.

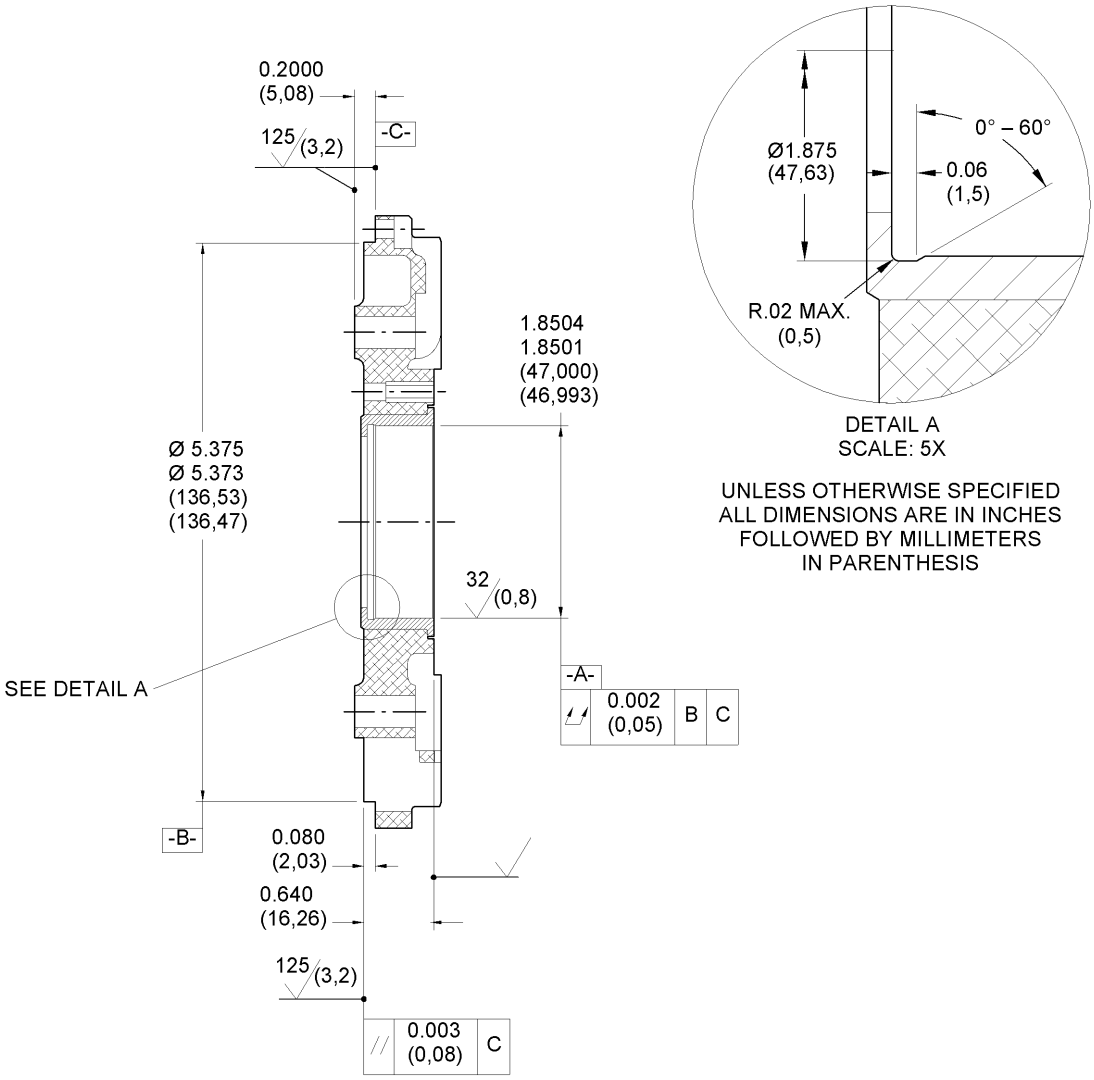


Figure 6002 - Anti-Drive End End Bell Bearing Liner Machining Specifications

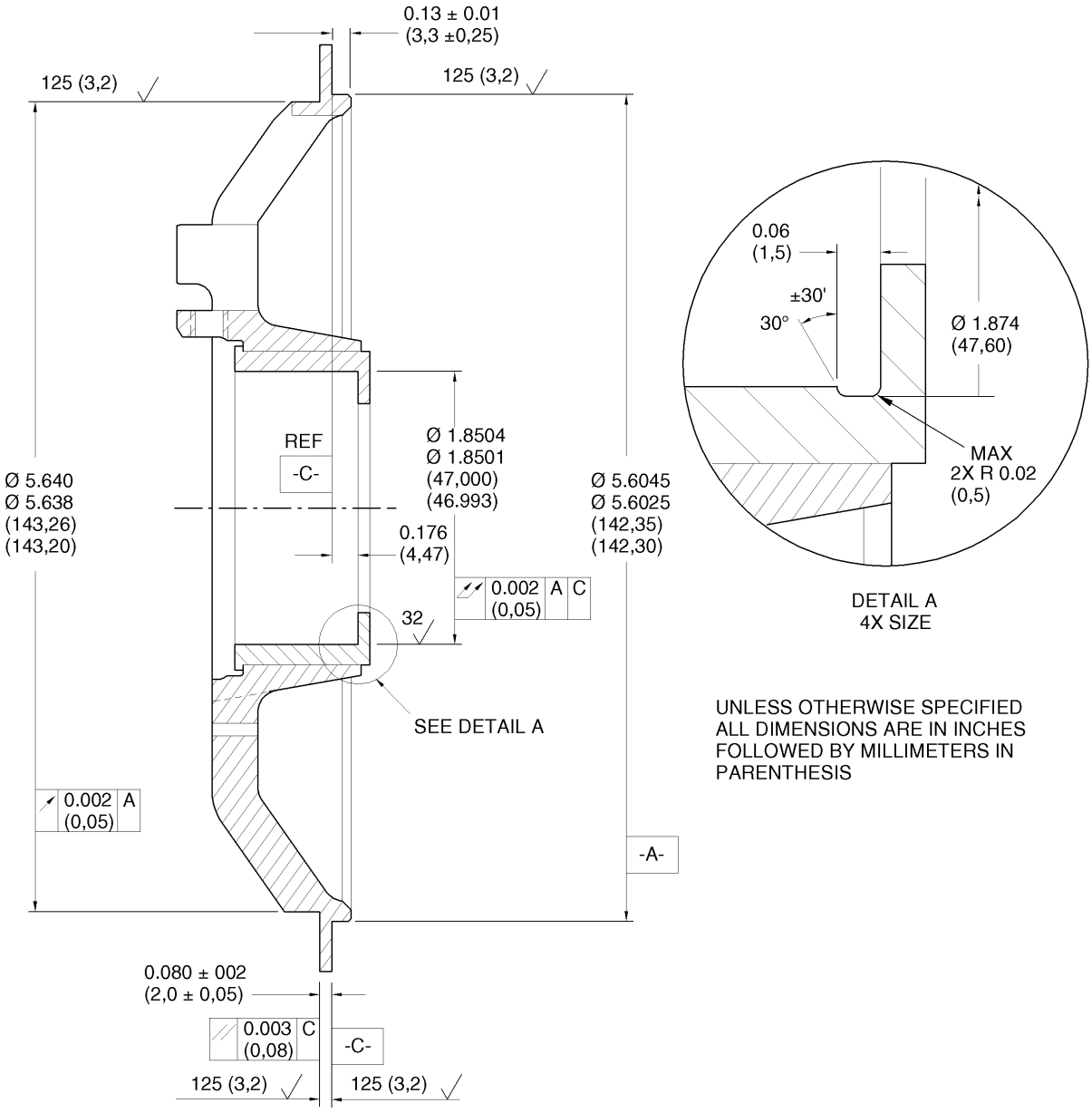


Figure 6003 - Drive End End Bell Bearing Liner Machining Specifications (Pre-Load)

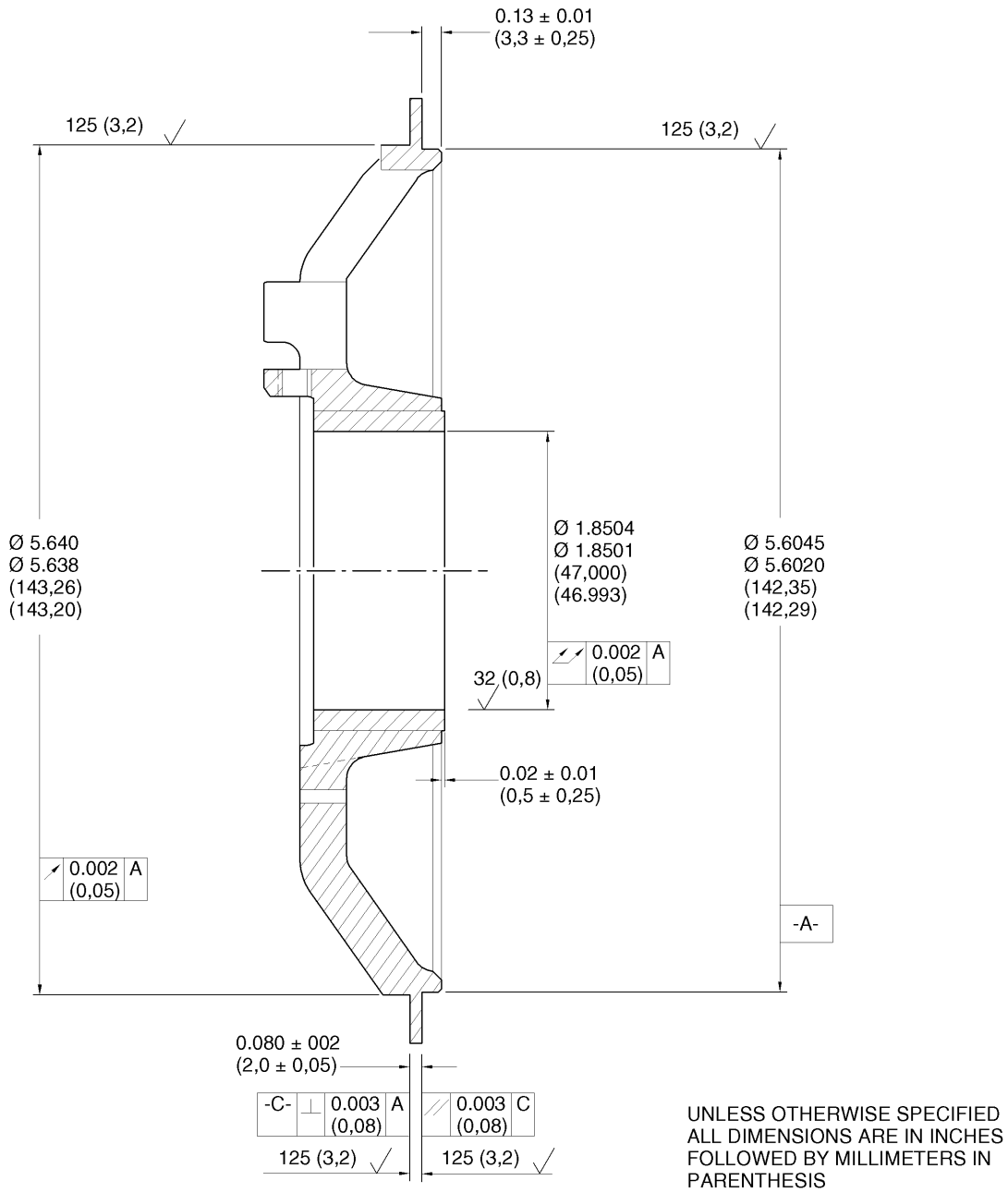


Figure 6004 - Drive End End Bell Bearing Liner Machining Specifications (Non-Preload)

8. Commutator Refinishing

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

If inspection reveals that the commutator is rough, pitted, scored, or burned, refinish the commutator on a lathe that is accurately set up and adjusted.

A. Setup

(1) Install a bearing (490) into the commutator turning fixture.

(2) Position the drive end of the armature (460) shaft at the lathe chucking head and the commutator turning fixture in a tail stock.

(3) Insert the commutator end of the armature (460) into the commutator turning fixture.

B. Repair Procedure. See Figure 6005.

CAUTION: DO NOT REMOVE TOO MUCH MATERIAL FROM THE COMMUTATOR. IF YOU DO, THE LIFE OF THE COMMUTATOR WILL BE DECREASED.

CAUTION: DO NOT TOUCH THE COMMUTATOR WITH YOUR BARE HANDS. CONTAMINATION FROM YOUR SKIN CAN CAUSE CORROSION AND UNSATISFACTORY ELECTRICAL CONTACT.

(1) Cut the commutator to a surface finish of 64 to 100 microinches (1,6 to 2,5 microns) RMS. The finish surface must extend from the end of the full undercut to within 0.02 to 0.04 inches (0,5 to 1,0 mm) of the outboard end of the commutator.

NOTE: The suggested feed rate is 0.006 to 0.007 inch (0,15 to 0,18 mm) per revolution at a surface speed of 1,000 to 1,500 surface feet per minute (305 to 457 surface meters per minute).

WARNING: **WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, CONTROL PRESSURE TO 29 PSIG (200 KPA) OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES. TAKE PRECAUTIONS TO AVOID INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR USED TO CLEAN OR DRY COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(2) Clean the armature (460) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(3) Measure the depth of the mica undercut between the commutator bars. Refer to the FITS AND CLEARANCES section for limits.

(4) If the undercut is out of limits, use a 0.31 to 0.50 inch (7,9 to 12,7 mm) diameter cutter wheel to undercut the mica to a depth of 0.050 to 0.070 inch (1,27 to 1,78 mm) and a width of 0.035 to 0.045 inch (0,89 to 1,14 mm).

NOTE: The beginning of mica undercut must be 0.030 inch (0,76 mm) max. from the finished face of the risers. All cuts must be equally spaced and parallel with the centerline of the armature shaft within 0.005 inch. (0,13 mm) of true position. All mica must be removed from the edges of the undercut.

(5) Use a triangular scraping tool to remove sharp edges and burrs.

(6) Remove the undercut residue from between the commutator bars with a soft bristle brush.

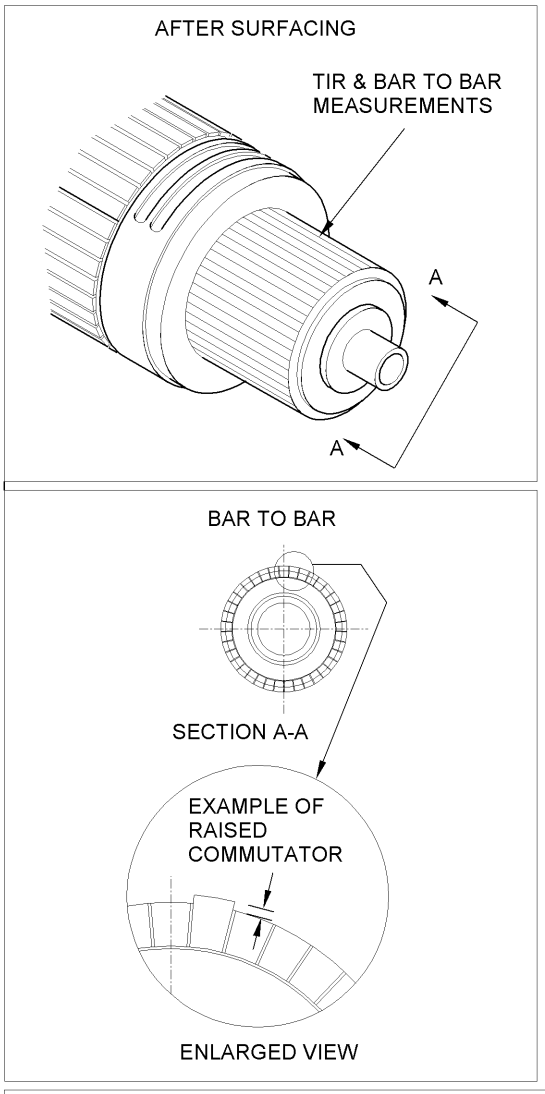
WARNING: WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, CONTROL PRESSURE TO 29 PSIG (200 KPA) OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES. TAKE PRECAUTIONS TO AVOID INJURY TO OTHER PERSONNEL IN AREA.

CAUTION: MAKE SURE THAT COMPRESSED AIR USED TO CLEAN OR DRY COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(7) Clean the armature (460) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(8) After the commutator is refinished, measure the commutator bar-to-bar and total indicator reading (TIR) run-out in full circumference of the commutator. Support the armature (460) on two “V” blocks.

(9) REPLACE the armature if the damage cannot be repaired.



AFTER COMMUTATOR SURFACING

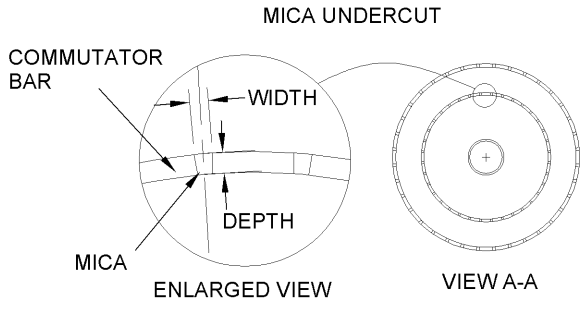
BAR TO BAR:
0.0001 IN. (0.003 MM)

T.I.R. (1 REV):
0.0005 IN. (0.013 MM)

MICA UNDERCUT:
DEPTH: 0.050 MIN. to 0.070 IN. (1.27 TO 1.78 MM) MAX.
WIDTH: 0.045 IN. (1.14 MM) MAX.

SURFACE FINISH:
64 TO100 µin. (1.6 TO 2.5 µM.) rms

CENTERLINE OF COMMUTATOR SLOT AND CENTERLINE OF ARMATURE SHAFT ARE TO BE WITHIN 0.005 IN. (0,13 MM).
ALL MICA MUST BE REMOVED FROM THE EDGE OF THE UNDERCUT.



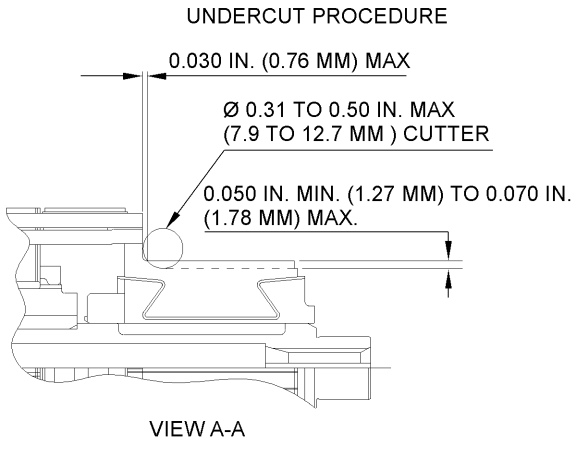


Figure 6005 - Armature Repair

9. Balancing the Armature

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

(1) Balance the armature (460) to the requirements listed in the FITS AND CLEARANCES section of this CMM according to the procedure in SPD 1001.

10. Restoring the Surface Coatings of Parts and Assemblies

A. Removal of surface coatings.

Remove the surface coatings of parts and assemblies that have been damaged using plastic blasting equipment and procedures in accordance with (IAW) SPD 1003.

NOTE: Use of plastic blasting equipment requires written authorization from Safran Power

B. Restoration of surface coatings.

Restore surface coating of parts and assemblies with materials and procedures given in Safran Power SPD 1002.

Clean all parts per CLEANING section of this CMM.

Use Table 6003 to find the correct primer and paint specification when using SPD 1002.

WARNING: **CHEMICAL CONVERSION MATERIALS ARE POISONOUS AND CAN CAUSE EXPLOSIONS WHEN MIXED WITH ACIDS, REDUCING AGENTS COMBUSTIBLE AND OXIDIZING MATERIALS. ISOLATED STORAGE OF THESE MATERIALS IS MANDATORY.**

WARNING: **BEFORE YOU USE CHEMICAL CONVERSION MATERIALS, PUT ON A RESPIRATOR, RUBBER APRON, RUBBER GLOVES AND EYE PROTECTION. THIS WILL PREVENT INJURY FROM SPILLS AND FROM THE FUMES.**

WARNING: **KEEP CHEMICAL CONVERSION MATERIALS AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. CHEMICAL CONVERSION MATERIALS ARE FLAMMABLE.**

Item Number	Nomenclature	Process	Coating Repair
10005-40	Mounting Adapter	Refinish	Chemical Film touch-up IAW MIL-C-5541, Class 3 or Wash Primer and touch up paint
10001-110	Air Inlet	Refinish	Chemical Film touch-up or Wash Primer and touch up paint
10001-130	Brush Access Cover	Refinish	Chemical Film touch-up or Wash Primer and touch up paint
10001-260	Dampener Back Plate	Refinish phosphate	Re-phosphate IAW TT-C-490 or Phosphate touch-up
10001-500	Stator and Housing Assembly. Housing can be refinished.	Refinish	Chemical Film touch-up or Wash Primer and touch up paint
10002-10	Anti-drive end end bell	Refinish	Chemical Film touch-up IAW MIL-C-5541, Class 3
10003-10	Drive end end bell	Refinish	Chemical Film touch-up IAW MIL-C-5541, Class 3
10003-30	Screen	Refinish Chem Film	Chemical Film touch-up IAW MIL-C-5541, Class 1A

Table 6003 - Refinishing Procedures

11. Polarizing the Output Voltage

NOTE: If the polarity of the output voltage of a DC starter-generator has been reversed, this can be corrected by polarizing the field.

A. Setup

CAUTION: NO OTHER POWER SUPPLY IS TO BE CONNECTED TO THE STARTER-GENERATOR

(1) Connect a 6 VDC, wet cell battery (or 6 VDC power supply and bump switch in series with the starter-generator field, as shown in Figure 6006.

(2) Connect the negative lead to terminal stud E.

(3) Connect the positive lead and bump switch to terminal stud A.

B. Procedure

CAUTION: DO NOT POLARIZE THE FIELD WHILE THE STARTER-GENERATOR IS IN OPERATION.

(1) Turn the power ON and turn bump switch ON for a maximum of five seconds to polarize the field.

NOTE: If the polarity of the field has not been corrected, check for incorrect connections or a defective field circuit.

(2) Turn the power OFF and disconnect the leads.

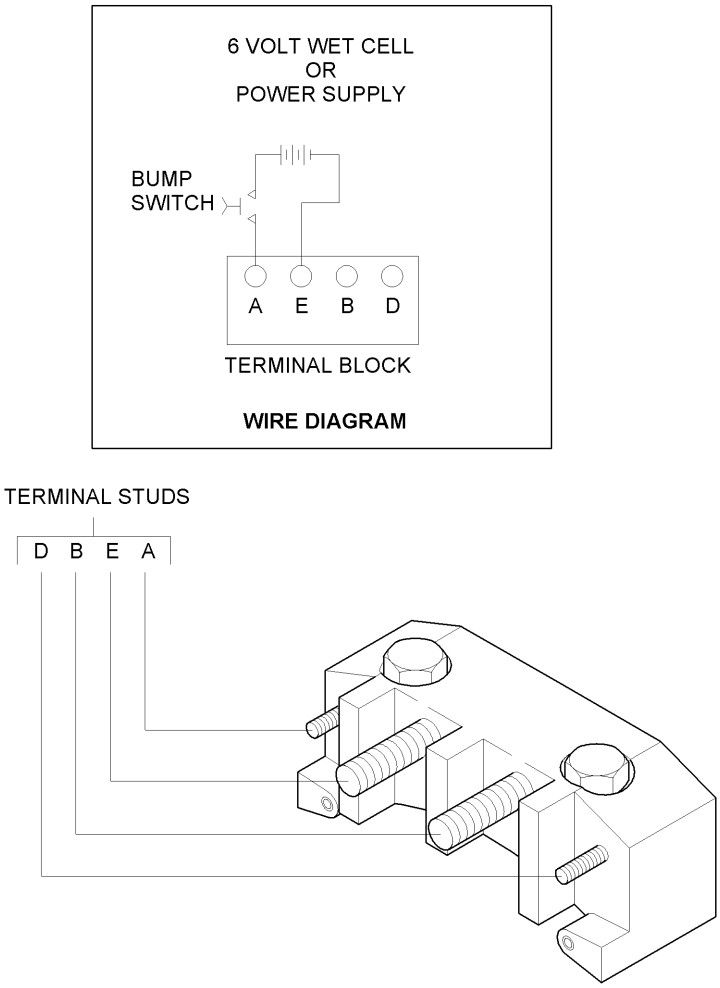


Figure 6006 - Terminal Block Schematic for Polarizing the Output Voltage

12. Terminal Lug Replacement

A. Remove and replace damaged terminal lugs (10004-90) as needed.

(1) Cut wire at base of terminal(s). Discard terminal(s).

(2) Strip 0.25 inch (6,4 mm) insulation from end of electrical wire(s).

(3) Use a crimping tool to install new terminal(s).

13. Brush Access Cover

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

A. Repair the brush access cover (130) as follows:

(1) Replace the insulating tape. See Figure 6007.

(a) Remove all signs of the insulating tape and clean the inside surface of the brush access cover (130). Refer to the CLEANING section.

(b) If the plating on the inner surface of the brush access cover (130) is damaged, coat the surface IAW the instructions in Paragraph 10.

(c) Cut the leading edge of the insulating tape square with the sides of the roll.

(d) Starting at one of the two sides of the brush access cover (130), line up the sides of the roll with the side of the brush access cover (130).

(e) Apply the insulating tape directly from the roll to the inner surfaces of the brush access cover (130)

NOTE: Installed insulating tape must be within 0.06 inch (1,5 mm) of the brush access cover (130), edges and ends. The insulating tape can overlap the brush access cover (130) edges by 0.02 inch (0,5 mm) on one side only. However, overlap is not permitted at the brush access cover (130) ends.

(f) Cut off unwanted insulating tape at the brush access cover (130) ends.

(2) Replace self-locking blind rivet nut (150) as follows. See Figure 6007.

(a) Remove self-locking blind rivet nut (150) from brush access cover (130) by drilling a 0.250 inch (6,35 mm) hole through self-locking blind rivet nut (150). The inboard and outboard sides of self-locking blind rivet nut (150) should become loose and fall off.

NOTE: A PlusNut® Fastener Header tool is required for repair procedure.

(b) Turn 1/2 inch (12,7 mm) nut in a counterclockwise direction until stud is fully extended. Engage all threads on stud in self-locking blind rivet nut (150) until nut is tight against tool face.

(c) Insert fastener header tool into hole in brush access cover (130).

(d) Use a 3/4 inch (19 mm) open ended wrench on tool body while holding tool stationary using a 3/4 inch (19 mm) socket wrench on 1/2 inch (12,7 mm) nut. While holding tool perpendicular to hole, turn tool clockwise.

NOTE: Do not overtighten self-locking blind rivet nut (150). Over-tightening may cause damage to threads.

(e) Turn nut until firm resistance is felt. Self-locking blind rivet nut (150) should be physically reformed. If self-locking blind rivet nut (150) is loose, tighten nut until self-locking blind rivet nut (150) is secure. Loosen nut by turning counterclockwise.

(f) Remove fastener header tool from self-locking blind rivet nut (150) by turning counterclockwise.

(g) Torque test self-locking blind rivet nut (150) to 60 lbf.in. (6,8 N·m).

(h) If the plating on the outer surface of the blind rivet nut (150) is damaged, coat the surface IAW the instructions in Paragraph 10.

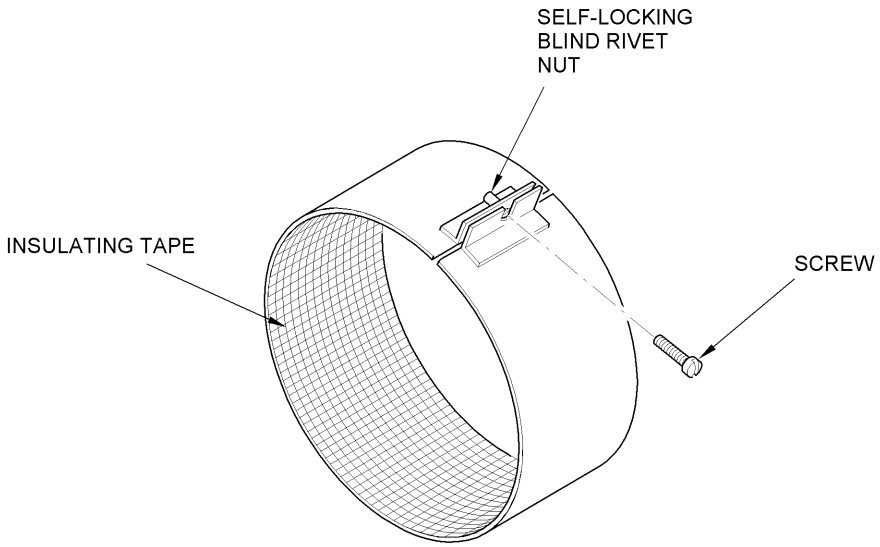


Figure 6007 - Brush Access Cover

14. Repair of the Complete Brush Holder

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10002 of ILLUSTRATED PARTS LIST.

A. Repair the complete brush holder (30) as follows:

(1) Disassembly of complete brush holder (30).

(a) Using a #40 drill bit, remove 2 rivets (120) from brush lead terminal board (110).

(b) Remove and discard brush lead terminal board (110) and insulating sheet (100).

(c) Repeat Paragraph 14.A.(1)(b) and Paragraph 14.A.(1)(b) for each brush holder (30).

(2) Assembly of complete brush holder (30). See Figure 6008.

(a) Secure rivet alignment fixture to press table.

(b) Secure rivet press tool to arbor press.

(c) Place insulating sheet (100) and brush lead terminal board (110) onto the brush holder (90) and insert two rivets (120) through the holes.

NOTE: When parts are correctly aligned, the section of insulating sheet (100) which extends outside the brush lead terminal board (110) will fold up against the brush holder (90).

(d) Set the brush holder (90) upside down onto rivet alignment fixture and align the rivets (120) with the two cones on the fixture.

(e) Press rivets (120) as shown in Figure 6008. The diameter of the rivet head must be a minimum of 1.5 times the diameter of the rivet.

(f) Repeat Paragraph 14.A.(2)(a) through Paragraph 14.A.(2)(e) for the remaining complete brush holder (30) assemblies.

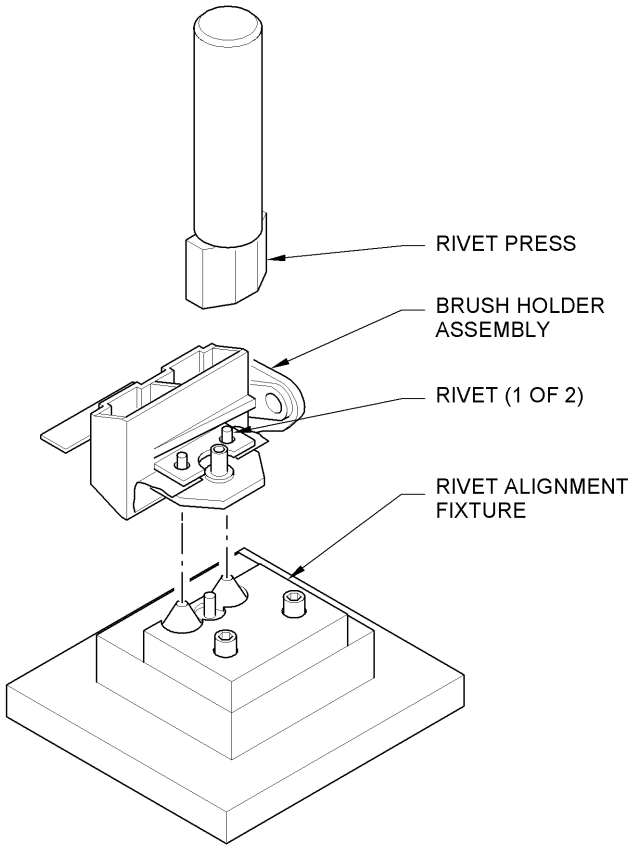


Figure 6008 - Brush Holder Rivet Alignment

15. Removal and replacement of the Mounting Adapter Guide Pin

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10005 of ILLUSTRATED PARTS LIST.

Use the following repair procedure to remove and replace the mounting adapter guide pin (80).

A. Tools

A set of pliers, vice grips or any suitable tool that lets you grip the guide pin (70) and pull it out.

B. Procedure (See Figure 6009)

(1) Secure the mounting adapter (40) in a vice making sure it is secured enough to handle the force required to pull the guide pin (70).

(2) Using the suitable tool, twist and pull on the guide pin until it releases from the mounting adapter.

WARNING: PRIMER CAN BE DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION. IF NECESSARY, PUT ON A RESPIRATOR.

(3) Apply zinc chromate primer to the new guide pin before inserting into the mounting adapter.

(4) Insert a new guide pin into the hole in the mounting adapter.

(5) Using an arbor press or light hammer, lightly tap the guide pin into the hole.

NOTE: The finished height of the guide pin is to be 0.180 to 0.200 inch (4,57 to 5,08 mm).

NOTE: It is not necessary to fully seat the guide pin.

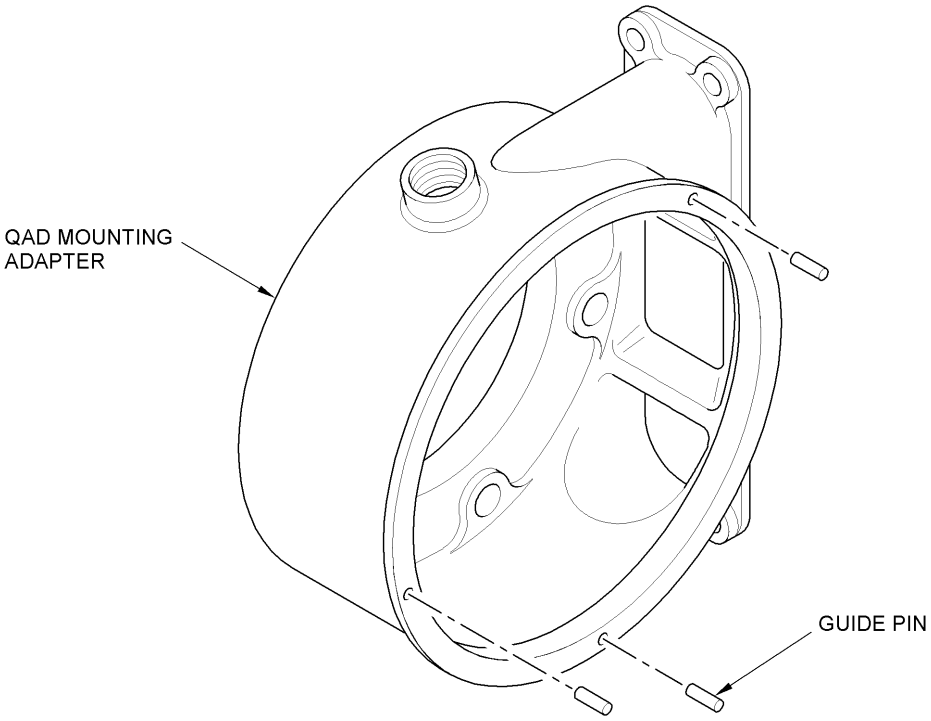


Figure 6009 - Repair of the Mounting Adapter Guide Pin

ASSEMBLY

1. Introduction

This Section gives assembly instructions for DC Starter-Generators 23080 Series III. Assemble the unit in a clean work area away from machining or other metal removing operations. Clean all parts in accordance with (IAW) instructions in the CLEANING section before final assembly.

In addition to specific procedures authorized by Safran Power in this manual, standard assembly procedures for starter-generators are described in the following Safran Power Standard Practice Documents (SPDs).

- Surface Repair and Coating - Refer to SPD 1002.
- Brush Holder Alignment Fixtures - Refer to SPD 1004.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Assembly Tools

In addition to normal shop tools, specific tools for assembly of the starter-generator are listed in Table 7001.

Tool Description	Reference
Arbor Press	Commercially Available
Brush Holder Alignment Fixture	SPD 1004
Crimp Tool	Commercially Available
Dampener Plate Driver	Figure 9007
Heat Gun	Commercially Available
Horizontal Stator Support	Figure 9016
Inner Race Bearing Driver	Figure 9004
Leather or Plastic Mallet	Commercially Available
Outer Race Bearing Driver	Figure 9005
Pin Insertion/Extraction Tool	Commercially Available
Pliers, Snap Ring	Commercially Available
Plug, Speed Pickup Adjustment (for use on starter-generators without bearing pre-load feature)	Figure 9010
Plug, Speed Pickup Adjustment (for use on starter-generators with bearing pre-load feature)	Figure 9011
Spline Wrench	Figure 9019
Support, Armature	Figure 9012

Table 7001 - Assembly Tools

Tool Description	Reference
Support, Anti-Drive End Hub	Figure 9014
Support, Drive End Bearing Hub	Figure 9015
Support, Vertical Shaft	Figure 9018
Support, Vertical Stator	Figure 9017
Terminal Block - unserviceable	None
Torque wrench	Commercially Available
Wire Hook Tool	Commercially Available

Table 7001 - Assembly Tools (Continued)

3. Assembly materials

Materials necessary for starter-generator assembly are listed in Table 7002.

NOTE: Equivalent substitutes may be used for the materials listed in Table 7002. Assembly materials are not available from Safran Power. All items can be purchased commercially.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source (CAGE Code)
Acrylic Coating	HumiSeal Type 1B31, Type AR MIL-I-46058	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 Fax: (718) 932-4345 www.humiseal.com (V0SR97)
Adhesive Sealant, RTV	Momentive FRV1106 5.4 ounce (160 ml) cartridge	R.S.Hughes 1162 Sonora Court Sunnyvale, CA Ph:(408) 739-3211 Fax:(877) 774-8443 www.rshughes.com (V1GWU4)

Table 7002 - Assembly Materials

Item	Description/Specification	Source (CAGE Code)
Enamel, Red Insulating	Synthite ER-41	John C. Dolph Company 320 New Road, PO Box 267 Monmouth, NJ 08852 Ph: (732) 329-2333 Fax: (732) 329-1143 www.dolphs.com (V72688)
Epoxy Bonding Cement	Two Part Kit: Ellsworth P/N 02-7001-27 (50mL Dual-Pack)	Ellsworth Adhesives P.O. Box 1002 W129 N10825 Washington Dr. Germantown, WI 53022-8202 Ph: 1-800-888-0698 Fax: 1-262-253-8619 www.ellsworth.com (VOPYJ1)
Isopropyl Alcohol See **WARNING** before using this material.	TT-I-735, Grade A Flash Point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available
Lockwire	MS20995C20 and MS20995C32	Commercially Available
Lubricating and Assembly Paste	Altemp QNB 50	Klueber Lubrication Londonderry, NH Ph: (603) 647-4104 www.klueber.com (V03053)
Masking Tape	N/A	Commercially Available
Protective Paper	MIL-B-121A, Grade A, Type II, Class I	National Paper and Packaging Co. Cleveland, OH www.nationalpaper.com (V0LAX1)
Sandpaper	180 Grit, non-aluminum oxide	Commercially Available
Sleeving	Heat Shrink/MIL-I-23053/5	Commercially Available
Sleeves, Wire Adapter (3)	P/N: 10-407979-205	Allied Amphenol Products Bendix. Connector Operations, Sidney, New York 13838 FSCM 77820

Table 7002 - Assembly Materials (Continued)

Item	Description/Specification	Source (CAGE Code)
Thread Locking Adhesive, Grade A	Loctite Grade A MIL-S-22473	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com (V7V827)
Thread Locking Adhesive, Grade D	Loctite Grade D MIL-S-22473	
Thread Locking Adhesive, Grade E	Loctite Grade E MIL-S-22473	
Thread Locking Primer, Grade N	Loctite Grade N MIL-S-22473	
Thread Sealing Compound	Lead Free/TT-S-1732 Soft Set Gasoila	GSA Supply on-line www.gsasupplyco.com or Federal Process Co. 4620 Richmond Rd. Beachwood, Ohio 44128

Table 7002 - Assembly Materials (Continued)

4. Assembly of Stator and Housing Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10004 of ILLUSTRATED PARTS LIST.

A. Attach terminal block (50) to the stator and housing assembly. See Figure 7001.

CAUTION: BEFORE ACCEPTANCE TESTING, ATTACH AN UNSERVICEABLE TERMINAL BLOCK TO THE STATOR AND HOUSING ASSEMBLY. ACCEPTANCE TESTING CAN DAMAGE THE INTERNAL CAPACITORS OF A TERMINAL BLOCK (50).

(1) Set the unit onto a horizontal stator support.

CAUTION: DO NOT BEND THE LARGE STATOR LEADS MORE THAN NECESSARY TO INSTALL THE TERMINAL BLOCK.

(2) Set terminal block (50) onto the stator and housing assembly and slide it into position in the large stator leads, B and E.

(3) Put the small stator leads onto terminal studs A and D.

(4) Put a lock washer (70) and flat washer (80) onto each of the two bolts (60).

(5) Put the two bolts (60) into the holes of the terminal block (50) and tighten two bolts (60) to a torque of 22.7 to 35.0 lbf.in (2,6 to 4,0 N·m).

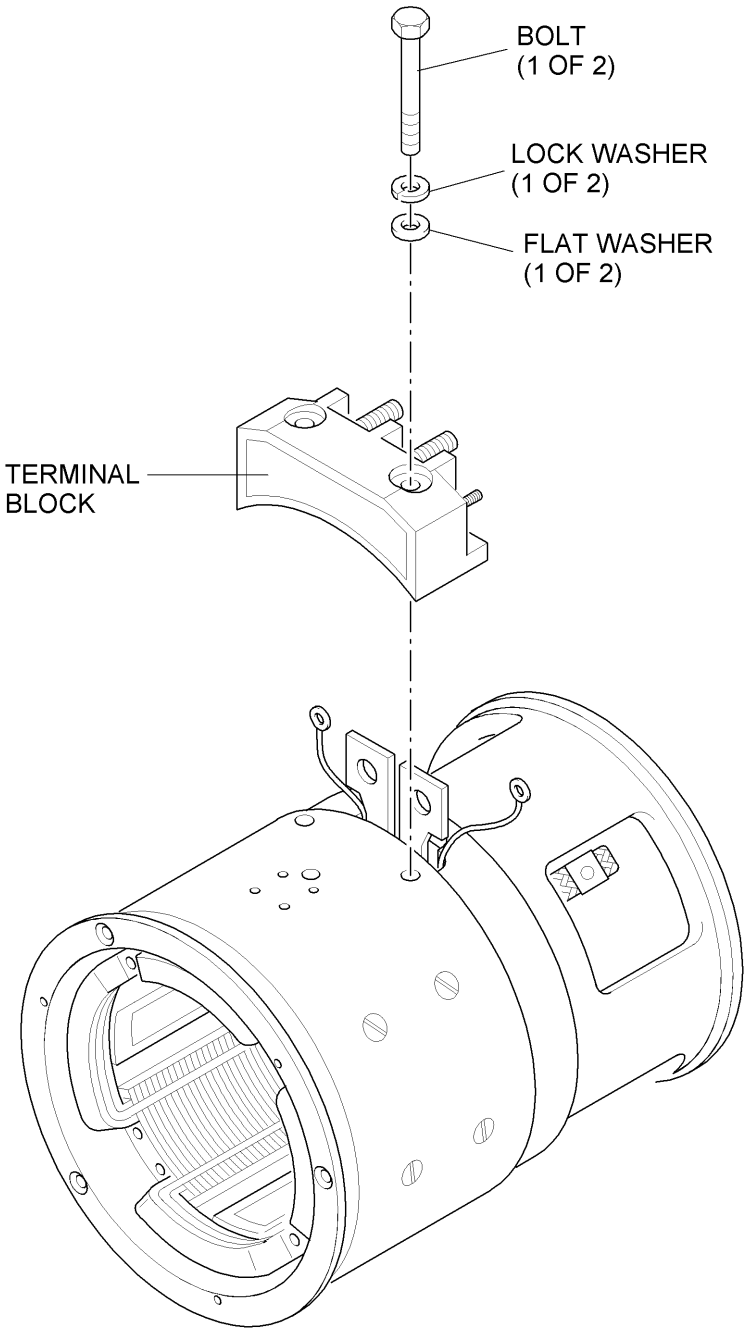


Figure 7001 - Attaching the Terminal Block to the Housing

B. Install hardware on terminal block (50). See Figure 7002

(1) Secure stator lead terminals A and D with flat washer (40) and self-locking nut (30) at each location.

NOTE: Do not tighten the nuts (30) on terminal block (50) studs A and D. They will be tightened at the time of installation into the aircraft. It is necessary to install the wires from the GCU at that time.

(2) Install one flat washer (20) and one self-locking nut (10) on each terminal stud, B and E.

NOTE: Do not tighten the nuts (10) on terminal block studs, B and E. They will be tightened at the time of installation into the aircraft.

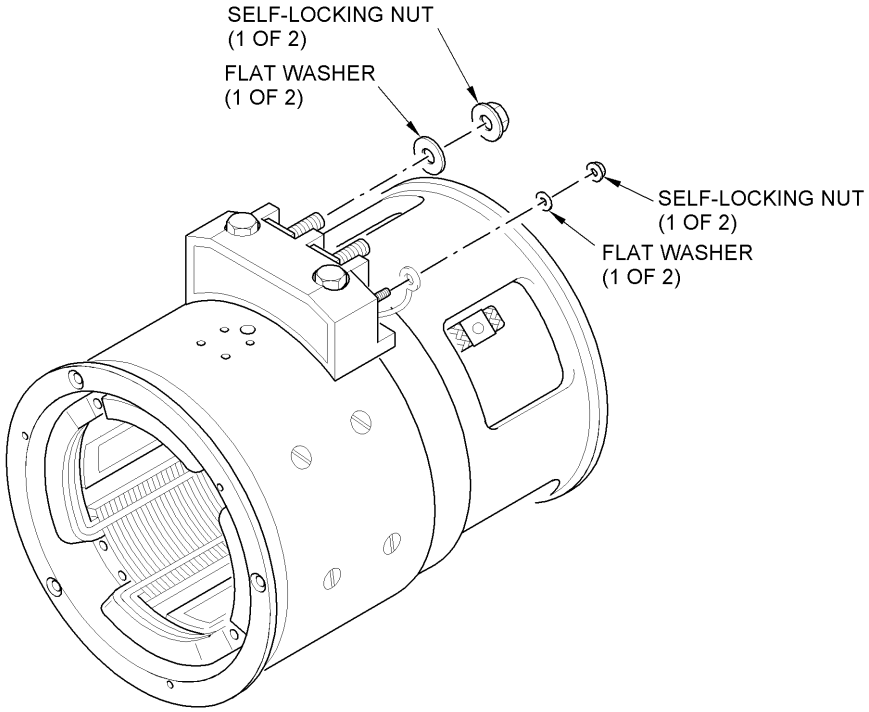


Figure 7002 - Installing Terminal Block Hardware

5. Assembly of Drive End Bearing Support Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10003 of ILLUSTRATED PARTS LIST.

A. Attach the screen (30) to the drive end end bell (10).

WARNING: USE PROTECTIVE GLOVES AND GOGGLES WHEN USING LIQUID EPOXY RESINS.

(1) Using a spatula, mix parts A and B of epoxy bonding cement equally on a smooth, flat surface until fully mixed.

(2) Apply a thin layer of mixture on each rib of drive end end bell (10).

(3) Put a flat washer (50) on each screw (40).

(4) Attach screen (30) to drive end end bell (10) in six places with screws (40) and flat washers (50).

(5) Place drive end bearing support assembly in oven and allow epoxy bonding cement to cure for 40 minutes at 200° F (97° C).

WARNING: WEAR INSULATED GLOVES AND OBSERVE ALL SAFETY PRECAUTIONS WHEN HANDLING HEATED PARTS TO AVOID PERSONAL INJURY.

(6) Remove drive end bearing support assembly from oven.

(7) Allow drive end bearing support assembly to cool to room temperature.

6. Assembly of the Bearing and Brush Support Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10002 of ILLUSTRATED PARTS LIST.

A. Install the brush springs (130) on the complete brush holder (30). See Figure 7003.

CAUTION: DO NOT WIND THE BRUSH SPRINGS TOO TIGHTLY OR THIS CAN RESULT IN REDUCED BRUSH SPRING FORCE.

Wind the brush springs (130) about 3/4 turn and put two brush springs (130) onto each brush holder (30) as shown in Figure 7003.

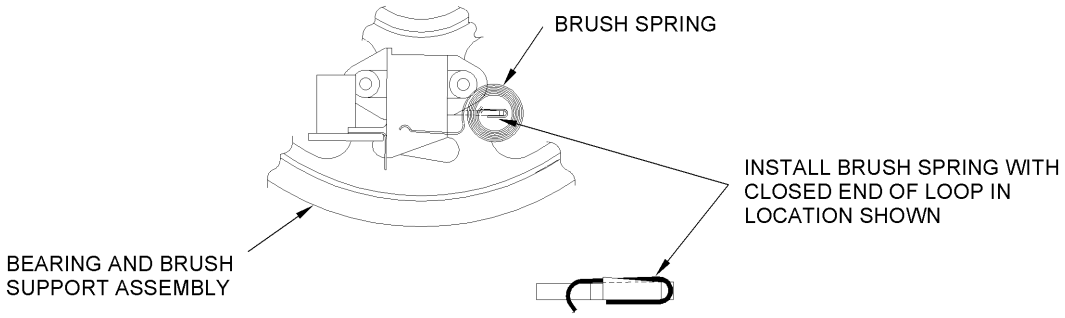


Figure 7003 - Brush Spring Installation

B. Attach each complete brush holder (30) to the anti-drive end end bell (10). See Figure 7004 and Figure 7005.

CAUTION: CORRECT INSTALLATION OF THE INSULATION SLEEVES IS CRITICAL. USE GREAT CARE WHEN INSERTING THE INSULATION SLEEVES INTO THE ANTI-DRIVE END END BELL. IF AN INSULATION SLEEVE IS PINCHED BETWEEN THE ANTI-DRIVE END END BELL AND A COMPLETE BRUSH HOLDER, CARBON DUST WILL COLLECT IN THE AREA WHERE THE INSULATION SLEEVE IS DAMAGED, CAUSING A PATH TO GROUND AND EQUIPMENT FAILURE. THE DAMAGE IS NOT DETECTABLE DURING THE DIELECTRIC TEST AFTER ASSEMBLY.

(1) Insert two insulation sleeves (70) at a brush holder location into two adjacent through holes in the anti-drive end end bell (10). Make sure the insulation sleeves (70) extend out of the through holes on both sides of the anti-drive end end bell (10).

(2) Put an insulating board (80) onto the ends of the exposed insulation sleeves (70) on the inboard side of the anti-drive end end bell (10).

(3) Put a non-metallic washer (50) onto the ends of each exposed insulation sleeves (70) on the outboard side of the anti-drive end end bell (10). Make sure the insulation sleeves (70) do not slide and that the insulating board (80) does not fall off.

(4) Put one flat washer (60) on each of two bolts (40).

(5) Insert one bolt (40) into each of two insulation sleeves (70) on the outboard side of the anti-drive end end bell (10). Make sure that the insulation sleeves (70) do not slide and that the insulating board (80) does not fall off.

WARNING: THREAD LOCKING ADHESIVE IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES.

(6) Apply thread locking adhesive, Grade D, to the threads of the two bolts (40).

(7) Put a complete brush holder (30) against the two bolts (40) on the inboard side of the anti-drive end end bell (10).

(8) Attach the complete brush holder (30) to the anti-drive end end bell (10) with the two bolts (40). ATTACH LOOSELY. DO NOT TIGHTEN THE BOLTS (40) AT THIS TIME.

(9) Repeat Paragraph 6.B.(1) through Paragraph 6.B.(8) for remaining brush holder locations.

(10) Lower the bearing and brush support assembly (10001-290) onto the brush holder alignment fixture as shown in Figure 7005.

CAUTION: MAKE SURE THE COMPLETE BRUSH HOLDERS ARE PROPERLY ALIGNED IN THE BRUSH HOLDER ALIGNMENT FIXTURE. IMPROPER ALIGNMENT CAN CAUSE ELECTRICAL FAILURE.

(11) Adjust all complete brush holders (30) until they are properly aligned. Refer to SPD 1004.

(12) Tighten bolts (40) to a torque of 25.0 to 30.0 lbf.in. (2,8 to 3,4 N·m).

(13) Remove the bearing and brush support assembly (10001-290) from the brush holder alignment fixture.

WARNING: **INSULATING ENAMEL IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN A WELL VENTILATED AREA FREE FROM SPARKS, FLAME AND/OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.**

(14) Apply insulating enamel to bearing and brush support assembly according to the procedure in SPD 1002.

C. Perform a dielectric test.

(1) Perform a dielectric test of the bearing and brush support assembly. Refer to the CHECK section.

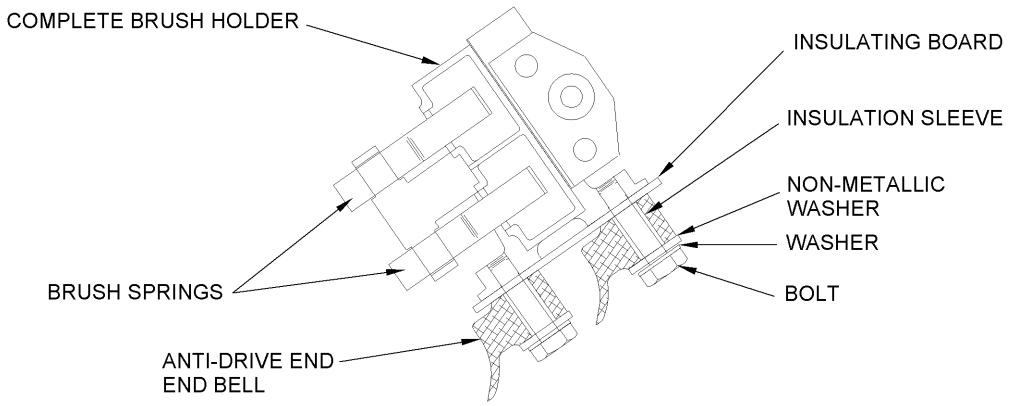


Figure 7004 - Bearing and Brush Support Assembly Detail

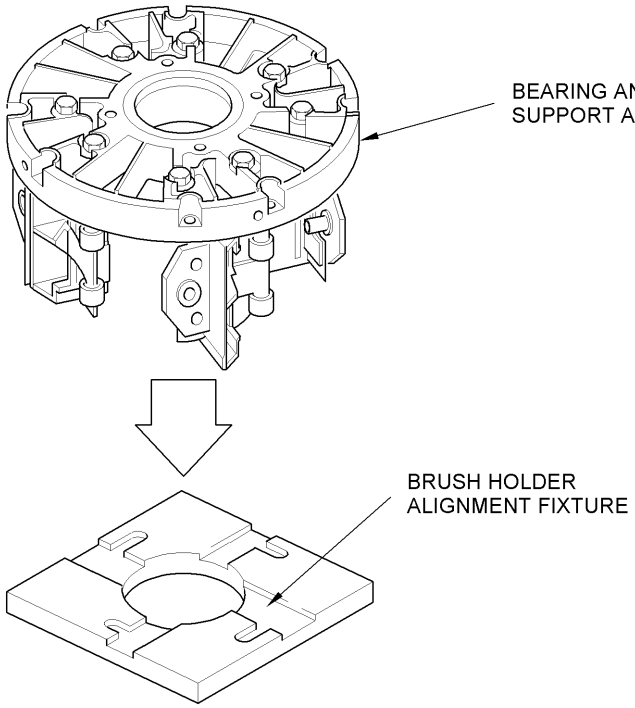


Figure 7005 - Aligning the Brush Holders

D. Press anti-drive end ball bearing (10001-490) into bearing and brush support assembly (10001-290). See Figure 7006.

CAUTION: FAILURE TO USE ANTI-DRIVE END HUB SUPPORT DURING ASSEMBLY OPERATIONS CAN CAUSE PERMANENT DAMAGE TO BEARING AND BRUSH SUPPORT ASSEMBLY.

(1) Set anti-drive end hub support on arbor press table.

(2) Set bearing and brush support assembly (10001-290), brush holders down, on anti-drive end hub support.

WARNING: DO NOT LET PASTE TOUCH THE EYES OR SKIN. OBEY THE MANUFACTURER'S INSTRUCTIONS. REFER TO MSDS SHEET BEFORE PASTE IS USED.

(3) Apply lubricating and assembly paste to the inside diameter of the bearing liner and assemble the bearing with the part marking facing the outside of the unit.

(4) Set anti-drive end bearing on bearing liner of bearing and brush support assembly.

NOTE: The Safran Power part marking on the anti-drive end ball bearing (10001-490) must be facing towards the outside of the starter-generator.

(5) Set outer race bearing driver onto anti-drive end ball bearing (10001-490).

(6) Press anti-drive end ball bearing (10001-490) into bearing and brush support assembly bearing liner.

(7) Make sure that anti-drive end ball bearing (10001-490) is fully seated against inner lip of bearing liner.

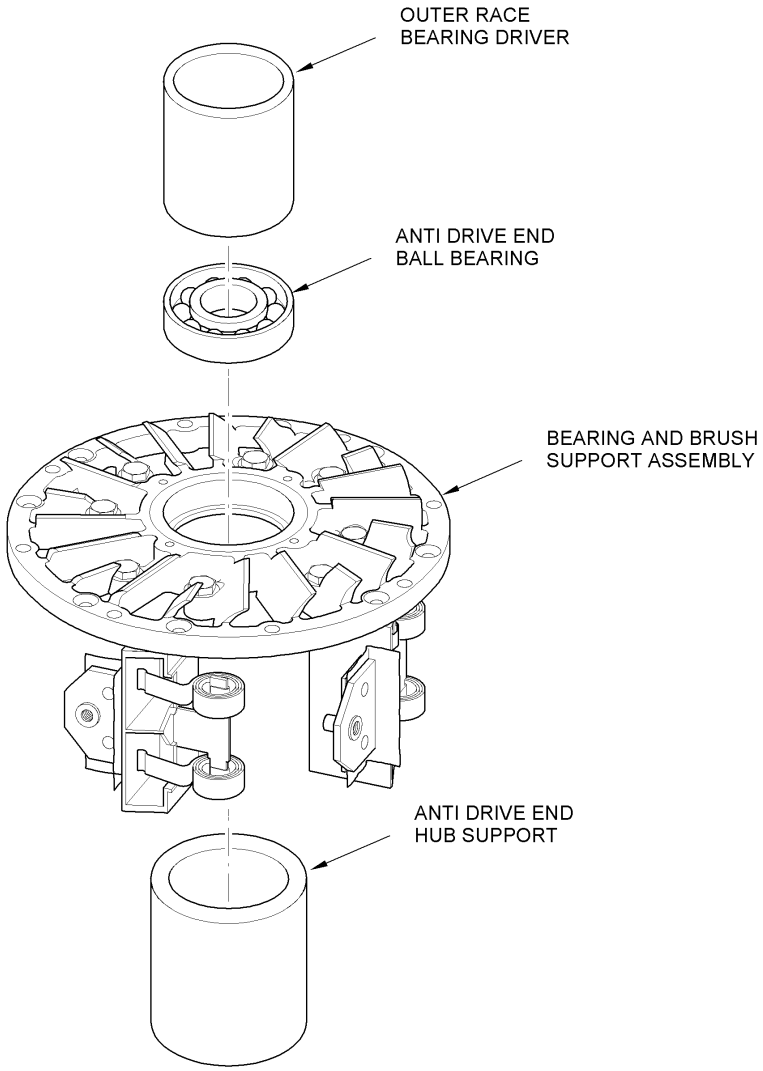


Figure 7006 - Anti-Drive End Bearing Installation

E. Attach bearing retainer (10001-470) to bearing and brush support assembly (10001-290). See Figure 7007.

WARNING: THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(1) Apply thread sealing compound to threads of four screws (10001-480).

(2) Attach bearing retainer (10001-470) to bearing and brush support assembly (10001-290) with four screws (10001-480). Torque screws (10001-480) from 13.5 to 18.0 lbf.in (1,5 to 2,0 N·m).

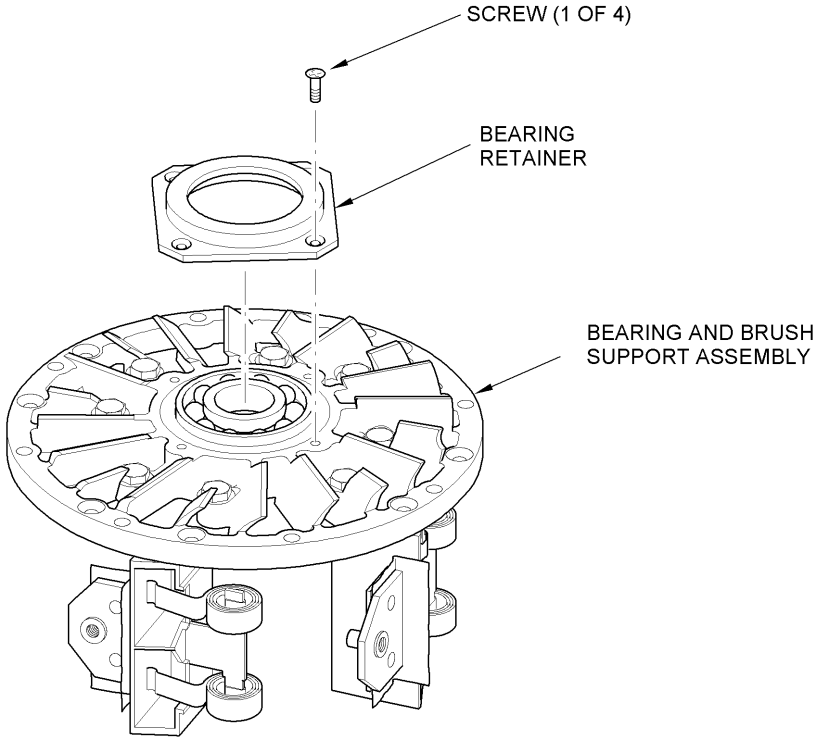


Figure 7007 - Installing Bearing Retainer

F. **Prepare armature (10001-460) for coarse brush seating. See Figure 7008.**

(1) Prepare the armature for coarse brush seating. Refer to SPD 1006.

NOTE: Make sure taped end of sandpaper is in the normal direction of rotation and abrasive side of sandpaper faces away from the commutator.

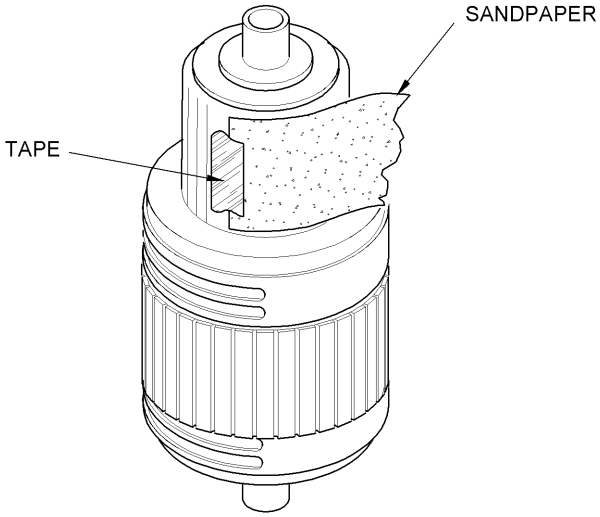


Figure 7008 - Preparing Armature for Rough Seating

G. Press bearing and brush support assembly (10001-290) onto armature (10001-460) shaft. See Figure 7009**.**

CAUTION: DO NOT TOUCH POLISHED SURFACE OF COMMUTATOR WITH BARE HANDS. SKIN ACIDS AND OILS CAN CONTAMINATE CONDUCTING SURFACES CAUSING CORROSION AND/OR POOR ELECTRICAL CONTACT.

(1) Place the armature (10001-460) on an armature support on an arbor press table with the commutator pointing upward.

(2) Set bearing and brush support assembly (10001-290), brush holders down, on commutator end of armature (10001-460) shaft.

(3) Set inner race bearing driver on anti-drive end ball bearing (10001-490).

(4) Press anti-drive end ball bearing (10001-490) onto armature (10001-460) shaft.

(5) Make sure that anti-drive end ball bearing (10001-490) is fully seated against shoulder of armature (10001-460) shaft.

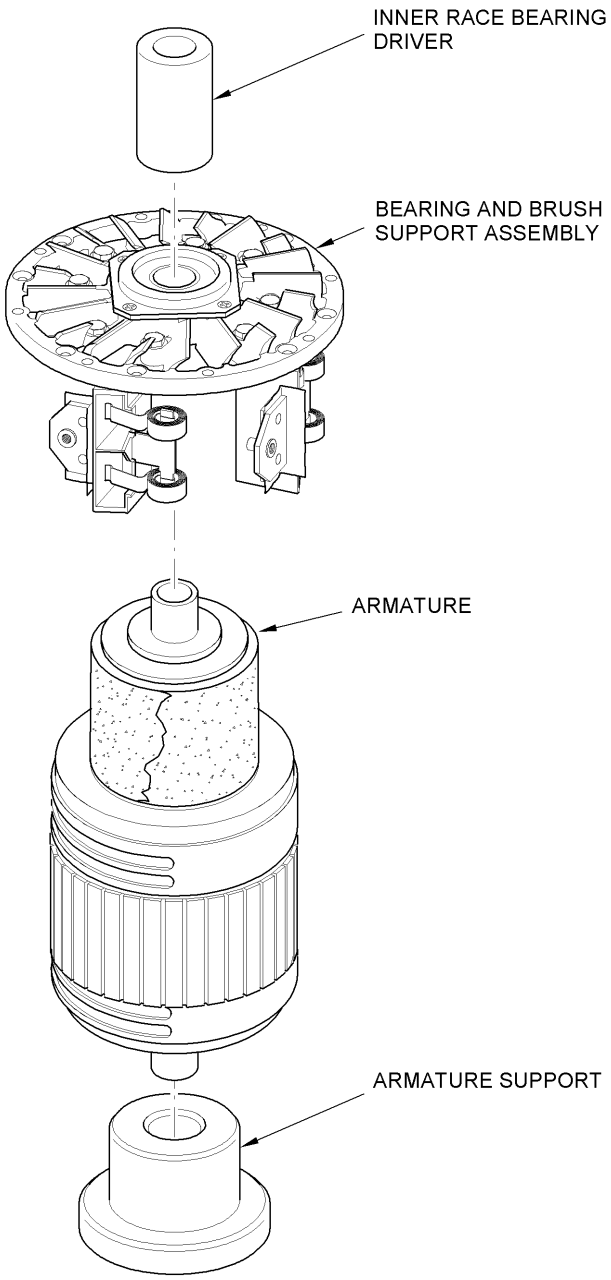


Figure 7009 - Armature on Armature Support

7. Attach Speed Pickup (400) and Grommet (410) to the Drive End Bearing Support Assembly (380). See Figure 7010.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

(1) Press the grommet (410) into an opening in the screen (10003-30) of the drive end bearing support assembly (380).

(2) Insert applicable speed pickup adjustment plug into the bearing liner of the drive end bearing support assembly (380).

(3) Screw the speed pickup (400) through the threaded hole in the drive end bearing support assembly (380).

(4) Clean the area of speed pick up with the isopropyl alcohol and apply the RTV adhesive sealant to the speed pickup if not already applied. (IAW SB 23080-013A-24-02).

NOTE: The RTV sealant is used to seal between the potted core and the lead wire.

(5) Adjust the speed pickup (400) until the tip of the speed pickup (400) lightly touches the speed pickup adjustment plug. Tighten the speed pickup (400) jam nut to a torque of 15.0 to 25.0 lbf.in. (1,7 to 2,8 N·m).

NOTE: The gap will be adjusted after the spur gear is assembled.

(6) Remove speed pickup adjustment plug.

NOTE: Paragraph 6.and Paragraph 7. apply to speed pickup 23072-1280 and 23072-1281 only. Speed pickup 23072-1400 does not require sleeving.

(7) If the heat shrink sleeving was removed during disassembly, put a piece of 1/8 inch (3,2 mm) diameter heat shrinkable sleeving over the speed pickup leads.

(8) Shrink the sleeving into place on the leads with a heat gun.

(9) Thread speed pickup (400) leads through grommet (410).

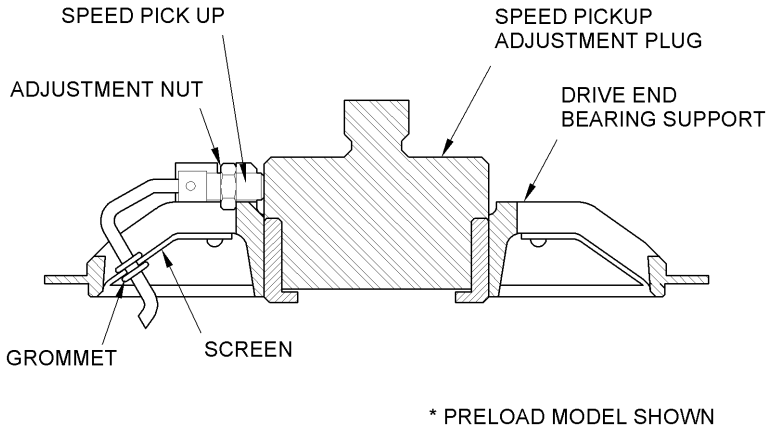


Figure 7010 - Adjusting the Speed Pickup

8. <u>For (Non-Preload) Models Only, Follow These Instructions for Installing Drive End Bearing Support and Bearing and Brush Support Assembly.</u>

<u>NOTE:</u> Unless otherwise specified, numbers in parentheses ( ) refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Assemble the drive end bearing support assembly (380) to the stator and housing assembly (500). See Figure 7011.

(1) Place the stator and housing assembly (500) vertically on the work bench with the drive end up.

(2) While holding drive end bearing support assembly (380), thread the speed pickup (400) leads through the stator and housing assembly (500) and out the hole.

<u>NOTE:</u> Sometimes it is easier to slide a separate 12 inch (305 mm) length of wire through the hole and pass between the stator poles out to the drive end. Attach this extra wire to the speed pickup (400) leads. Pull out the extra wire as the speed pickup (400) leads are pulled in on the same path. Disconnect the extra wire.

(3) Place the drive end bearing support assembly (380) on the stator and housing assembly (500). Align the speed pickup (400) unit towards the terminal block (10004-50) on the stator and housing assembly (500).

<u>WARNING:</u> THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(4) Apply thread sealing compound to threads of three screws (390).

(5) Attach the drive end bearing support assembly (380) to the stator and housing assembly (500) with three screws (390). Tighten the screws (390) to a torque of 7.7 to 10.3 lbf.in. (0,87 to 1,16 N·m).

NOTE: Make sure that the head of the screws (390) are flush or below face of the drive end bearing support assembly (380) when installed.

NOTE: The speed pickup (400) leads may dangle outside the stator and housing assembly (500) until connected in later steps.

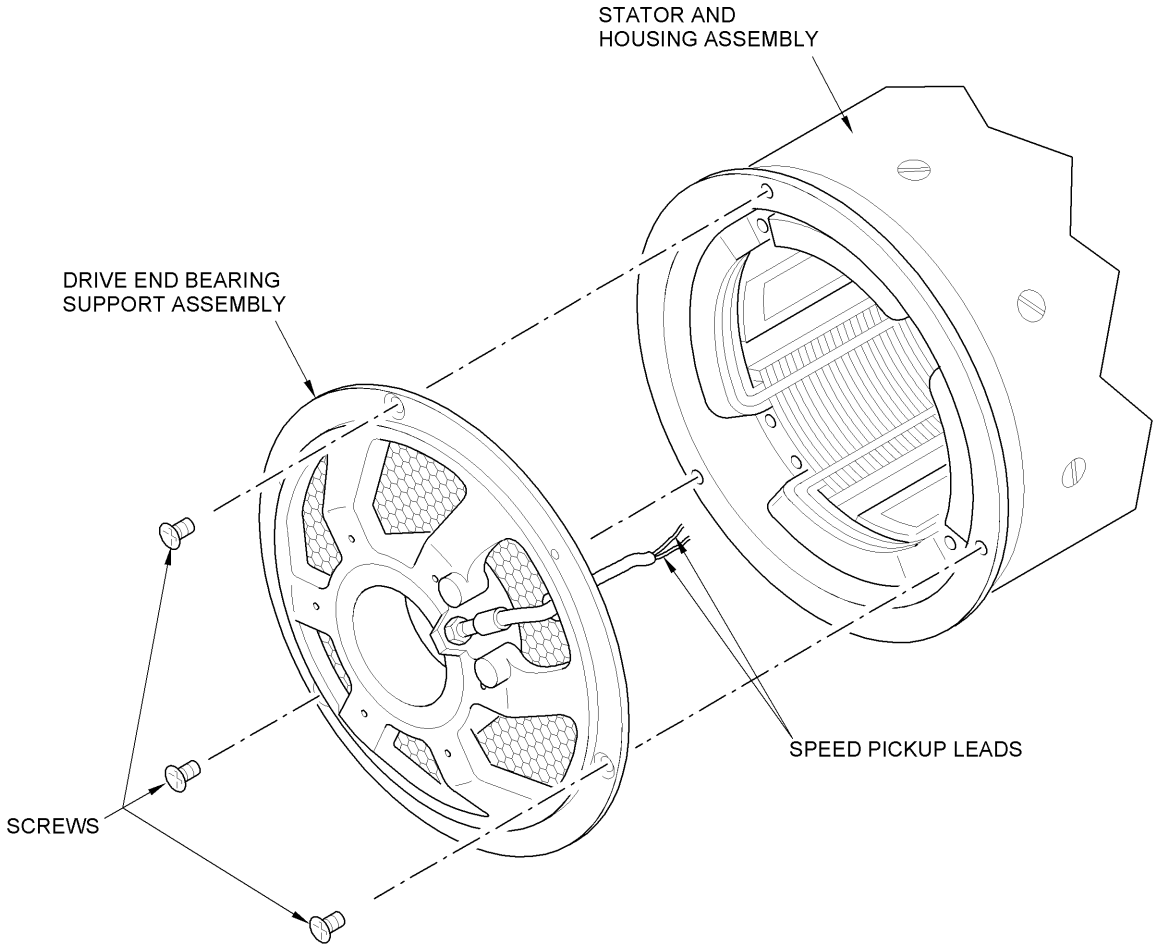


Figure 7011 - Installing Drive End Bearing Support Assembly (Non-Preload)

B. Press the drive end ball bearing (420) onto the armature (460) shaft.

(1) Place the armature (460) on the work bench with the bearing and brush support assembly (290) down.

NOTE: The armature assembly will sit on its bearing retainer plate on the bottom.

(2) Slide a baffle disc (320), concave side to armature onto the armature shaft.

NOTE: The Safran Power part marking on the bearing (420) must be facing towards the outside of the starter-generator.

(3) Lightly press a ball bearing (420) on the armature (460) shaft. Use an inner race bearing driver to finish pressing the bearing in an arbor press.

(4) Make sure the ball bearing is fully seated against the baffle disc.

C. Assemble the bearing and brush support assembly (290) (with attached armature (460) to the stator and housing assembly (500). See Figure 7012 and Figure 7013.

(1) Place the stator and housing assembly (500) drive end down, into the outboard hub support on the work bench. Tuck the four brush harness straps to the side.

(2) Insert the armature (460) with the attached bearing and brush support assembly (290) into the stator and housing assembly.

(3) Make sure the four brush harness straps are within reach of the brush holders. Align the holes of the bearing and brush support assembly (290) with the threaded holes in the stator and housing assembly (500).

(4) If the bearing and brush support assembly (290) has not seated against the housing, it will have to be pressed on. Use an inner race bearing driver on the anti-drive end bearing (490) and gently tap with a mallet or use an arbor press to seat the assembly.

(5) Put a flat washer (310) onto each of eight self-locking screws (300).

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(6) Apply thread sealing compound to threads of screws (300).

(7) Attach the bearing and brush support assembly to the stator and housing assembly with eight screws (300) and washers (310). Tighten the screws (300) to a torque of 13.5 to 18.0 lbf.in. (1,53 to 2,03 N·m).

(8) Slide speed pickup gear (280) onto the drive end of the armature (460) shaft. The inner rim on the speed pickup gear (280) faces the drive end bearing (420). See Figure 7014.

(9) Install a new retaining ring (270) into the groove of the armature (460) shaft. Make sure retaining ring (270) is fully seated.

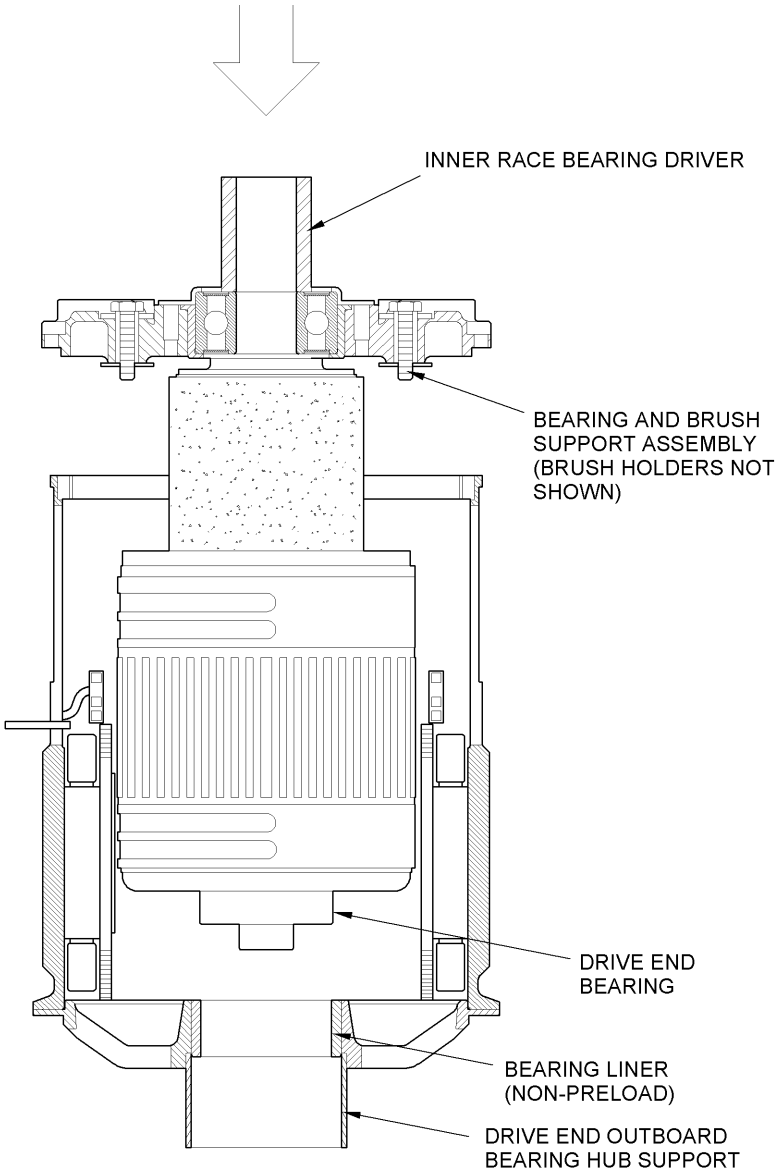


Figure 7012 - Pressing the Bearing and Brush Support Assembly with Attached Armature into the Stator and Housing Assembly (Non-Preload)

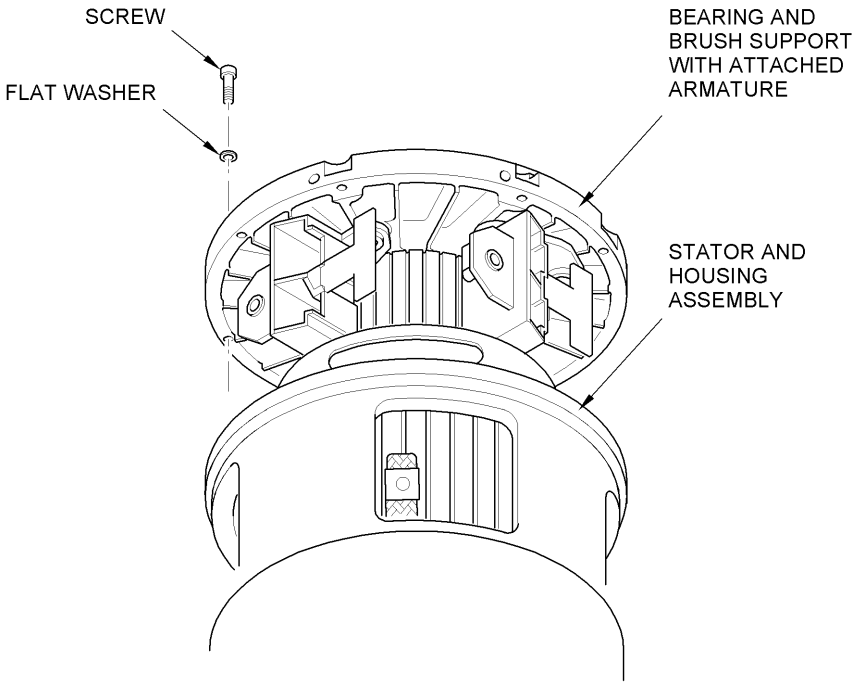


Figure 7013 - Installing the Bearing and Brush Support Assembly with Attached Armature to Stator and Housing Assembly (Non-Preload)

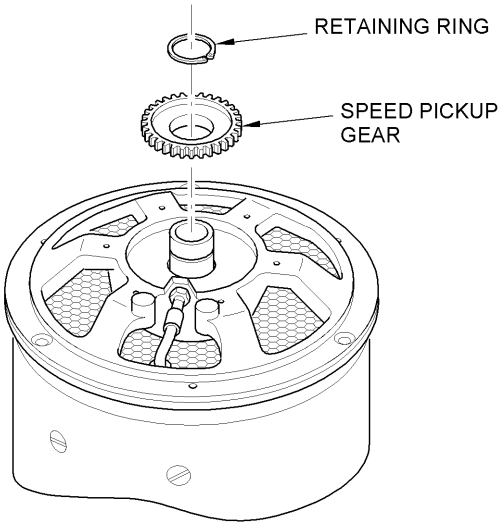


Figure 7014 - Installing Speed Pickup Gear and Retaining Ring onto Armature Shaft (Non-Preload)

9. For (Pre-load) Models, Follow These Instructions for Installing Both Drive End Bearing Support and Bearing and Brush Support Assembly.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Assemble the drive end bearing support assembly (380) to the stator and housing assembly (500). See Figure 7015.

(1) Place the stator and housing assembly (500) vertically on the work bench with the drive end up.

(2) While holding drive end bearing support assembly (380), thread the speed pickup (400) leads through the stator and housing assembly (500) and out the hole.

NOTE: Sometimes it is easier to slide a separate 12 inch (305 mm) length of wire through the hole and pass between the stator poles out to the drive end. Attach this extra wire to the speed pickup (400) leads. Pull out the extra wire as the speed pickup (400) leads are pulled in on the same path. Disconnect the extra wire.

(3) Place the drive end bearing support assembly (380) on the stator and housing assembly (500). Align the speed pickup (400) unit towards the terminal block (10004-50) on the stator and housing assembly (500).

WARNING: THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(4) Apply thread sealing compound to threads of three screws (390).

(5) Attach the drive end bearing support assembly (380) to the stator and housing assembly (500) with three screws (390). Tighten the screws (390) to a torque of 7.7 to 10.3 lbf.in. (0,87 to 1,16 N·m).

NOTE: Make sure that the head of the screws (390) are flush or below face of the drive end bearing support assembly (380) when installed.

NOTE: The speed pickup (400) leads may dangle outside the stator and housing assembly (500) until connected in later steps.

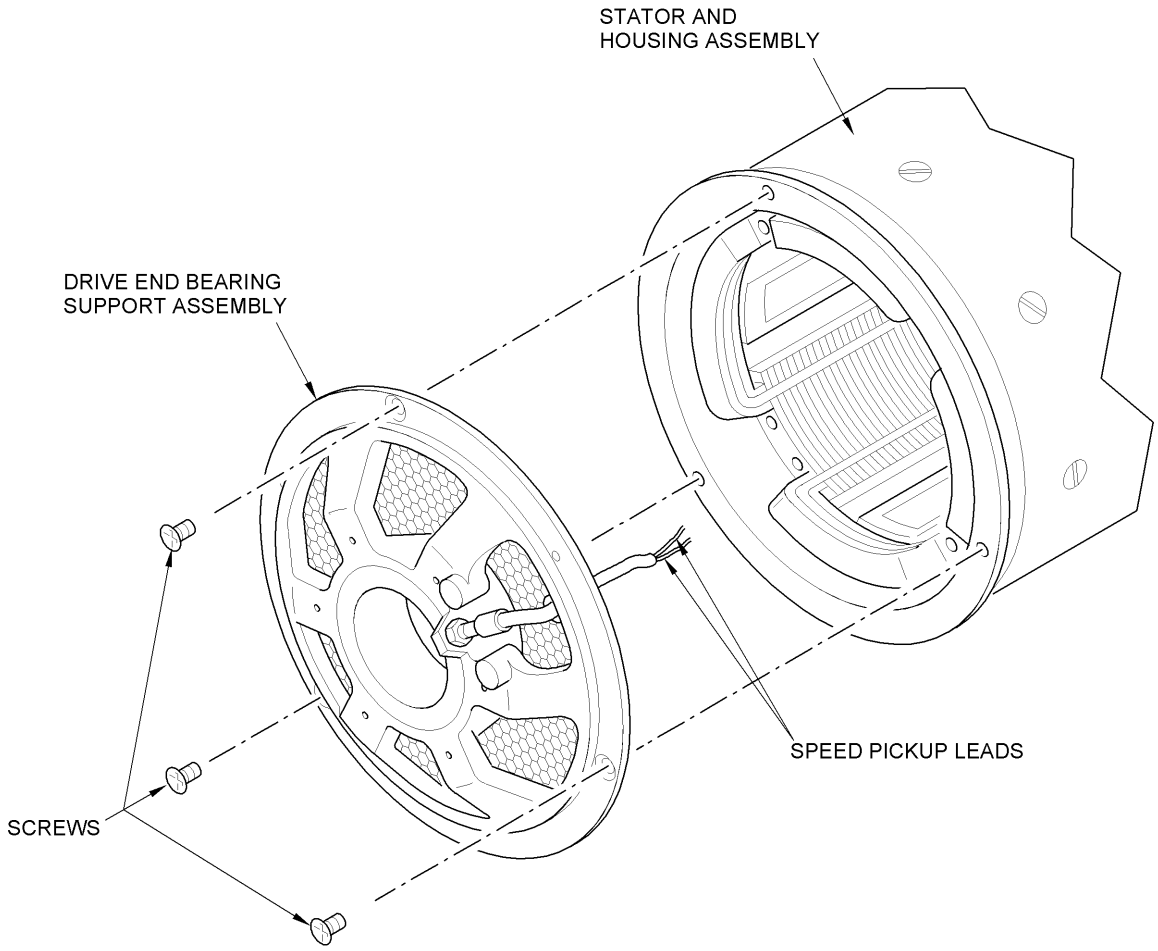


Figure 7015 - Installing Drive End Bearing Support Assembly (Pre-Load)

B. Determine shim(s) requirements. See Figure 7016**.**

(1) Put spacer (320) on the drive end of armature (460) shaft with the part identification stamping facing inboard.

(2) Measure and record the distance from the mounting surface of the bearing and brush support assembly (290) to the top surface of the spacer (320) on armature shaft. Record as dimension ‘A’.

(3) Measure and record the distance from the mounting surface of the stator and housing assembly (500) to the bottom of the bearing liner in drive end bearing support assembly (380). Record as dimension ‘B’.

(4) Subtract dimension ‘B’ from dimension ‘A’ and record difference. The difference is the gap without shims.

NOTE: The calculated difference between dimensions ‘A’ and ‘B’ is the gap for the spring wave washer (430). The desired gap of the compressed spring wave washer is between 0.018 and 0.041 inch (0,46 and 1,04 mm).

(5) If required, make a shim pack with enough shims (440) and (450) to reduce the gap to below 0.041 inch (1,04 mm).

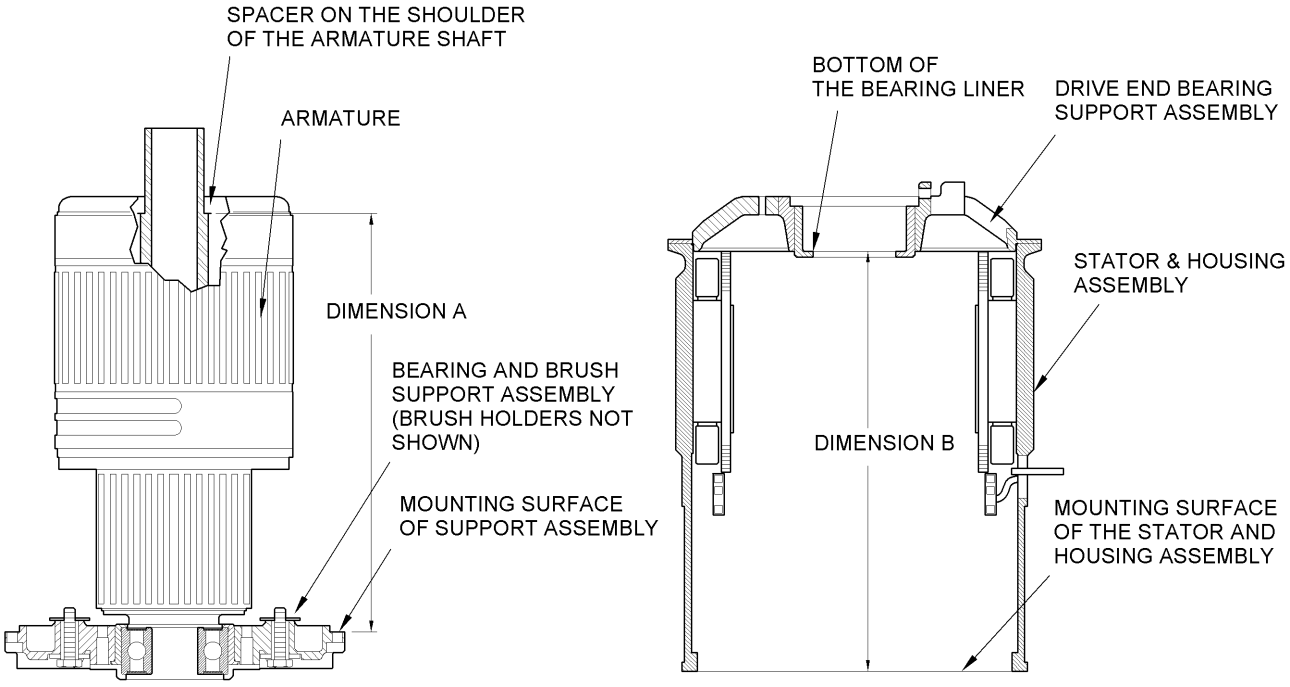


Figure 7016 - Determining Shim Requirements (Pre-Load)

C. Installing the shim(s) (440, 450) (if required), spring wave washer (430) and drive end ball bearing (420). See Figure 7017.

(1) Place the stator and housing assembly (500) vertical on the arbor press table with the drive end up.

(2) Put the shim(s) (440, 450) (if required) into the bottom of the bearing liner in the drive end bearing support assembly (380).

(3) Put the spring wave washer (430) in the bearing liner on top of the shim(s) (if present).

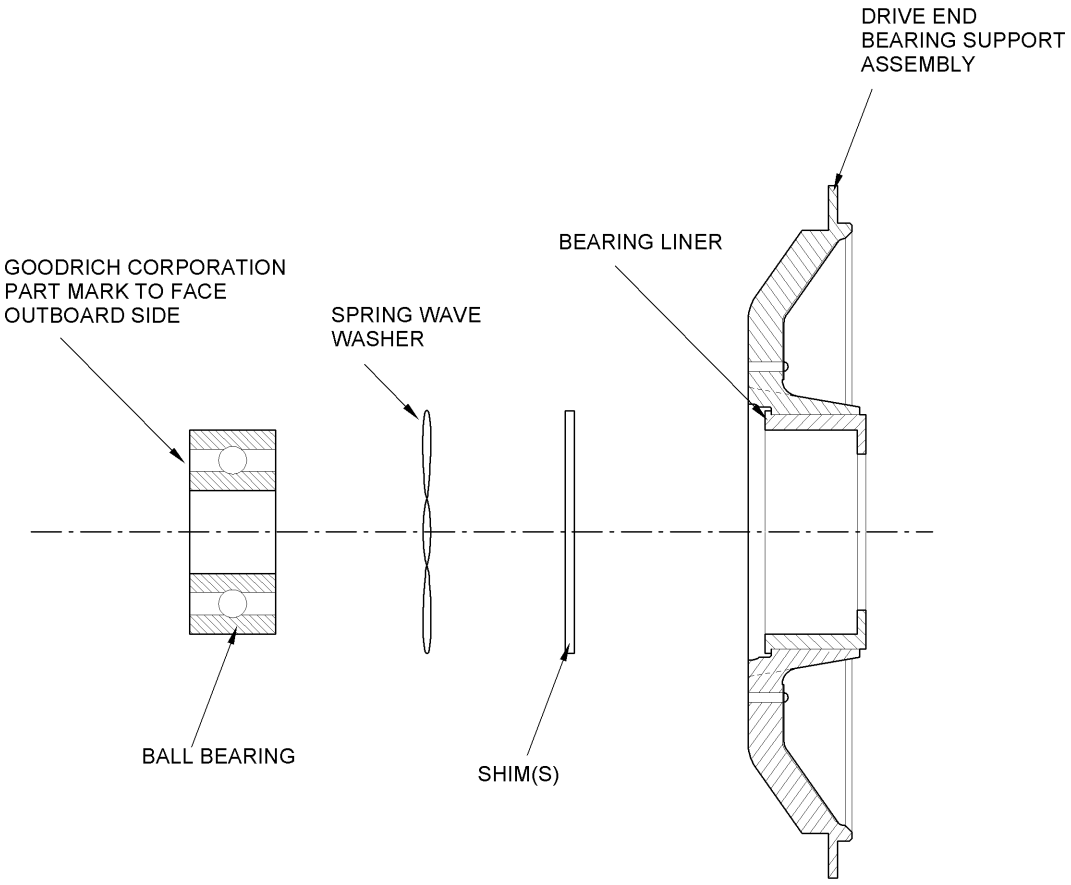


Figure 7017 - Spring Loaded Assembly, Sectional View (Pre-Load)

WARNING: DO NOT LET PASTE TOUCH THE EYES OR SKIN. OBEY THE MANUFACTURER'S INSTRUCTIONS. REFER TO MSDS SHEET BEFORE PASTE IS USED.

(4) Apply lubricating and assembly paste to the inside diameter of the bearing liner.

(5) Lightly press a drive end ball bearing (420) into the drive end bearing support assembly (380) using an outer race bearing driver.

NOTE: The Safran Power part marking on the ball bearing (420) must be facing towards the outside of the starter-generator.

D. Assemble the bearing and brush support assembly (290), with attached armature (460), to the stator and housing assembly (500). See Figure 7018

(1) Set vertical shaft support on arbor press table.

(2) Set stator and housing assembly (500) with attached drive end bearing support assembly (380) (drive end down) onto vertical shaft support.

(3) Insert armature (460) with attached bearing and brush support assembly (290) into stator and housing assembly (500).

NOTE: Make sure the spacer (320) is still on the armature (460) shaft.

(4) Align four brush harness straps with brush holder assemblies. If necessary, use a probe to move brush harness straps to correct positions.

(5) Set inner race bearing driver onto anti-drive end ball bearing (490).

(6) Press armature (460) shaft into drive end bearing (420). Make sure that screw holes in bearing and brush support assembly (290) are correctly aligned with mounting holes in stator and housing assembly (500). Make sure that bearing and brush support assembly (290) is properly seated against stator and housing assembly (500).

(7) Put a flat washer (310) onto each of the eight self-locking screws (300).

WARNING: THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(8) Apply thread sealing compound to threads of screws (300).

(9) Attach bearing and brush support assembly (290) to stator and housing assembly (500) with eight attaching screws (300). Tighten screws (300) to a torque of 13.5 to 18.0 lbf.in. (1,53 to 2,03 N·m).

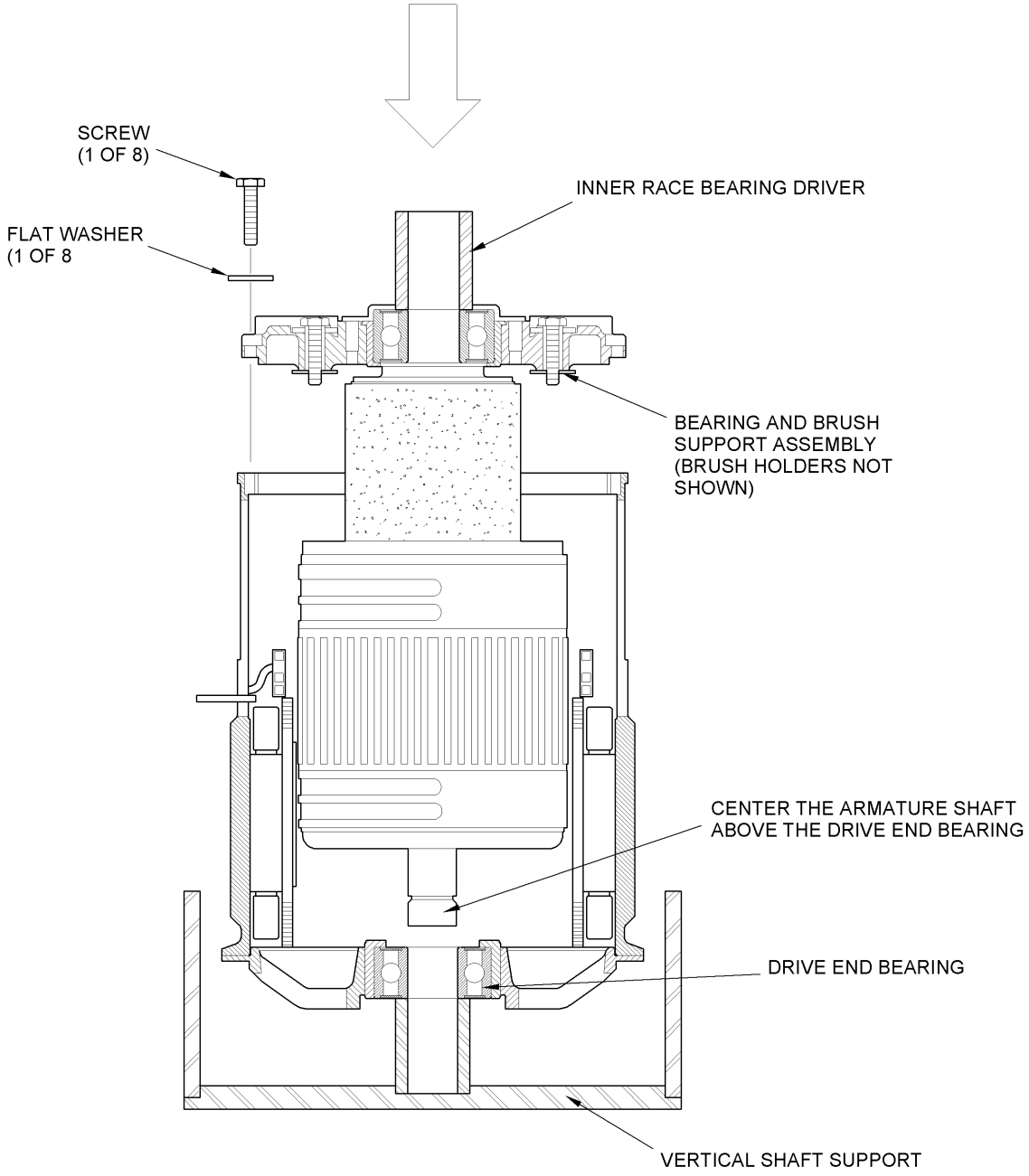


Figure 7018 - Pressing the Bearing and Brush Support Assembly with Attached Armature into the Stator and Housing Assembly (Pre-Load)

E. Installing speed pickup gear (280) and retaining ring (270) onto armature (460) shaft. See Figure 7019

(1) Slide the speed pickup gear (280) on the armature (460) shaft. The inner rim on the speed pickup gear (280) faces the drive end bearing (420). See Figure 7019.

(2) Install a new retaining ring (270) into the groove of the armature (460) shaft. Make sure retaining ring (270) is fully seated.

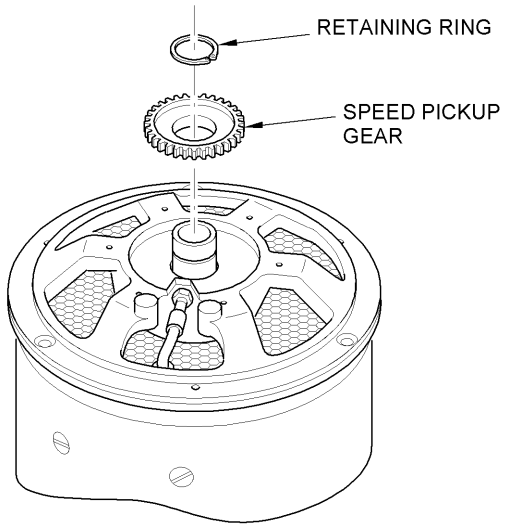


Figure 7019 - Installing Speed Pickup Gear and Retaining Ring onto Armature Shaft (Pre-Load)

10. Final Assembly of the DC Starter-Generator

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

A. Attach thermal switch (370) to stator and housing assembly (500).

WARNING: DO NOT GET LOCTITE GRADE A ON YOUR SKIN. IF YOU GET SOME ON YOUR SKIN, FLUSH WITH CLEAN WATER. REFER TO THE APPLICABLE MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION.

WARNING: THREAD LOCKING ADHESIVE IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(1) Apply Loctite, Grade A, to internal thread of tapped hole in stator and housing assembly (500).

(2) Thread thermal switch (370) into hole in stator and housing assembly (500).

B. Attach spacers (340 and 350) and 3-pin connector (330) to stator and housing assembly (500). See Figure 7020.

NOTE: Allow enough lead length to reach through both spacers.

(1) Cut to length and strip leads from speed pickup (400) and thermal switch (370).

(2) Assemble wire adapter sleeve on each of three leads.

(3) Crimp connector pin on each of three leads using appropriate crimp tool.

(4) Thread speed pickup leads and thermal switch lead through spacers (350 and 340).

(5) Use a pin insertion/extraction tool to insert pins into connector (330).

NOTE: When properly installed, the slot in the spacer (350) will be against the stator and housing assembly (500). The speed pickup leads route through the slot in the spacer. The open area of the spacer will be over the thermal switch (370).

(6) Carefully coil wires around connector to avoid pressing against thermal switch.

NOTE: Position polarizing key of 3-pin connector as shown (see Figure 7020).

(7) Position the spacer (340) and the 3-pin connector (330) on spacer (350).

WARNING: THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(8) Apply thread sealing compound to threads of four screws (360).

(9) Attach spacers (340 and 350) and connector (330) to the stator and housing assembly (500) using four screws (360). Tighten the screws (360) to a torque of 4.2 to 5.5 lbf.in. (0,47 to 0,62 N·m).

(10) Check for continuity between speed pickup connector pins.

(11) Lockwire the four screws (360) with lockwire P/N MS20995C20 IAW MS33540.

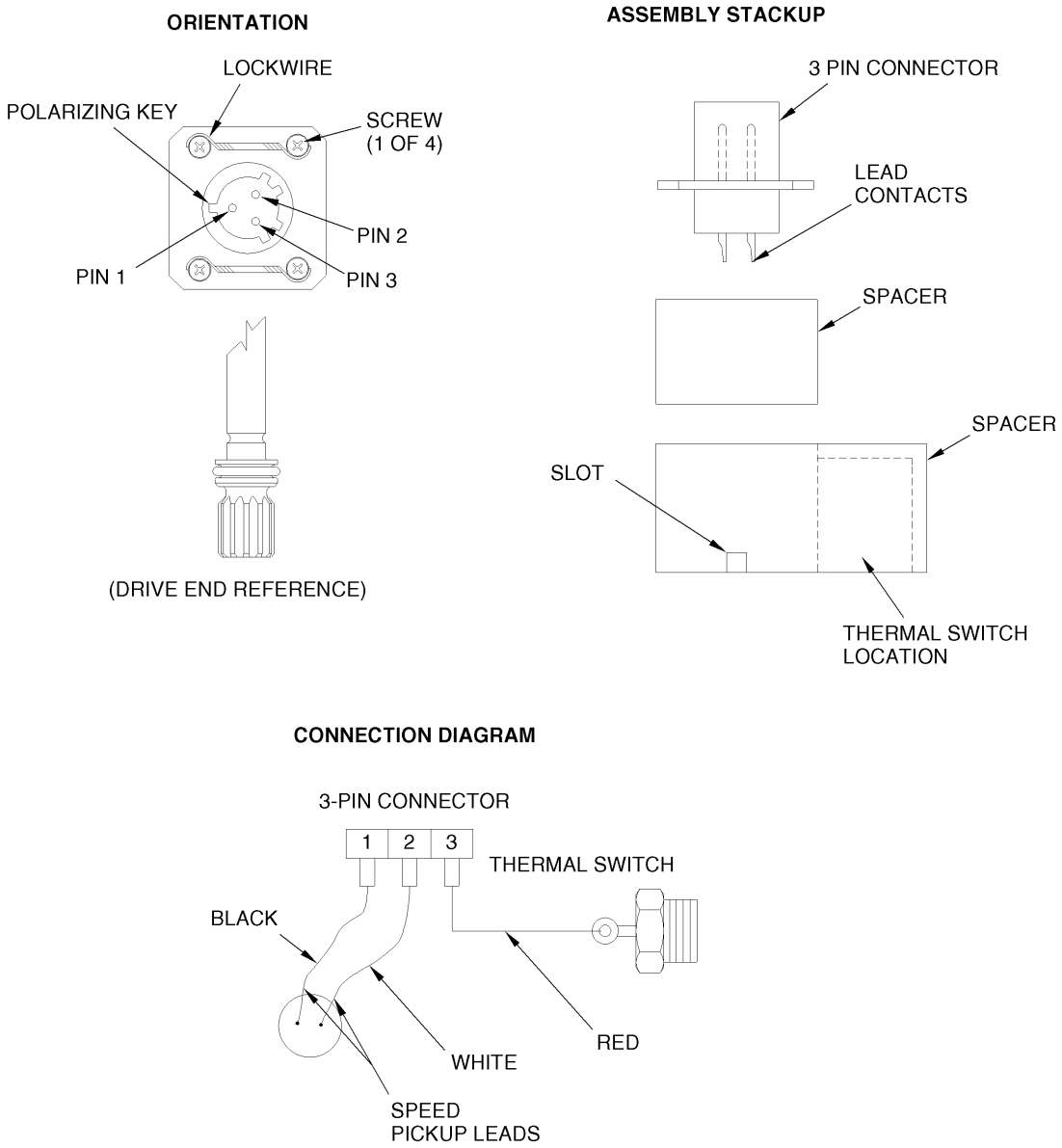


Figure 7020 - Assembling the 3-Pin Connector and Spacers

C. Installing dampener backplate (260) and friction ring (230) onto armature (460) shaft. See Figure 7021.

(1) Set stator and housing assembly (500) on horizontal stator support.

(2) Twist dampener backplate (260) onto drive end of armature shaft until fully seated.

(3) Put friction ring (230) into recess of dampener backplate.

NOTE: Friction ring (230) may not stay in place until drive shaft (210) with attached dampener plate (240) is installed.

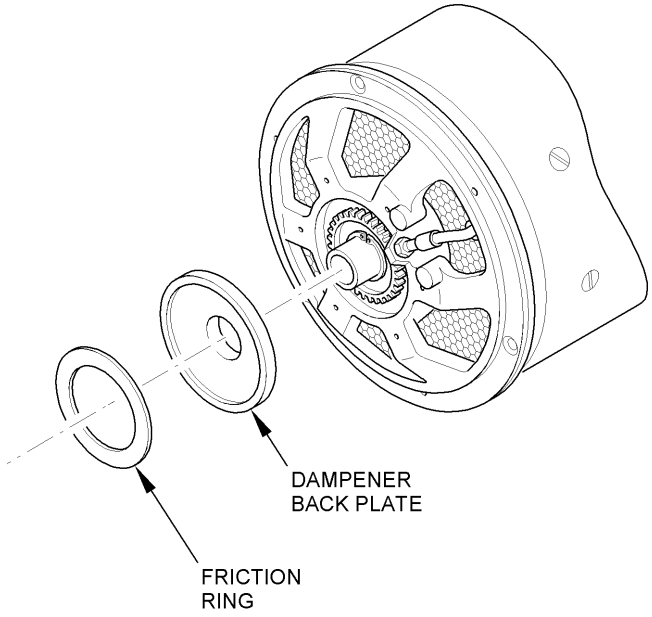


Figure 7021 - Installing Dampener BackPlate and Friction Ring

D. Assemble dampener hub (250) and dampener plate (240) on drive shaft (210). See Figure 7022.

CAUTION: DO NOT FORCE DAMPENER HUB ON DRIVE SHAFT MATING TAPER. TOO MUCH FORCE CAN CAUSE THE DAMPENER HUB TO FRACTURE.

(1) Press dampener hub (250) on drive shaft (210) if it was removed.

(2) Put drive shaft (210) and dampener hub (250) through dampener plate (240) and dampener plate driver. Align splines.

(3) Using a leather or plastic mallet, lightly tap drive end of drive shaft to seat dampener plate on dampener hub.

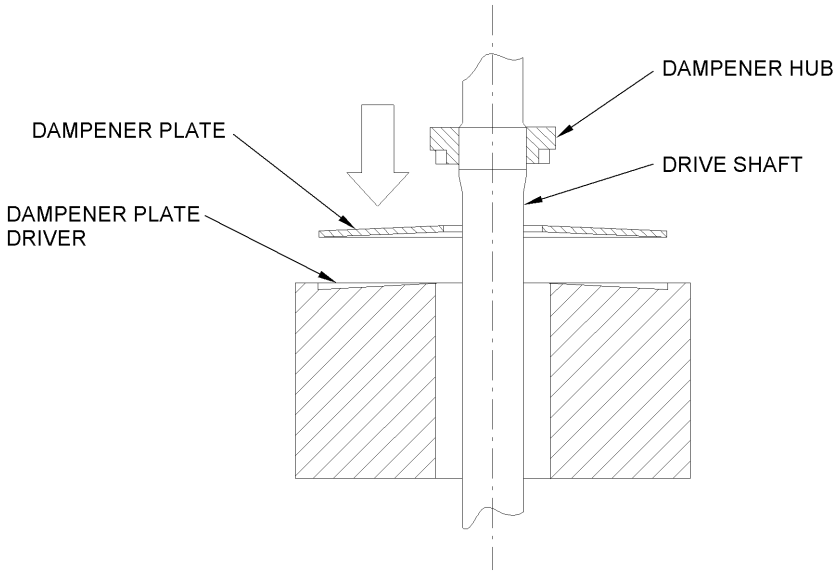


Figure 7022 - Dampener Plate and Driver

E. Insert drive shaft (210) in armature (460) shaft. See Figure 7023.

CAUTION: DO NOT USE HIGH FORCE TO ENGAGE THE DRIVE SHAFT AND ARMATURE SHAFT MATING SPLINES. FAILURE TO CORRECTLY ENGAGE THE SPLINES CAN CAUSE DAMAGE TO THE DRIVE SHAFT AND ARMATURE SHAFT.

(1) Insert drive shaft (210) in drive end of armature (460) shaft.

(2) Push drive shaft (210) through armature (460) shaft until dampener plate (240) is fully seated against friction ring (230).

(3) Turn drive shaft (210) in direction of rotation (counterclockwise facing the drive end) to make sure that armature (460) shaft and drive shaft tapered spline seats into the spline in the armature (460) shaft.

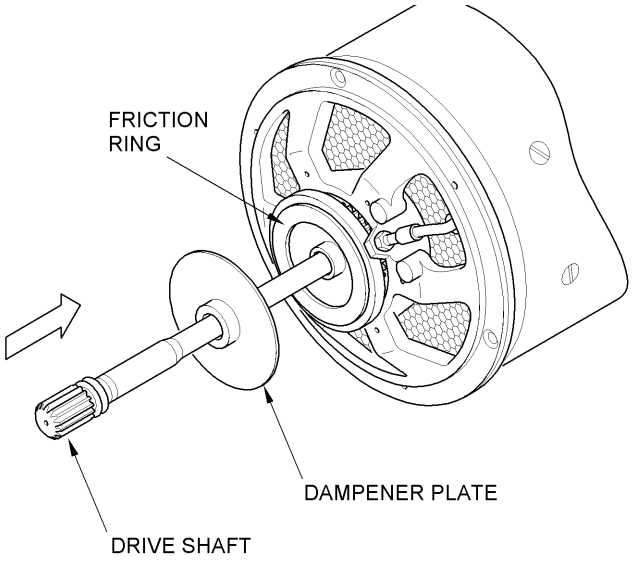


Figure 7023 - Installing Drive Shaft into Armature Shaft

F. Attach fan (180) to drive shaft. See Figure 7024.

(1) Put fan (180) on drive shaft (210).

(2) Attach fan (180) to drive shaft with a flat washer (200) and a self-locking nut (190).

(3) Use a spline wrench to hold the drive shaft (210) in place. Tighten self-locking nut (190) to a torque of 100 to 120 lbf.in. (11,3 to 13,6 N·m).

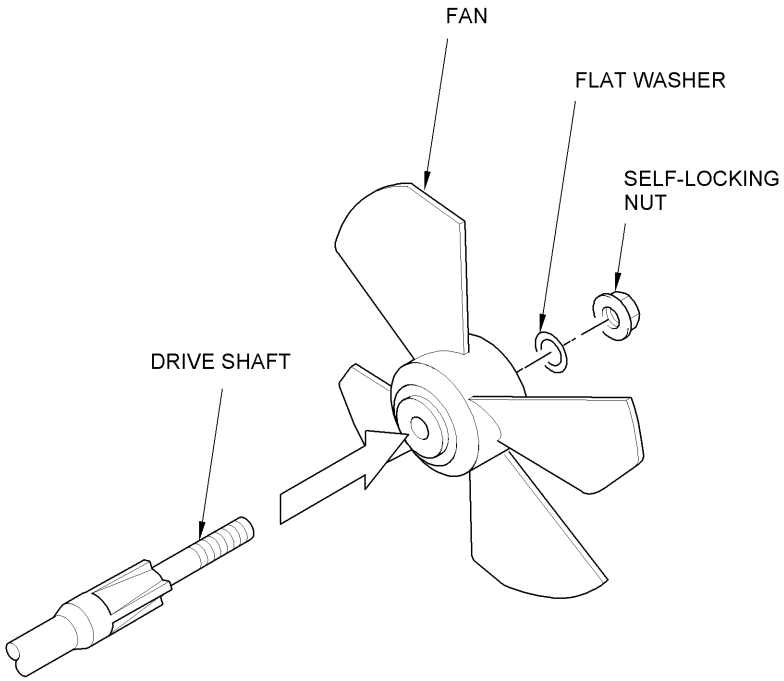


Figure 7024 - Installing the Fan

G. Install the brushes (160).

NOTE: If new brushes (160) are to be used, identify the brushes (160) with the numbers 1 through 4.

CAUTION: RAISE AND LOWER BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO INSERT BRUSH SETS INTO BRUSH HOLDER ASSEMBLY.

(1) Set starter-generator, anti-drive end up, onto a vertical stator support.

(2) At each brush holder location, lift one brush spring at a time with a wire hook tool and insert brush set into a brush holder assembly.

(3) Slowly lower springs on top of brushes. Make sure that brush leads are not caught under brush springs.

(4) Install four electrical brushes (160) into the corresponding complete brush holders (10002-30).

(5) Secure the four brush (160) leads and four braided stator leads to complete brush holders (10002-30) with four screws (170) to a torque of 25.0 to 35.0 lbf.in. (2,8 to 4,0 N·m). Ensure leads are arranged over brush springs (10002-130) to prevent brushes (160) from hanging up.

H. Coarse seat the new brushes (160).

(1) Coarse seat the brushes (160) IAW SPD 1006.

NOTE: The sandpaper should first touch the leading edge (short side) of the brush (160) when the armature (460) is rotated in its normal direction.

I. Perform brush (160) run-in.

CAUTION: FAILURE TO FULLY SEAT THE BRUSHES CAN DECREASE BRUSH LIFE, LOWER STARTER- GENERATOR PERFORMANCE, OR CAUSE STARTER-GENERATOR FAILURE.

CAUTION: DO NOT LET THE STARTER-GENERATOR HANG UNSUPPORTED DURING INSTALLATION ONTO AND REMOVAL FROM THE DRIVE STAND. TOO MUCH LOAD ON THE DRIVE SHAFT SHEAR SECTION CAN DAMAGE THE UNIT.

(1) Run-in the brushes (160) IAW SPD 1006.

NOTE: A correctly seated brush (160) has a smooth and semi-gloss contact surface.

(2) Remove sandpaper IAW SPD 1006 when done with brush run-in.

J. Install brush access cover (130).

CAUTION: THE JOINT FORMED BY THE BRUSH ACCESS COVER MUST NOT BE POSITIONED OVER AN ACCESS WINDOW IN THE HOUSING. THE BRUSH SHUNT WIRES CAN SHORT TO THIS AREA.

(1) Install brush access cover (130) on bearing and brush support assembly (290) and tighten screw (140) to a torque of 25.0 to 35.0 lbf.in. (2,8 to 4,0 N·m) to secure.

NOTE: Brush access cover (130) will be removed for acceptance testing and replaced after acceptance testing.

K. For model 23080-014, install air inlet (110).

(1) Using a vertical stator support, place stator and housing assembly (500), fan (180) up, on a work bench.

(2) Position air inlet (110) covering bearing and brush support (290) and secure with four screws (120) to a torque of 9.0 to 12.0 lbf.in. (1,0 to 1,4 N·m).

(3) After acceptance testing, lockwire (MS20995C32) the four attaching screws (120) IAW MS33540.

NOTE: Do not attach lockwire to screws until after acceptance testing.

L. Install patent label (-70) and TSO label (-80), if required.

WARNING: ISOPROPYL ALCOHOL IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(1) Clean stator and housing assembly (500) surface adjacent to the identification plate, where label is to be applied, using isopropyl alcohol and a clean, lint-free cloth.

(2) Allow the isopropyl alcohol to dry.

(3) Remove the protective backing on the patent label (-70) and/or TSO label (-80) and install label on stator and housing assembly (500).

M. Install caution decal (-60), if required.

WARNING: ISOPROPYL ALCOHOL IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(1) Clean stator and housing assembly (500) surface where decal is to be applied using isopropyl alcohol and a clean, lint-free cloth.

(2) Allow the isopropyl alcohol to dry.

(3) Remove the protective backing on the caution decal (-60) and install caution decal (-60) on stator and housing assembly (500).

N. Install replacement identification plate (-30), if required.

NOTE: The replacement identification plate (-30) includes a modification status box. If the identification plate is replaced, the modification status label (-50) (if present) must be removed from the unit.

(1) Transfer information from old identification plate(-30) and modification status label (-50) to replacement identification plate (-30).

(2) Position replacement identification plate (-30) on stator and housing assembly (500) and secure with four drive screws (-40).

WARNING: KEEP ACRYLIC COATING AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. CONFORMAL COATING IS FLAMMABLE.

WARNING: DO NOT GET ACRYLIC COATING ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ACRYLIC COATING IS A POISONOUS MATERIAL.

(3) Coat the replacement identification plate (-30) with acrylic coating and let the coating air dry.

11. Perform Acceptance Test on Starter-Generator

CAUTION: BEFORE ACCEPTANCE TESTING, ATTACH AN UNSERVICEABLE TERMINAL BLOCK (10004-50) TO THE STATOR AND HOUSING ASSEMBLY (500).

Perform acceptance test procedure on the assembled starter-generator as detailed in the TESTING AND FAULT ISOLATION section.

12. Final Assembly after Acceptance Testing

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10004 of ILLUSTRATED PARTS LIST.

A. Attach serviceable terminal block (50) to housing.

(1) Remove unserviceable terminal block from housing. Refer to DISASSEMBLY section.

(2) Set unit on horizontal stator support.

CAUTION: AS TERMINAL BLOCK IS GENTLY PUSHED INTO PLACE, MAKE SURE THAT TERMINAL LEADS A AND D ARE NOT UNDERNEATH TERMINAL BLOCK.

(3) Set terminal block (50) on housing and gently push terminal block into position on larger stator leads B and E.

(4) At each mounting hole, attach terminal block (50) to housing with bolt (60), lock washer (70), and a flat washer (80). Tighten the bolts (60) to a torque of 22.7 to 35.0 lbf.in. (2,6 to 4,0 N·m).

B. Install terminal block hardware.

(1) Put stator lead terminals on studs A and D.

(2) Secure stator lead to terminals A and D with self-locking nut (30) and flat washer (40) at each location.

(3) At terminals B and E install a flat washer (20) and self-locking nut (10).

C. Attach terminal block cover (10001-90) (if present).

NOTE: When a starter-generator is removed from aircraft for service, the terminal block cover usually stays on the aircraft.

Attach terminal block cover (10001-90) to the terminal block (50) with two screws (10001-100). Tighten the screws (10001-100) to a torque of 7.7 to 10.3 lbf.in (0,87 to 1,19 N·m).

D. Remove commutation viewing adapter.

Unthread the screw (10001-140) from self-locking blind rivet nut that secures commutation viewing adapter to starter-generator. Remove the commutation viewing adapter.

E. Attach brush access cover (10001-130).

(1) Position brush access cover (10001-130) around stator and housing assembly (10001-500).

CAUTION: THE JOINT FORMED BY THE BRUSH ACCESS COVER MUST NOT BE POSITIONED OVER AN ACCESS WINDOW IN THE HOUSING.

(2) Thread screw (10001-140) into self-locking blind rivet nut. Tighten screw to a torque of 25.0 to 35.0 lbf.in. (2,8 to 4,0 N·m).

F. For Model 23080-014 Lockwire screws (10001-120) that attach air inlet to starter-generator.

Lockwire the four screws (10001-120) that attach air inlet (10001-110) to starter-generator with Lockwire P/N MS20995C32 IAW MS33540.

G. For Models 23080-014 and 23080-013, Attach QAD kit (10001-10) to starter-generator.

(1) Put V-retainer coupling (10005-10) over drive end bearing support assembly.

(2) Put mounting adapter (10005-40) in inner rim of V-retainer coupling (10005-10) and engage QAD adapter's alignment pins (10005-70) in mating holes in drive end bearing support assembly (10001-380).

(3) Torque self-locking nut (10005-20) on T-bolt (10005-30) to 70 lbf.in. (7,9 N·m)

WARNING: DO NOT GET LOCTITE GRADE E AND GRADE N ON YOUR SKIN. IF YOU GET SOME ON YOUR SKIN, FLUSH WITH CLEAN WATER. REFER TO THE APPLICABLE MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION.

WARNING: LOCTITE GRADE E IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(4) Apply Loctite, Grade N primer, followed by Loctite, Grade E, to the threads of the drain or plug fitting (10001-20).

NOTE: Let the Loctite, Grade N primer, dry for a few minutes before applying the Loctite, Grade E.

(5) Thread the drain or plug fitting (10001-20) into the mounting adapter (10005-40). Torque 40 to 60 lbf.in. (4,5 to 6,8 N·m).

13. Preparation for Shipment/Storage

Refer to STORAGE section for shipment/storage instructions.

14. Package the Starter-Generator for Shipment or Storage

Wrap the drive spline with protective paper according to MIL-B-121A, Grade A, Type II, Class 1.

For shipment or storage, seal starter-generator unit in suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

FITS AND CLEARANCES

1. Introduction

A. The following paragraphs provide information for determining the acceptability of fits and clearances of the starter-generator.

B. Examine the parts for damage. Refer to CHECK section, for details.

C. Repair the parts before assembly. Refer to REPAIR section, for details.

D. The acceptance limits for starter-generator components and subassemblies are listed in Paragraph 2.

E. The required torque values to be used during repair and assembly of starter-generator components and attaching parts are listed in Paragraph 3.

2. Component Acceptance Limits

Refer to Table 8001 for starter-generator component and subassembly acceptance limits. Paragraph designations in the CHECK column refer to the applicable inspection procedure found in the CHECK section.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers on the illustration in the ILLUSTRATED PARTS LIST.

CHECK Para. Ref.	Nomenclature and IPL Number	Inspect for...	Acceptance Limits
8.B.	Mounting Adapter (10005-40)	Guide pin height	0.180 to 0.200 inch (4,57 to 5,08 mm)
8.I.	Drive Shaft (10001-210)	Spline diameter	0.757 inch (19,23 mm) min. over two gage pins with a diameter of 0.1094 inch (2,779 mm). This allows wear of approximately 0.0105 inch (0,267 mm) or 50% of the case depth.
8.J.	Friction Ring (10001-230)	Thickness	0.060 inch (1,52 mm) min.
8.K.	Dampener Plate (10001-240)	Thickness	0.038 inch (0,96 mm) min.
		Internal spline diameter	Gage pin dia: 0.090 inch (2,29 mm) Distance between two pins: 0.655 inch (16,637 mm) max.
8.N.	Bearing and Brush Support Assembly (10001-290)	Bearing liner diameter	1.8501 to 1.8504 inch (46,992 to 47,002 mm) See Figure 8002.

Table 8001 - Acceptance Limits

CHECK Para. Ref.	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
8.N.(7)	Brush Spring (10002-130)	Force	Position “A” 3.28 lb (1,5 kg) min. Position “B” 4.00 lb (1,8 kg) max.
8.Q.	Thermal Switch (10001-370)	Actuation	Opens at 300° F (149° C), closes at 330° F (166° C), and reopens at 300° F (149° C).
8.R.	Drive End Bearing Support Assembly (10001-380)	Bearing liner diameter	1.8501 to 1.8504 inch (46,992 to 47,002 mm) See Figure 8002.
8.S.	Speed Pickup (10001-400)	Resistance, lead to ground	Greater than 1 MΩ
		P/N 23072-1400 Resistance between leads	20 to 45 Ω
		P/N 23072-1280 or 23072-1281 Resistance between leads	95 to 137 Ω

Table 8001 - Acceptance Limits (Continued)

CHECK Para. Ref.	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
8.U.	Armature (10001-460)	Bearing Journal Diameter (A, C)	0.7872 to 0.7875 inch (19,995 to 20,003 mm). See Figure 8001.
		Commutator Diameter (B)	2.500 inch (63,50 mm) Min.
		Mica Undercut (Before recut)	Depth: 0.045 inch (1,14 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.035 inch (0,89 mm) to 0.045 inch (1,14 mm).
		Mica Undercut (After recut)	Depth: 0.050 inch (1,27 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.035 inch (0,89 mm) to 0.045 inch (1,14 mm).
		Commutator bar to bar acceptance test values	Bar to Bar: 0.0002 inch (0,005 mm) max. T.I.R: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar (Before refinishing)	Bar to Bar: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar and concentricity (After refinishing)	Bar to Bar: 0.0001 inch (0,0025 mm) max. T.I.R: 0.0005 inch (0,0127 mm) max.
		Balance	5 grain inch (8,2 gr mm) max. (each end).
8.X.	Terminal Block (10004-50)	Capacitance Values B and E Capacitance Values B and Ground	5.1 to 10.5 µF 1.0 µA @ 50 VDC 0.0184 to 0.0264 µF 1.0 µA @ 100 VDC

Table 8001 - Acceptance Limits (Continued)

3. Torque Values

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers on the illustration in the ILLUSTRATED PARTS LIST.

Table 8002 gives information necessary to tighten fasteners to specified torque. Values shown do not include frictional torque caused by self-locking devices or rundown resistance. Frictional torque values must be added to the specified torque.

Nuts, bolts, and screws not listed in Table 8002 are to be tightened in accordance with Safran Power methods and techniques or practices acceptable to your administration as specified in FAR PART 43.

Hardware Description	Torque Acceptance Limits
Plug or Drain Fitting (10001-20)	40.0 to 60.0 lbf.in. (4,5 to 6,8 N·m)
Screw (10001-120)	9.0 to 12.0 lbf.in. (1,0 to 1,4 N·m)
Fillister Head Screw (10001-140)	25.0 to 35.0 lbf.in. (2,8 to 4,0 N·m)
Screw (10001-170)	25.0 to 35.0 lbf.in. (2,8 to 4,0 N·m)
Self-locking Nut (10001-190)	100 to 120 lbf.in. (11,3 to 13,6 N·m)
Self-locking Screw (10001-300)	13.5 to 18.0 lbf.in. (1,53 to 2,03 N·m)
Screw (10001-360)	4.2 to 5.5 lbf.in. (0,47 to 0,62 N·m)
Screw (10001-390)	7.7 to 10.3 lbf.in. (0,87 to 1,16 N·m)
Jam Nut (Part of Speed Pickup) (10001-400)	15.0 to 25.0 lbf.in. (1,7 to 2,8 N·m)
Screw (10001-480)	13.5 to 18.0 lbf.in (1,5 to 2,0 N·m)
Machine Bolt (10002-40)	25.0 to 30.0 lbf.in. (2,8 to 3,4 N·m)
Hex. Head Bolt (10004-60)	22.7 to 35.0 lbf.in. (2,6 to 4,0 N·m)
Self-locking Nut (10005-20)	70 lbf.in. (7,9 N·m)

Table 8002 - Torque Values

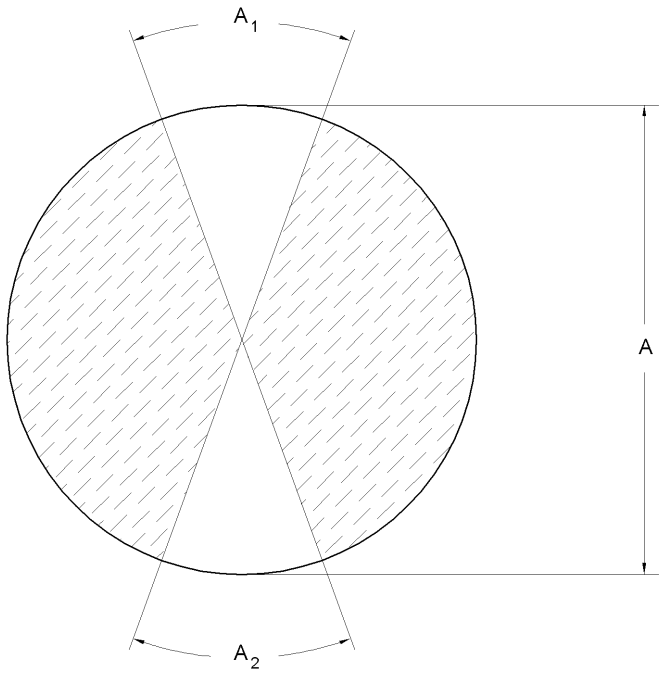


Figure 8001 - Measuring Armature Bearing Journal Diameters

NOTE: During overhaul/service inspection, diameter of bearing journal is considered to be acceptable if not more than 25% of circumference is below the minimum diameter limit (See Figure 8001). When the starter-generator is to be repaired and returned to service on a “continued time” basis, the minimum diameter limit of bearing journal diameter “A” is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) below minimum diameter limit.

NOTE: Acceptance criteria for used journals, not new or repaired journals.

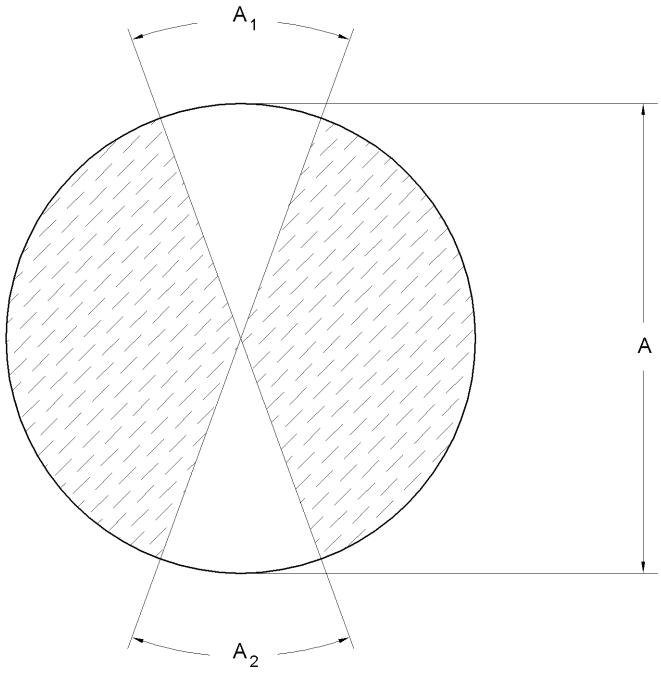


Figure 8002 - Measuring Bearing Liner Diameters

NOTE: During overhaul/service inspection, diameter of bearing liner is considered to be acceptable if not more than 25% of circumference is above the maximum diameter limit (See Figure 8002). When the starter-generator is to be repaired and returned to service on a “continued time” basis, the maximum diameter limit of bearing liner diameter “A” is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) above maximum diameter limit.

NOTE: Acceptance criteria for used liners, not new or repaired liners.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. Introduction

Table 9001 lists the approved special tools, fixtures, and equipment necessary for starter-generator service.

Nomenclature	Figure
Adapter, Armature Shaft (Anti-Drive End)	Figure 9001
Adapter, Armature Shaft (Drive End)	Figure 9002
Adapter, Commutation Viewing	Figure 9003
Driver, Bearing (Inner Race)	Figure 9004
Driver, Bearing (Outer Race)	Figure 9005
Driver, Dampener Hub	Figure 9006
Driver, Dampener Plate	Figure 9007
Fixture, Commutator Turning	Figure 9008
Fixture, Rivet Alignment and Press	Figure 9009
Plug, Speed Pickup Adjustment (for use on starter-generators without bearing pre-load feature)	Figure 9010
Plug, Speed Pickup Adjustment (for use on starter-generators with bearing pre-load feature)	Figure 9011
Support, Armature	Figure 9012
Support, Bearing and Brush Support Assembly	Figure 9013
Support, Anti-Drive End Hub	Figure 9014
Supports, Drive End Bearing Hub (inboard and outboard)	Figure 9015
Support, Horizontal Stator	Figure 9016
Support, Vertical Stator	Figure 9017
Support, Vertical Shaft	Figure 9018
Wrench, Spline	Figure 9019
PlusNut® Fastener Header	Figure 9020
Dampener Plate Gauge Tool, P/N 19-601076	Figure 9021

Table 9001 - Special Tools, Fixtures and Equipment

2. Tool Descriptions and Fabrication Instructions

The drawings in this section provide material and fabrication instructions for the tools listed in Table 9001. Where dimensions and fabrication instructions are provided, the tool or fixture is approved for local manufacture. Unless otherwise specified all measurements are in inches followed by metric equivalents. The tools and fixtures cannot be procured from Safran Power. Equivalent tooling and fixture requirements meeting with Safran Power specifications can be used.

A. Armature Shaft Adapters. See Figure 9001 and Figure 9002.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Materials: Brass.

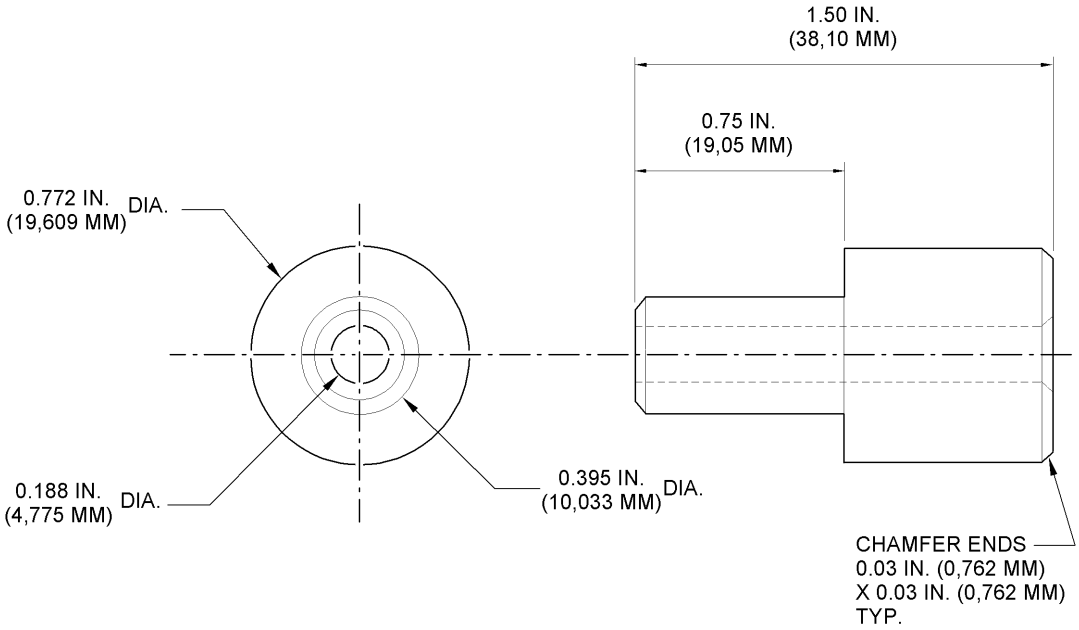


Figure 9001 - Anti-Drive End Armature Shaft Adapter

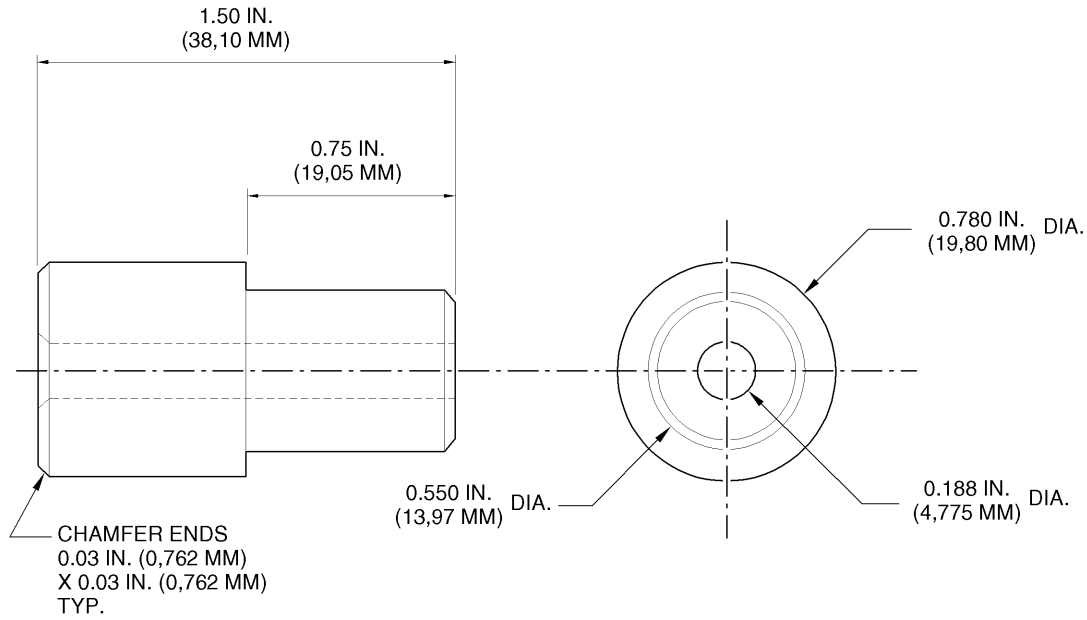


Figure 9002 - Drive End Armature Shaft Adapter

B. Commutation Viewing Adapters. See Figure 9003.

This adapter is constructed using a used brush access cover. Two designs are shown. Design one uses four pieces of acrylic, 2.00 inch (50,8 mm) high by 1.75 inch (44,5 mm) wide by 0.063 inch (1,60 mm) thick. Design two uses one piece of acrylic, 19.00 inch (482,6 mm) long by 2.60 inch (66,0 mm) by 0.125 inch (3,18 mm) thick. Construction of these designs is as follows:

(1) Design One

(a) Cut four holes in a brush access cover. Each hole should be positioned above one of the four brush holder assemblies to allow for viewing the brushes as they make contact with the commutator during test.

(b) Cut four pieces of clear acrylic to be larger than the brush access holes in the stator and housing assembly.

(c) Apply adhesive on the inside surface of the viewing adapter to the frame of the cut out viewing windows.

(d) Attach the four pieces of acrylic to the viewing windows on the inner surface of the viewing adapter using four pop rivets.

(2) Design Two

(a) Remove the brackets from a used brush access cover.

(b) Attach the brackets to a piece of clear acrylic.

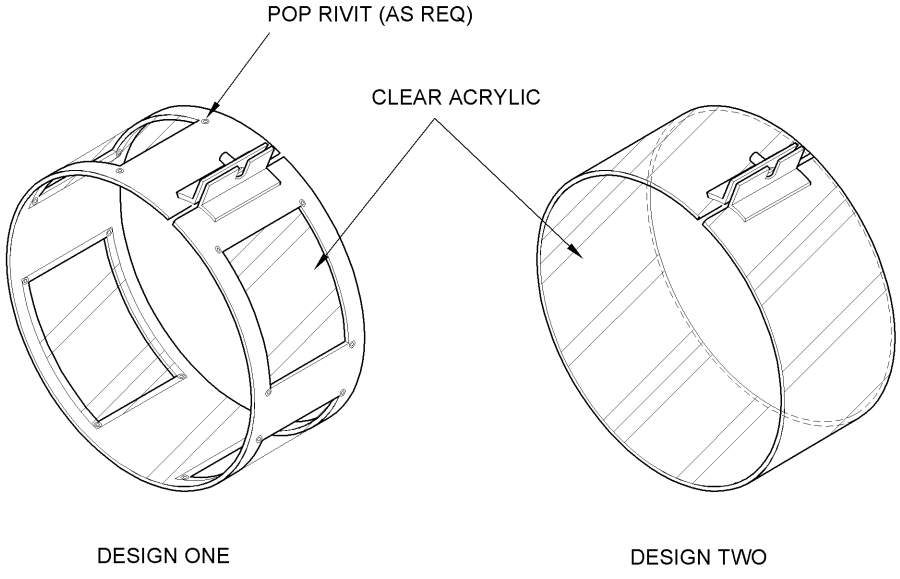


Figure 9003 - Commutation Viewing Adapter

C. Bearing Drivers. See Figure 9004 and Figure 9005.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell Rc 55-60. Material: 1040 Steel, 2.00 inch (50,8 mm) diameter stock size.

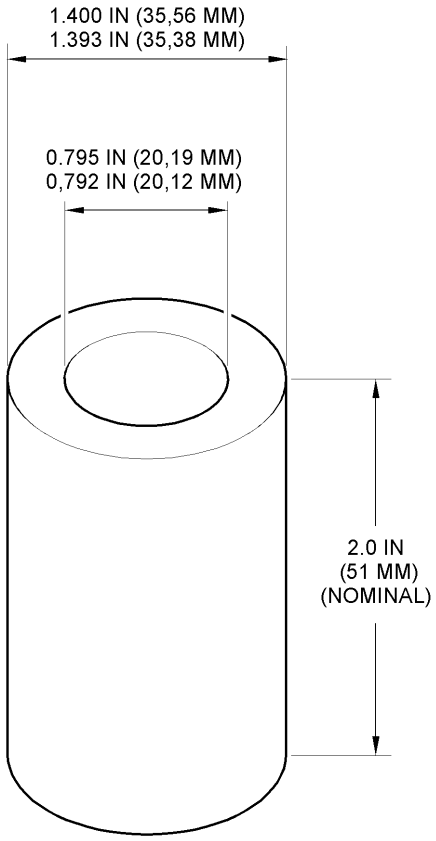


Figure 9004 - Inner Race Bearing Driver

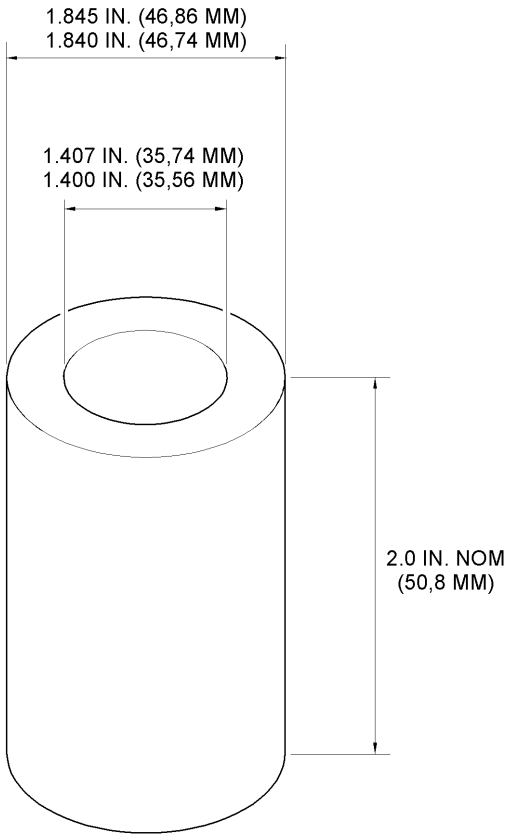


Figure 9005 - Outer Race Bearing Driver

D. Dampener Hub Driver. See Figure 9006.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Material: 1040 Steel.

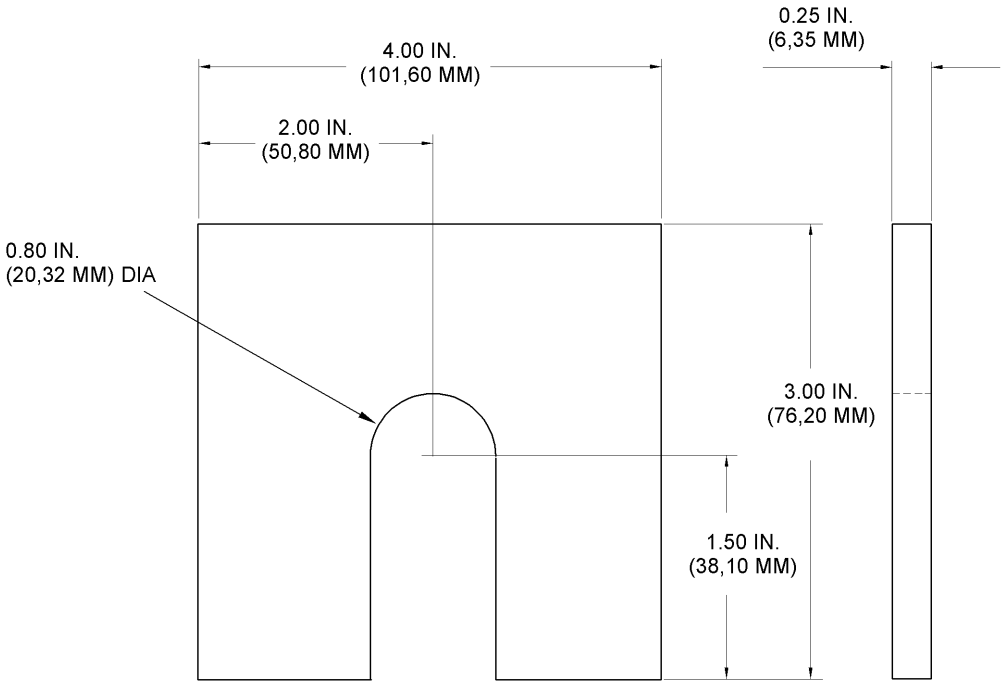


Figure 9006 - Dampener Hub Driver

E. Dampener Plate Driver. See Figure 9007.

Harden to Rockwell Rc 55-60.

Material:	01 tool steel or equivalent
Stock Size:	3.0 inch diameter (76,2 mm)
Tolerances on:	Decimals 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm)
Angles:	± 1 Degrees

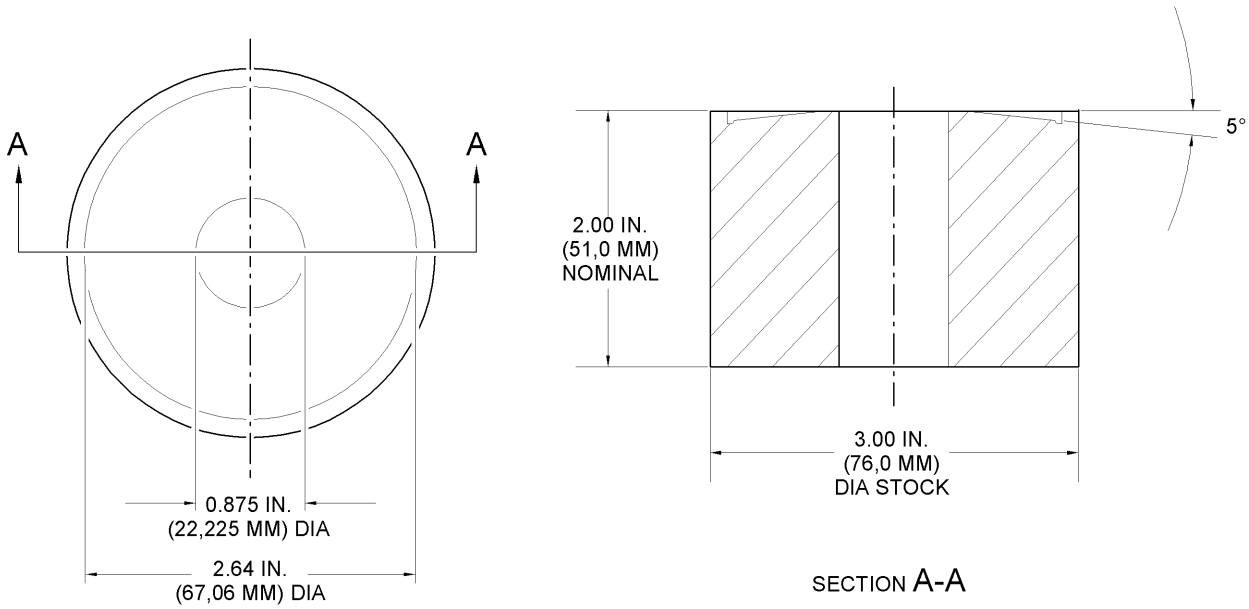


Figure 9007 - Dampener Plate Driver

F. Commutator Turning Fixture. See Figure 9008.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell Rc 35-40. Material: 1040 Steel, Stock size: 2.50 inch (63,5 mm) diameter.

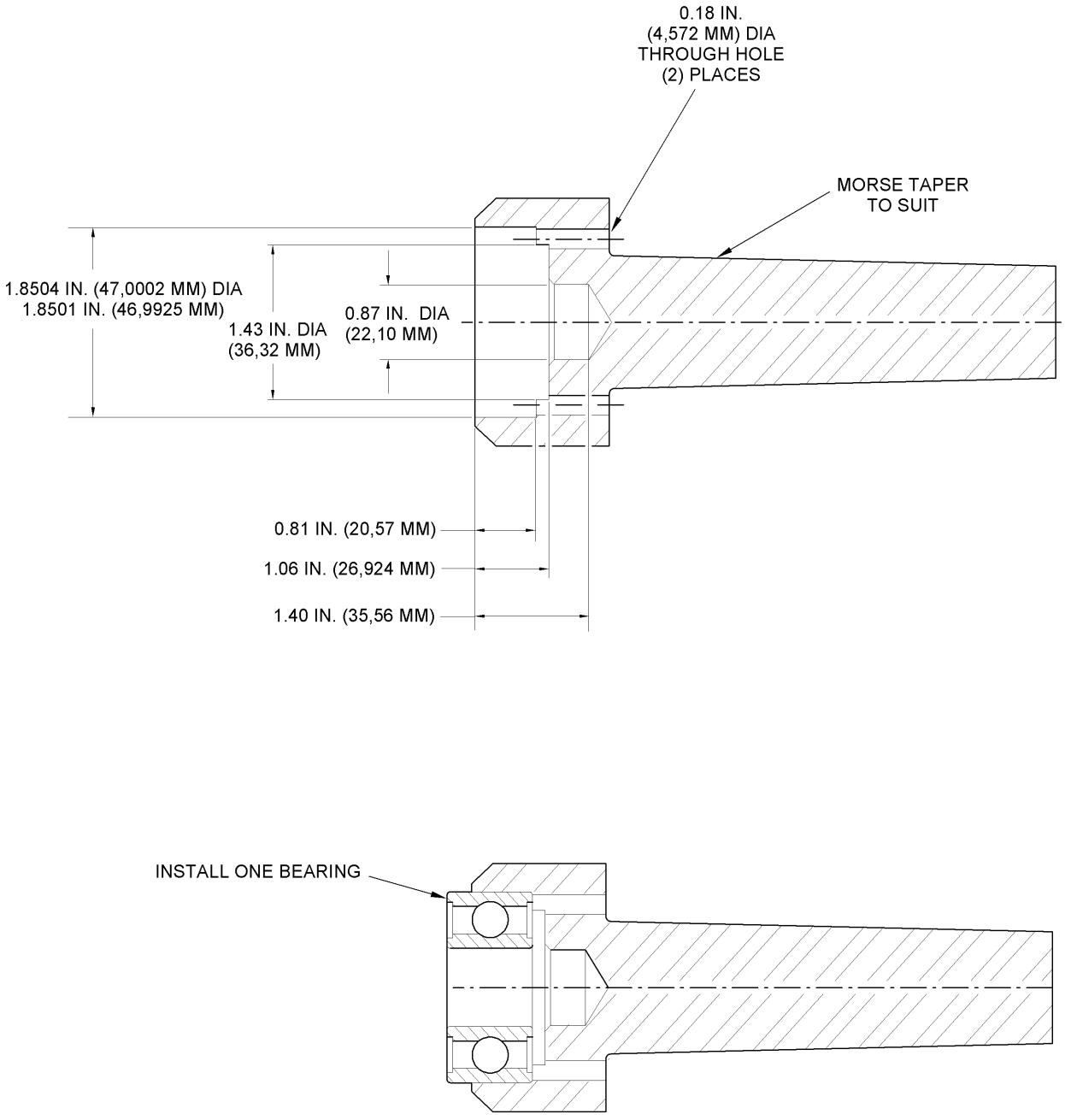


Figure 9008 - Commutator Turning Fixture

G. Rivet alignment and Press Fixture. See Chart below and Figure 9009

Tolerances on: Decimals 0.XX ± 0.01 inch (± 0,3 mm)
0.XXX ± 0.005 inch (± 0,13 mm)

Angles ± 5 Degrees

Materials:

Item	Qty	Dimensions	Description
1	1	0.50 inch (12,7 mm) x 5.00 inch (127,0 mm) x 5.00 inch (127,0 mm)	1010 Cold Roll Steel
2	1	0.75 inch (19,05 mm) x 3.00 inch (76,2 mm) x 3.00 inch (76,2 mm)	1010 Cold Roll Steel
3	1	0.50 inch (12,7 mm) x 2.50 inch (63,5 mm) x 2.50 inch (63,5 mm)	1010 Cold Roll Steel
4	1	0.188 inch (4,76 mm) Dia x 1.750 inch (44,45 mm) Long	O1 Tool Steel, Drill Rod
5	2	0.625 inch (15,88 mm) Dia x 1.750 inch (44,45 mm) Long	O1 Tool Steel, Drill Rod
6	2	0.190 inch (4,83 mm) -24	Screw, Cap, Socket Head
7	3	0.250 inch (6,35 mm) -20	Screw, Cap, Socket Head
8	1	1.50 inch (38,1 mm) Dia x 4.13 inch (104,9 mm) Long	A2 Tool Steel, Harden to Rockwell C 55-60

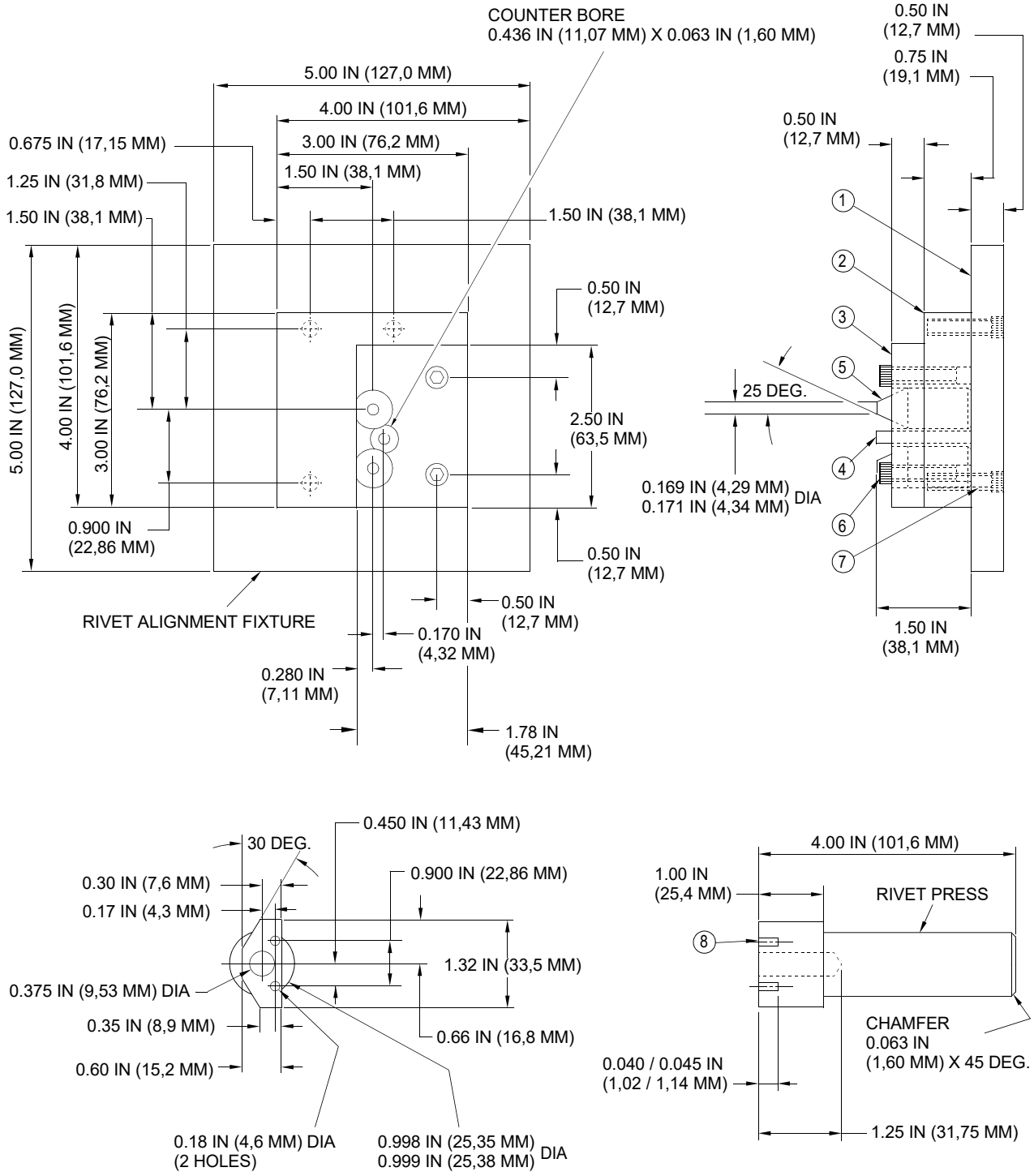


Figure 9009 - Rivet Alignment and Press Fixture

H. Speed Pickup Adjustment Plug. See Figure 9010 and Figure 9011.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Ground diameters must be concentric to within 0.0005 inch (0,0127 mm) TIR. Material: 1040 Steel hardened Rc 35-40, Stock size - 2.00 inch (50,8 mm) diameter.

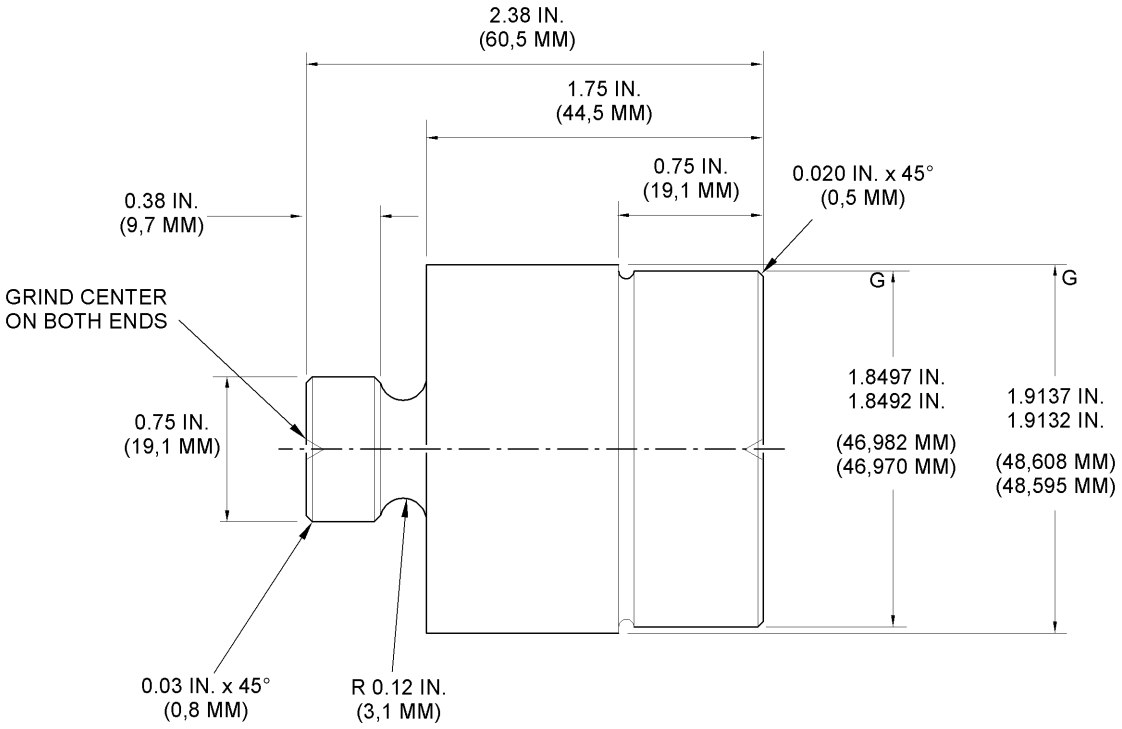


Figure 9010 - Speed Pickup Adjustment Plug (for use with spur gear P/N 23072-1221)

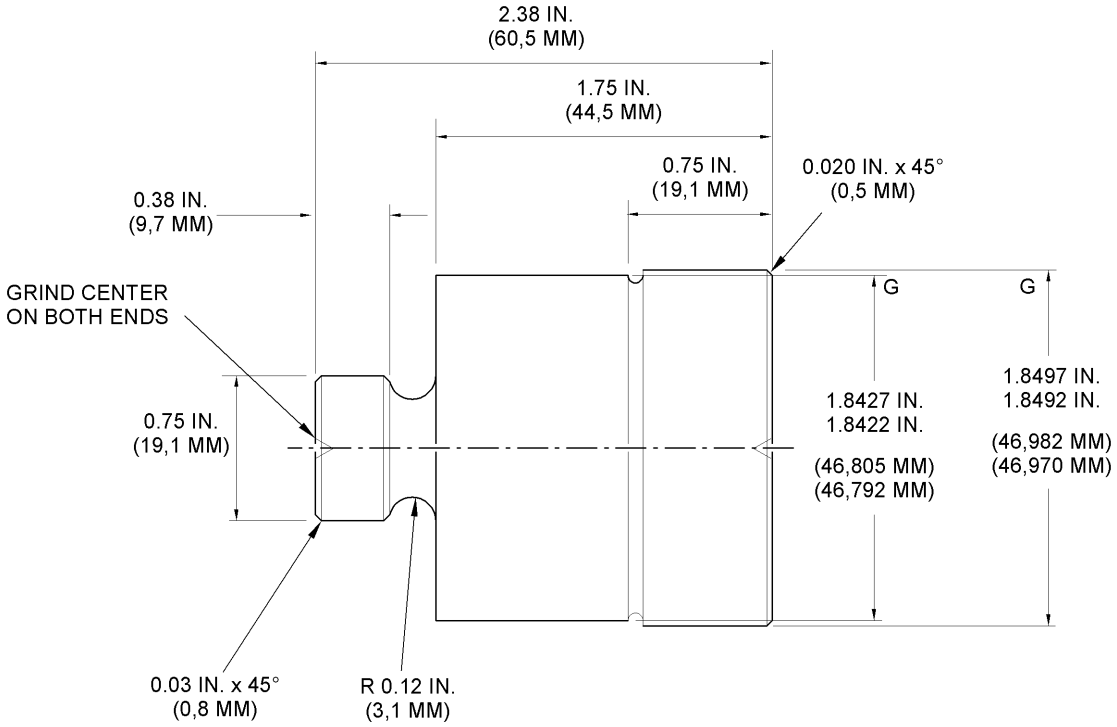


Figure 9011 - Speed Pickup Adjustment Plug (for use with spur gear P/N 23072-1220)

I. Armature Support. See Figure 9012.

Material 0-1 tool steel, Rc 35-40. Tolerances on decimal 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm).

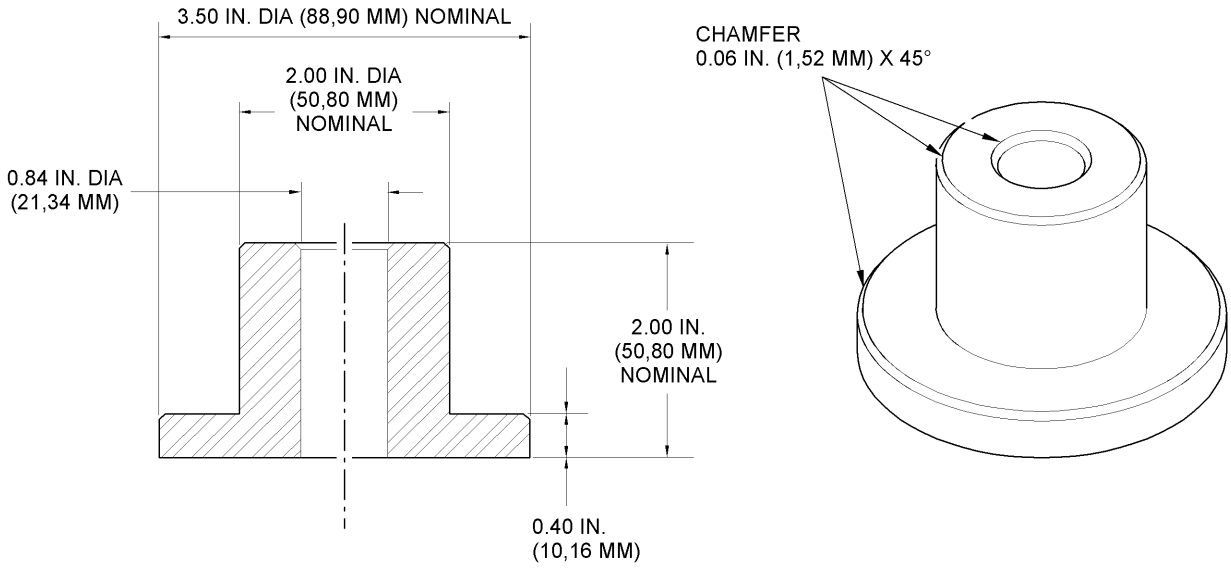


Figure 9012 - Armature Support

J. Bearing and Brush Support Assembly Support. See Figure 9013.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Angles ±2°0'. Material is 1040 Steel, Stock size: 6.00 inch (152,4 mm) diameter.

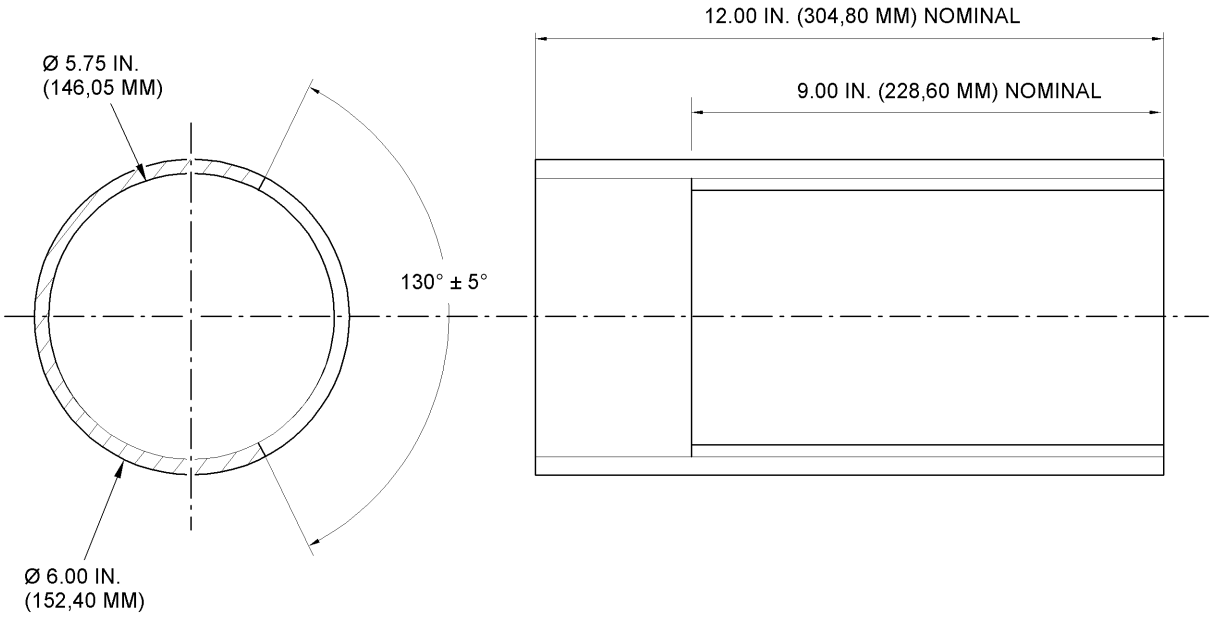


Figure 9013 - Bearing and Brush Support Assembly Support

K. Anti-Drive End Bearing Hub Support. See Figure 9014.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Material is 1040 Steel hardened to Rc 35 - 40, Stock size: 2.50 inch (63,5 mm) diameter.

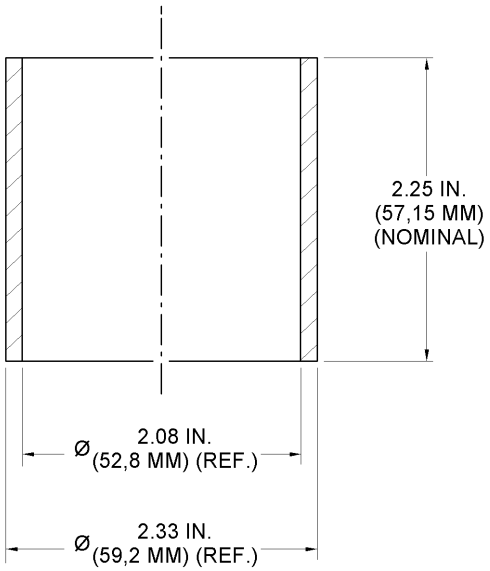


Figure 9014 - Anti-Drive End Bearing Hub Support

L. Drive End Bearing Hub Supports (Inboard and Outboard). See Figure 9015.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Angles ±2°0'. Material is 1040 Tool Steel hardened to Rc 35 - 40, Stock size: 2.50 inch (63,5 mm) diameter.

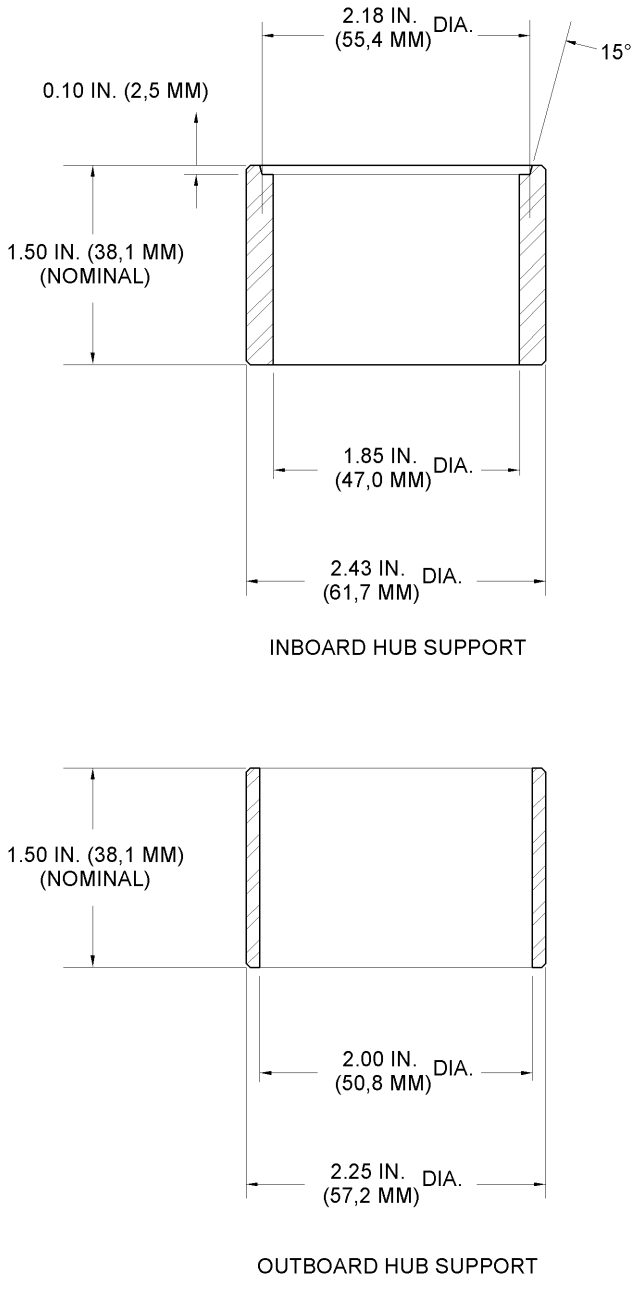


Figure 9015 - Drive End Bearing Hub Supports (Inboard and Outboard)

M. Horizontal Stator Support. See Figure 9016.

All dimensions are nominal. The material is any suitable hardwood.

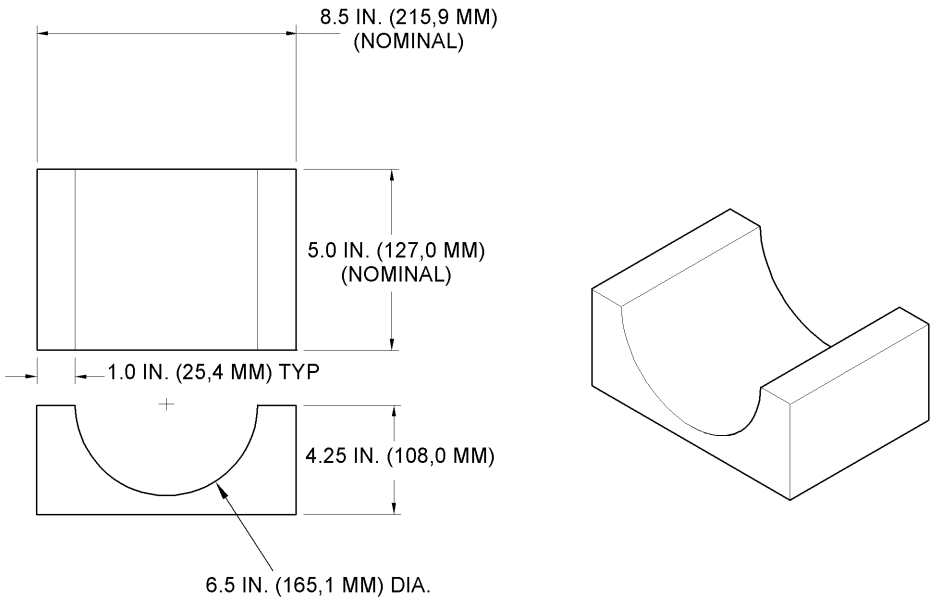


Figure 9016 - Horizontal Stator Support

N. Vertical Stator Support. See Figure 9017.

All dimensions are nominal. The material is any suitable hardwood.

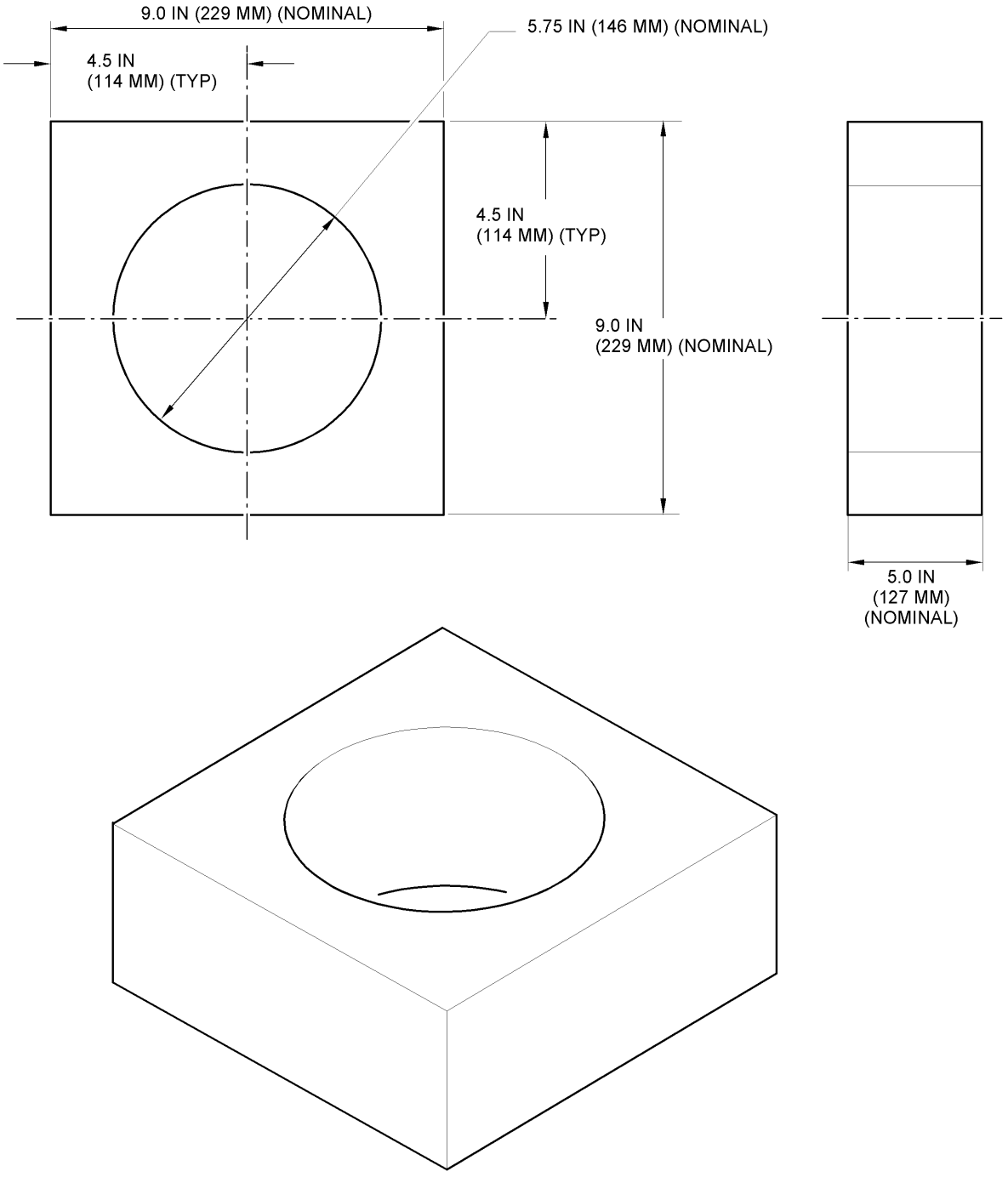


Figure 9017 - Vertical Stator Support

O. Vertical shaft support. See Figure 9018.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm).
Material: AISI-01 tool steel or equivalent, Stock size: 7.00 inch (177,8 mm) diameter.

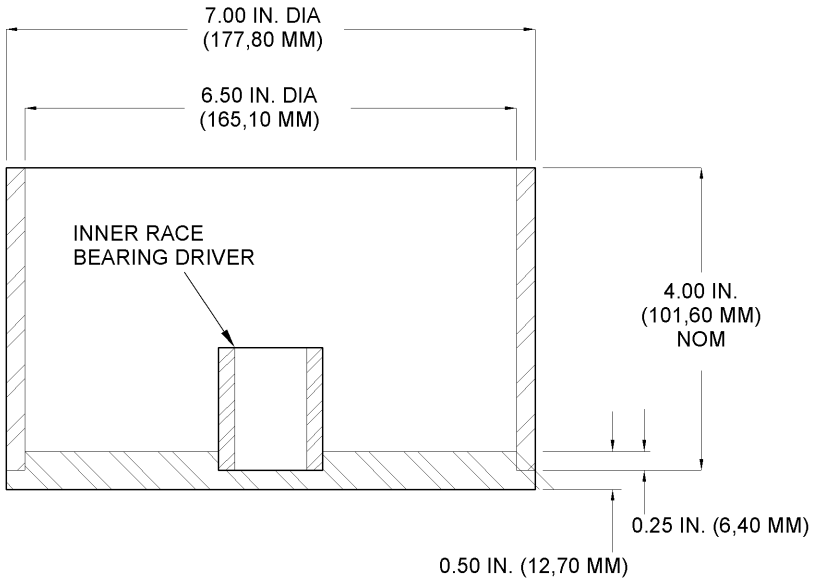
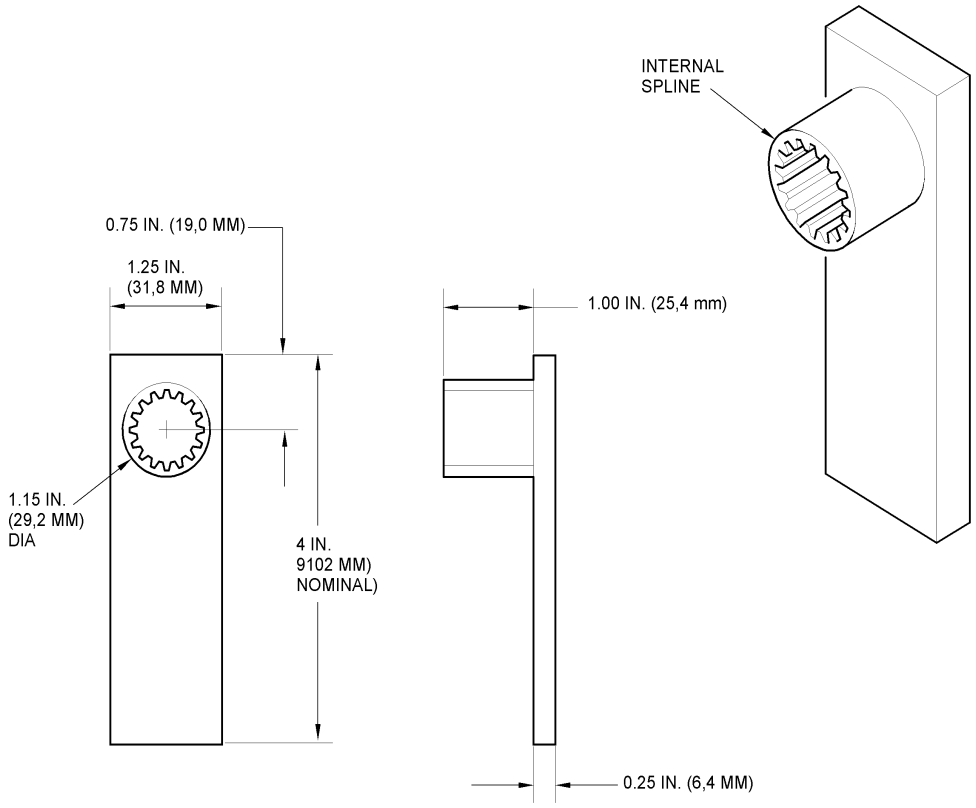


Figure 9018 - Vertical Shaft Support

P. Spline Wrench. See Figure 9019.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Angles ±2°0'. Material is 1040 Steel, Stock size: 1.0 inch (25,4 mm) diameter, 4.00 inch (102,0 mm) long x 1.25 inch (31,75 mm) wide.



12 TOOTH SPLINE

INTERNAL INVOLUTE SPLINE DATA FILLET ROOT SIDE FIT	INCH	MM
NUMBER OF TEETH	12	
DIAMETRAL PITCH	20/40	
PRESSURE ANGLE	30°	
PITCH DIAMETER	0.6000	15,240
MINOR DIAMETER (MIN)	0.5550	14,097
MAJOR DIAMETER (MIN)	0.6500	16,510
CHORD SPACE (MIN)	0.0730	1,853
PIN DIAMETER	0.0720	1,829
BETWEEN THREE 0.0720 IN (1,829 MM) PINS (MIN)	0.5095	12,941

Figure 9019 - Spline Wrench

Q. PlusNut® Fastener Header. See Figure 9020.

NOTE: For rivet nut replacement - Reference REPAIR section.

Part Number: C1000-1032

Vendor Cage Code: V 0ZVN9

Reference ILLUSTRATED PARTS LIST section for Vendor CAGE Code name and address for tool procurement.

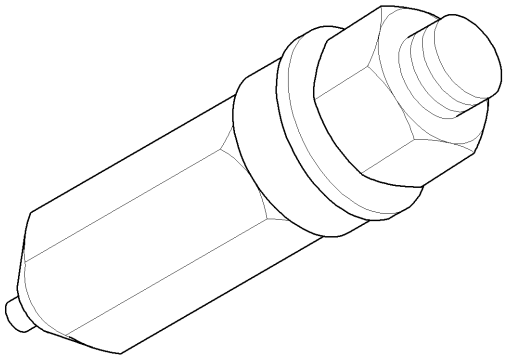
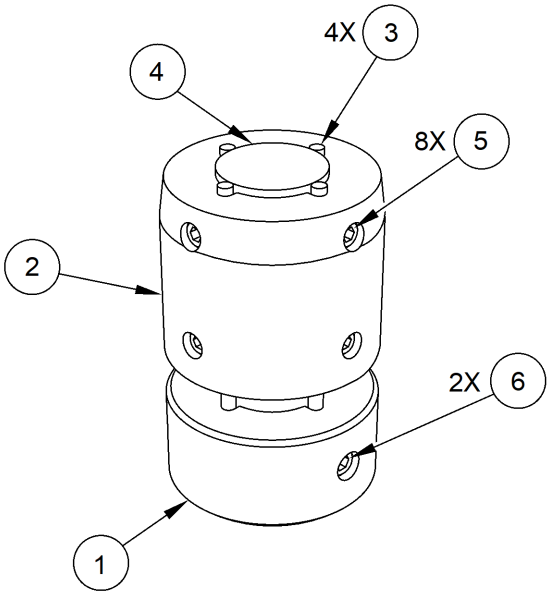


Figure 9020 - PlusNut® Fastener Header

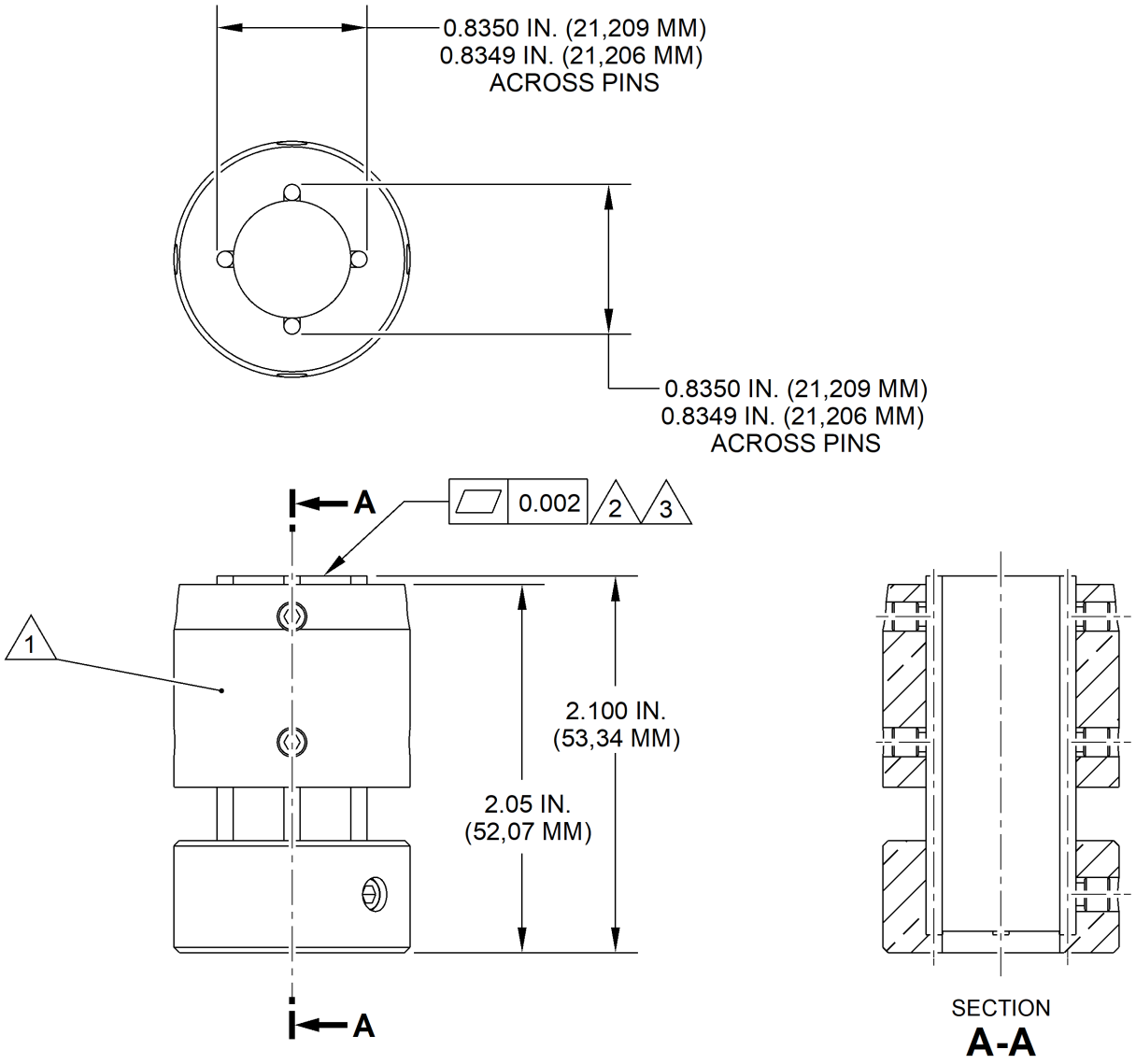
R. Dampener Plate Gauge Tool. See (Figure 9021)

NOTE:)To check the splines of the dampener plate - Reference CHECK section.



ITEM	PART	MATERIAL	QTY.
1	BOTTOM COLLAR, KNURLED	W1 TOOL STEEL OR O1 TOOL STEEL	1
2	TOP COLLAR	W1 TOOL STEEL OR O1 TOOL STEEL	1
3	CLASS X GAUGE PIN, Ø 0.0900 IN. (2,286 MM) X 2.00 IN. (50,8 MM) LENGTH	TOOL STEEL	4
4	CLASS X GAUGE PIN, Ø 0.6550 IN. (16,637 MM) X 2.00 IN. (50,8 MM) LENGTH	TOOL STEEL	1
5	#8-32 UNC-3A X 3/16 SET SCREW	STEEL	8
6	#10-24 UNC-3A X 3/16 SET SCREW	STEEL	2

Figure 9021 - Dampener Plate Gauge (P/N 19-601076) (Sheet 1 of 4)



NOTES:

1. MARK TOOL WITH PART NUMBER 19-601076 APPROXIMATELY WHERE SHOWN.
2. WHEN ASSEMBLED, FACES OF ITEMS ④ AND ITEM ③ SHALL MEET REQUIREMENT.
3. DIAMOND KNURL FINISH ITEM ① ON SURFACE INDICATED.

Figure 9021 - Dampener Plate Gauge (P/N 19-601076) (Sheet 2 of 4)

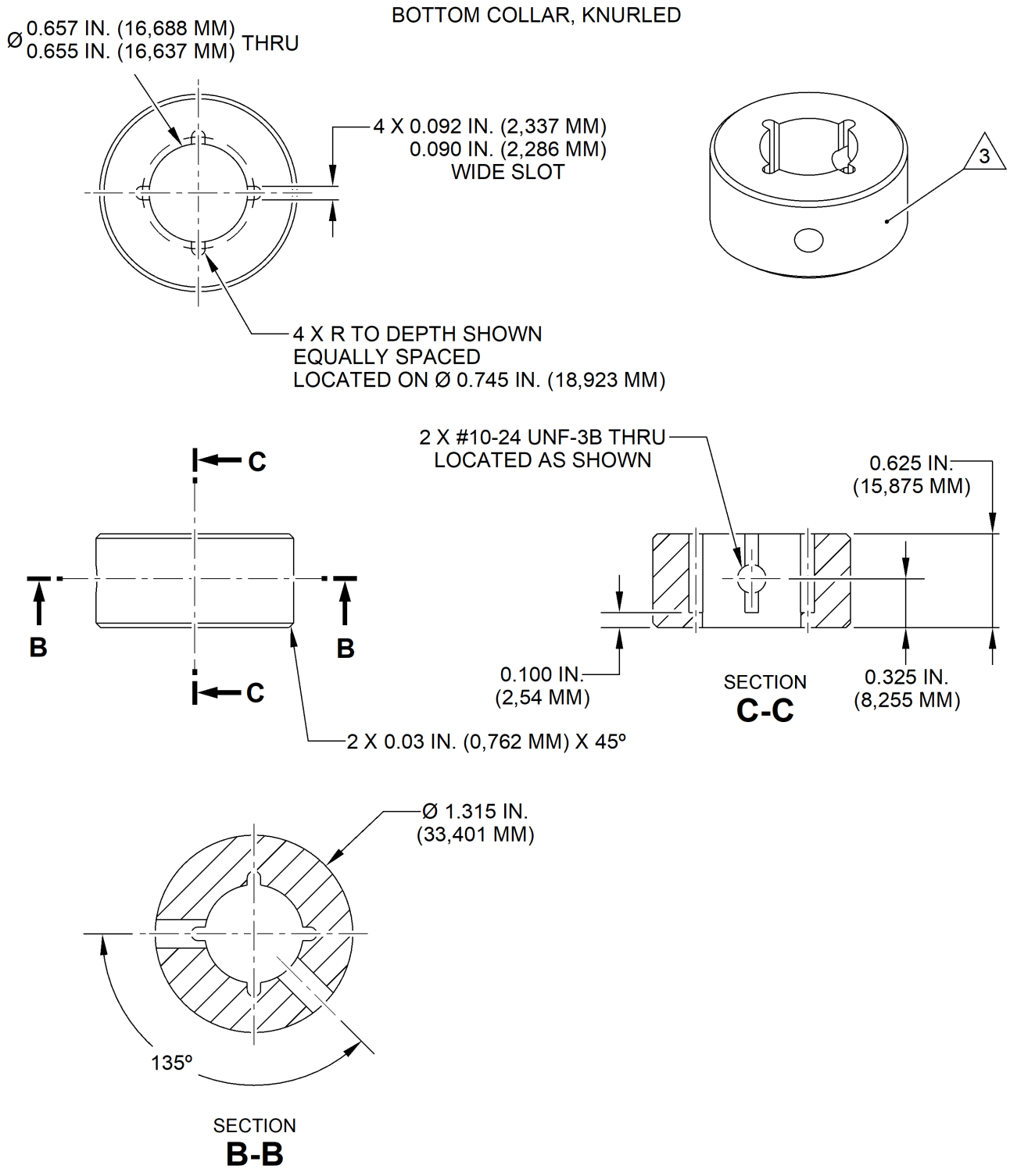


Figure 9021 - Dampener Plate Gauge (P/N 19-601076) (Sheet 3 of 4)

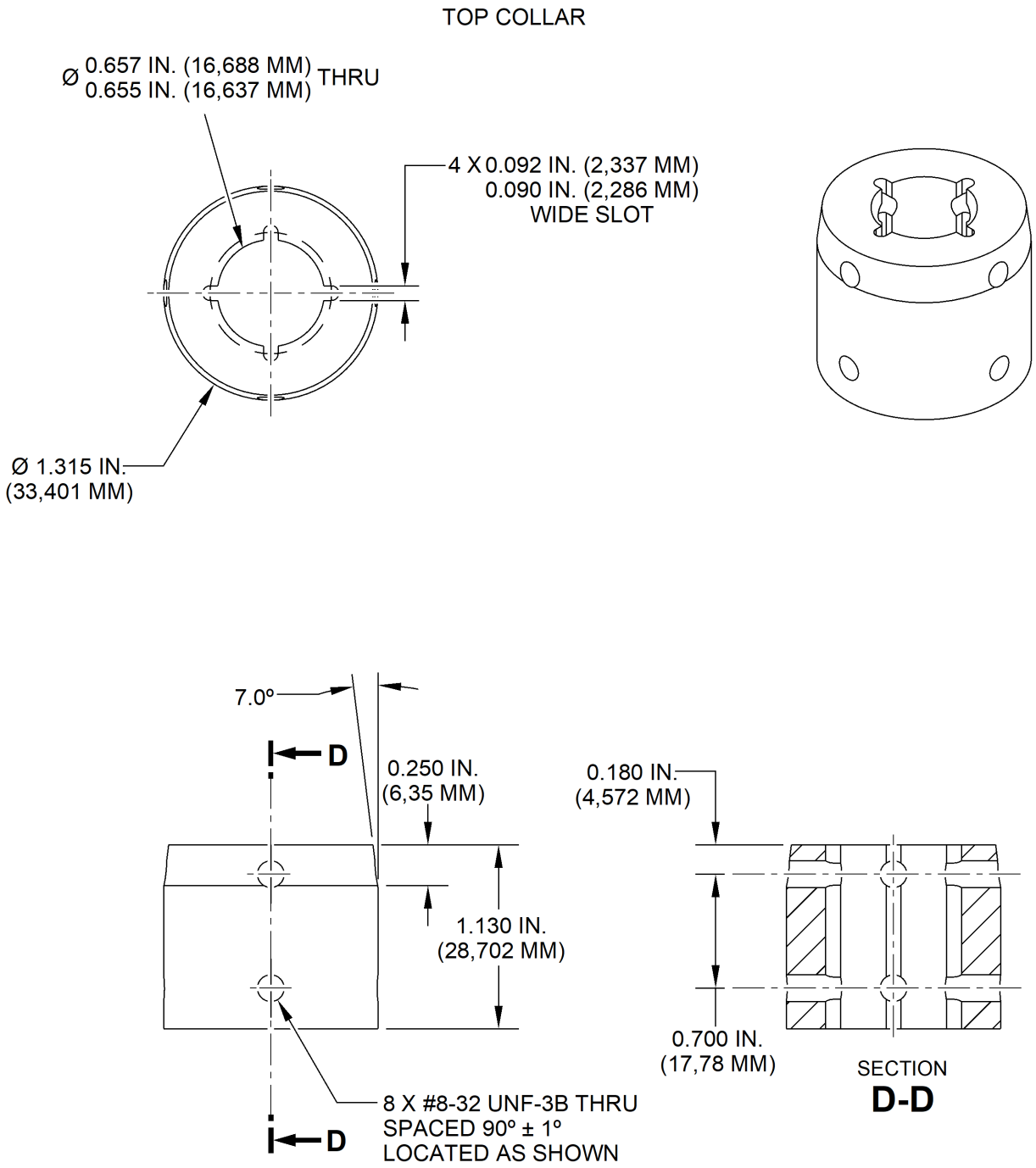


Table 9021 - Dampener Plate Gauge (P/N 19-601076) (Sheet 4 of 4)

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ILLUSTRATED PARTS LIST

1. Introduction

This section contains a listing of assemblies and detail parts for 23080 Series III DC Starter-Generators. All parts are listed, except for parts which lose their identities by being permanently fastened to other parts or are part of an assembly not subject to disassembly. Each list is arranged in disassembly sequence, except that attaching parts are listed immediately after the parts they attach, under the heading of (ATTACHING PARTS).

All replacement parts are manufactured or source-controlled by Safran Power with the exceptions listed in Paragraph 2.B.

CAUTION: DO NOT USE PARTS, MATERIALS OR PROCEDURES NOT APPROVED BY SAFRAN POWER. IF YOU DO, YOU WILL INVALIDATE THE CONTINUED FLIGHT WORTHINESS OR CERTIFICATION OF THE STARTER-GENERATOR.

To order authorized Safran Power parts, contact your regional Safran Power Customer Service Center.

2. Arrangement of Parts List

A. Figure and Item Number

The figure number indicates the figure where the part is illustrated. Each item number corresponds to a part illustrated in the applicable figure. Several item numbers can have a letter following a number (e.g. 10 A). This indicates that the part has the same function and location as the base number (e.g. 10), but can be different in form and material. An item number that is preceded by a dash (e.g. -30) is not illustrated in the applicable figure.

B. Part Number

The part numbers listed in this column are the only authorized parts for replacement and overhaul of the starter-generator. Part numbers in this IPL consists mainly of Safran Power part numbers, and does include Military Standard (MS), Army Navy (AN), National Aerospace Standard (NAS) and industry standard (ANSI, ASME, ISO, etc.) part numbers unless a Commercial and Government Entity (CAGE) code appears in the Nomenclature column. Refer to Paragraph 3. for details.

C. Nomenclature

The proper name and type of each part is provided in this column. The description of each item is indented by columns to indicate the relationship to the next higher assembly. The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

(1) The description of each item is indented by columns to indicate the relationship to the next higher assembly (NHA). Each listed item is placed in the NOMENCLATURE column one indenture (one dot) to the right of the assembly to which it belongs. Items at equal indentures are all components of a single assembly or subassembly. The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

1 2 3 4 5
Assembly, level 1, no bullets
Detail Parts for Assembly, level 2, 1 bullet
Sub-Assembly, level 3, 2 bullets
Attaching Parts for Sub-Assembly, level 4, 3 bullets
Detail Parts for Sub-Assembly, level 5, 4 bullets

The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. The abbreviations used to show this are as follows:

ALT	One of the two part numbers may be used. If the part number in the Nomenclature column is NOT specified as 'ALT', it may not be used as an alternative. The information is for reference only or as a way to help identify the part.
OPT	Optional. The part is fully interchangeable in form, fit and function with the subject part number. This gives an alternative part for procurement and support functions.
PRFD	Preferred. The part is the preferred part to the other optional parts shown.
REPLD BY	Replaced by. The part is replaced by and interchangeable with the item number shown.
REPLS	Replaces. The part replaces and is interchangeable with the item number shown.
SUPSD BY	Superseded by. The part is replaced by and is not interchangeable with the item number shown.
SUPSDS	Supersedes. The part replaces and is not interchangeable with the item number shown.

D. Effect Code

This column establishes part relationships with starter-generator models, which are essentially the same, but have minor variations. These starter-generator models are the end items on the detailed parts list and are assigned reference letters such as A, B, C, D, etc. Subassemblies or detail parts, which are not common to all configurations, but are associated with one or more of the coded end items, carry the letter or letters assigned to the end item(s) with which they are associated. When parts are used on all models, the column is left blank. Effectivity codes are redefined for each major subassembly figure.

E. Units Per Assembly

The numbers listed in this column indicate the quantity of parts used per assembly at the location shown and are not necessarily the total quantity per unit. For bulk items, the abbreviation AR is used to indicate the part quantity is "as required". The abbreviation NP indicates non-procurable and refers to items which are not procurable and may not be ordered. The abbreviation RF indicates that the item is listed for reference only.

3. Vendors

In the case of an item supplied by a vendor and not listed under the prime manufacturer's part number, a vendor CAGE code is prefixed by the capital letter V appearing in the nomenclature column. This CAGE code number designates the original manufacturer of non-Safran Power components, and is in accordance with Cataloging Hand Books H4-1, H4-2, and H4-3. CAGE codes are listed in the NOMENCLATURE column, except for the government codes below, which are not listed:

V80205	National Aircraft Standard (prefix NAS)
V81349	Military Specifications (prefix M)
V88044	Army/Navy Standard (prefix AN)
V96906	Military Standard (prefix MS)

The Customer Support division in your region is to be contacted for parts dispatch.

VENDOR CODE	NAME AND ADDRESS
0LAX1	National Paper & Packaging Co. 1240 E. 55th Street Cleveland, OH 44103 www.nationalpaper.com
0PYJ1	Ellsworth Adhesives P.O. Box 1002, W129 N10825 Washington Dr. Germantown, WI 53022-8202 Ph: 1-800-888-0698 Fax: 1-262-253-8619 www.ellsworth.com
0SR97	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 Fax: (718) 932-4345 www.humiseal.com
0S8S8	Enviro Tech International Inc Alameda, CA 94501 www.ensolv.com
0ZVN9	Omni Fasteners Inc. DBA Fastener Distributor 909 Towpath Road Broadview Heights, OH Ph: 1-440-838-1800 Fax: 1-440-838-6200
03053	Klueber Lubrication Londonderry, NH Ph: (603) 647-4104 www.klueber.com

VENDOR CODE	NAME AND ADDRESS
1DS07	Saint Gobain New Haven CT Ph: 1-203-777-3631 www.saint-gobain.com/us
1N6B3	Henkel Surface Technologies Madison Heights, MI Ph: (248) 583-9300 Fax: (248) 583-2976
7V827	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com
72688	John C. Dolph Company Monmouth, NJ Ph: (732) 329-2333 Fax: (732) 329-1143 www.dolphs.com
8W674	Titanium Finishing Company East Greenville, PA Ph: (215) 679-4181 Fax: (215) 679-2399 www.titaniumfinishing.com
94058	The Brulin Corporation Indianapolis, IN Ph: (317) 923-3211 Fax: (317) 925-4596 www.brulin.com

4. NOTES:

NOTE 1: The 23080-013 starter-generator is not supplied with a QAD kit or air inlet.

NOTE 2: The 23080-013A starter-generator is not supplied with a QAD kit or air inlet. QAD kit P/N 23080-523 and air inlet P/N 23065-1347 must be ordered separately.

NOTE 3: The 23080-013B starter-generator is not supplied with a QAD kit or air inlet.

NOTE 4: The 23080-014 starter-generator consists of a 23080-013 starter-generator, P/N 23080-505 QAD kit, P/N 23080-1450 drain fitting and P/N 23065-1341 air inlet. It is identified as a model 23080-013 starter-generator although this IPL lists it as a distinct unit.

NOTE 5: The 23080-014A starter-generator consists of a 23080-013 starter-generator, P/N 23080-505 QAD kit and a P/N 23080-1630 plug fitting. It is identified as a model 23080-013 starter-generator although this IPL lists it as a distinct unit.

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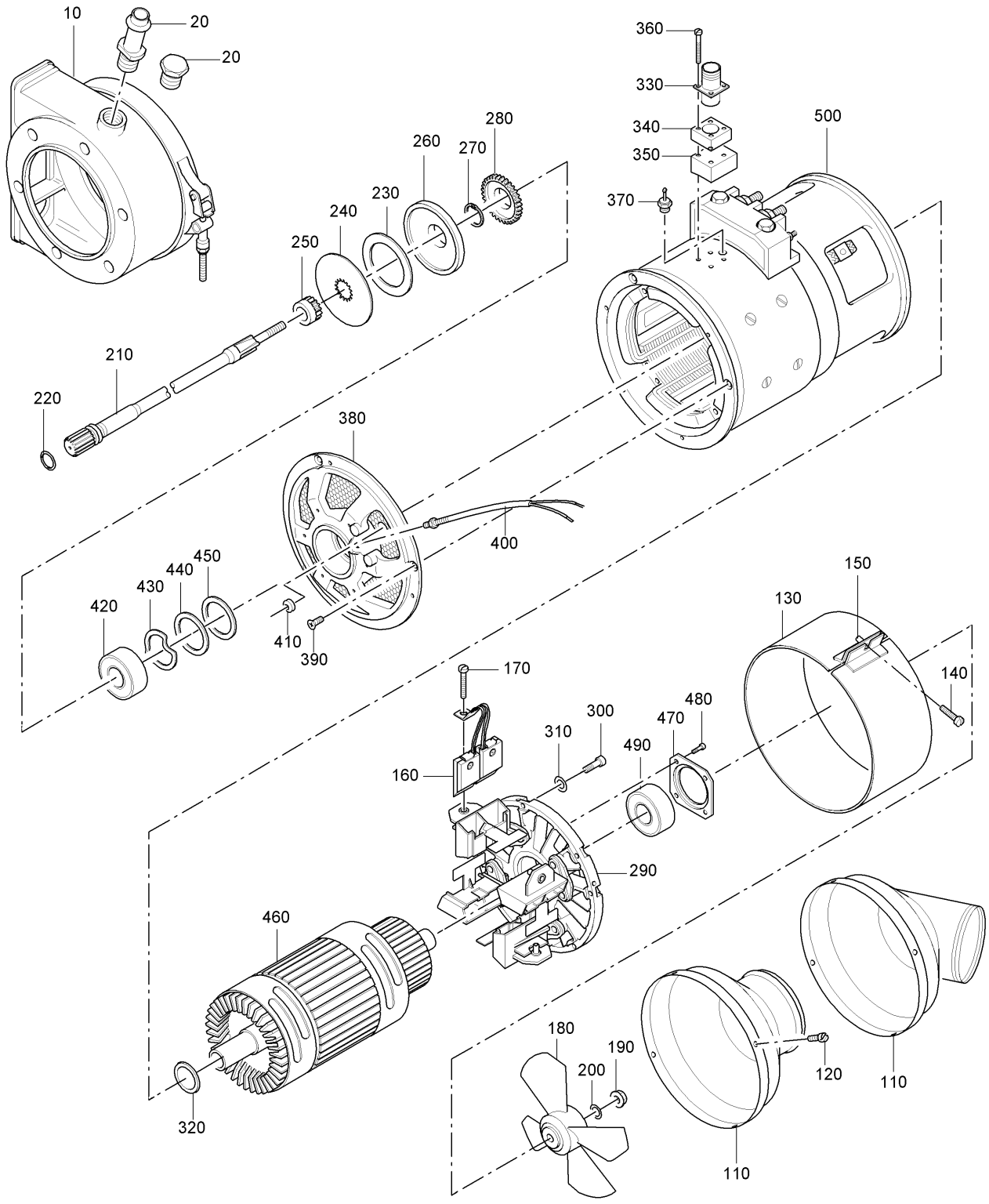

Figure 10001 - DC Starter-Generator

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
	23080-013	DC STARTER-GENERATOR. . . . . (See Note 1)	A	RF
	23080-013A	DC STARTER-GENERATOR. . . . . (See Note 2)	B	RF
	23080-013B	DC STARTER-GENERATOR . . . . . (See Note 3)	C	RF
	23080-014	DC STARTER-GENERATOR . . . . . (See Note 4)	D	RF
	23080-014A	DC STARTER-GENERATOR . . . . . (See Note 5)	E	RF
10	23080-523	• KIT, QAD (Quick-Attach-Detach), ... Mounting (SEE Figure 10005 FOR DETAILS)	B	1
	23080-505	• KIT, QAD, Mounting . . . . . (SEE Figure 10005 FOR DETAILS)	D,E	1
-20	23080-1630	• FITTING, Plug.	E	1
	23080-1450	• FITTING, Drain	D	1
-30	06-209284	• IDENTIFICATION PLATE, Replacement REPLD BY 06-209285	A,D,E	RF
	06-209285	• IDENTIFICATION PLATE, Replacement REPLS 06-209284	A,D,E	1
	06-209285	• IDENTIFICATION PLATE, Replacement	B,C	1
		(ATTACHING PARTS)		
-40	MS21318-13	• SCREW, Drive		4
		---------- * ----------		
-50	06-201100	• LABEL, Modification Status . . . . . SUPSD BY 06-209284/06-209285		1
-60	06-201020	• DECAL, Caution.		1
-70	06-200001	• LABEL, Patent		1
-80	06-201123	• LABEL, TSO.	B,C	1
-90	23069-1241	• COVER, Terminal Block		1
		(ATTACHING PARTS)		
-100	NAS1189-06P14L	• SCREW . . . . . ALT: 05-350108		2
		---------- * ----------		
110	23065-1347	• INLET, Air (See Note 2)	B	1
	23065-1341	• INLET, Air (See Note 4)	D	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		(ATTACHING PARTS)		
120	MS35265-43	• SCREW	B,D	4
		---------- * ----------		
130	23075-1021	• COVER, Brush Access.		1
		(ATTACHING PARTS)		
140	AN502-10-14	• • SCREW, Mach, Fillister Head.		1
150	NAS1329H3K130L	• • NUT, Blind Rivet, Self-locking		1
		---------- * ----------		
160	30300-1296	• BRUSH, Electrical . . . . . SUPSD BY 23080-1902	A,D,E	RF
	23080-1902	• BRUSH, Electrical . . . . . (MOD F) SUPSDS 30300-1296, Refer to SB 23080-01X-24-03, SUPSD BY 23080-1971	A,D,E	RF
	23080-1902	• BRUSH, Electrical . . . . . (MOD F) Refer to SB 23080-01X-24-07	C	4
	23080-1971	• BRUSH, Electrical . . . . . (MOD K) SUPSDS 23080-1902, Refer to SB 23080-01X-24-04	A,D,E	4
	23080-1982	• BRUSH, Electrical . . . . . ALT: 23080-1922	B	4
		(ATTACHING PARTS)		
170	05-340209	• SCREW		4
		---------- * ----------		
180	23065-1740	• FAN		1
		(ATTACHING PARTS)		
190	02-4107-01	• NUT, Self-locking . . . . . SUPSD BY MS21042-4	A,D,E	RF
	MS21042-4	• NUT, Self-locking . . . . . SUPSDS 02-4107-01, Refer to SIL 23703	A, D, E	1
	MS21042-4	• NUT, Self-locking	B, C	1
200	AN960-416	• WASHER, Flat		1
210	02-6100-12	• SHAFT, Drive . . . . . SUPSD BY 23080-1520	A,D,E	RF
	23080-1520	• SHAFT, Drive . . . . . SUPSDS 02-6100-12	A, D, E	1
	23080-1520	• SHAFT, Drive	B, C	1
220	M83248/1-113	• O-RING		1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
230	02-5600-05	• RING, Friction, ... WARNING: CAN CONTAIN ASBESTOS, SUPSD BY 02-5600-13	A,D,E	RF
	02-5600-13	• RING, Friction . . . . . . SUPSDS 02-5600-05, Refer to SIL 02-5600-03	A, D, E	1
	02-5600-13	• RING, Friction	B, C	1
240	23032-1910	• PLATE, Dampener		1
250	23032-1900	• HUB, Dampener		1
260	23032-2710	• BACKPLATE, Dampener		1
270	MS16628-1078	• RING, Retaining		1
280	23072-1220	• SPUR GEAR, Speed Pickup . . . . . . REPLD BY 23072-1221	A,D,E	RF
	23072-1221	• SPUR GEAR, Speed Pickup . . (MOD L) REPLS 23072-1220, Refer to SB 23080-01X-24-05	A,D,E	1
	23072-1221	• SPUR GEAR, Speed Pickup	B	1
	23072-1221	• SPUR GEAR, Speed Pickup . . (MOD L)	C	1
290	23065-366	• BEARING AND BRUSH SUPPORT. . . . ASSEMBLY (SEE Figure 10002 FOR DETAILS) ALT: 23075-332, REPLD BY 23080-360	A,D,E	RF
	23075-332	• BEARING AND BRUSH SUPPORT. . . . ASSEMBLY (SEE Figure 10002 FOR DETAILS) ALT: 23065-366, REPLD BY 23080-360	A,D,E	RF
	23080-360	• BEARING AND BRUSH . . . . .(MOD E) SUPPORT ASSEMBLY (SEE Figure 10002 FOR DETAILS) REPLS 23065-366 AND 23075-332, Refer to SB 23080-01X-24-06	A,D,E	1
	23080-360	• BEARING AND BRUSH SUPPORT. . . . ASSEMBLY (SEE Figure 10002 FOR DETAILS)	B	1
	23080-360	• BEARING AND BRUSH . . . . .(MOD E) SUPPORT ASSEMBLY (SEE Figure 10002 FOR DETAILS) (ATTACHING PARTS)	C	1
300	MS21262-28	• SCREW, Self-locking		8
310	05-370232	• WASHER, Flat		8

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		---------- * ----------		
320	G128-178	• DISC, Baffle . . . . . SUPSD BY 23080-3110	A,D,E	RF
	23080-3110	• DISC, Baffle . . . . . SUPSDS G128-178, REPLD BY 23032-1145, Refer to SIL 23080-3110-01	A,D,E	RF
	23032-1145	• SPACER. . . . . (MOD L) REPLS 23080-3110, Refer to SB 23080-01X-24-05	A, D, E	1
	23032-1145	• SPACER.	B	1
	23032-1145	• SPACER. . . . . (MOD L)	C	1
330	M83723/83R0803N	• CONNECTOR, Electrical		1
340	23072-1314	• SPACER.		1
350	23076-1240	• SPACER.		1
		(ATTACHING PARTS)		
360	MS35265-22	• SCREW		4
		---------- * ----------		
370	23076-1250	• SWITCH ASSEMBLY, Thermal		1
380	23080-1341	• BEARING SUPPORT ASSEMBLY, ... DRIVE END (SEE Figure 10003 FOR DETAILS) REPLD BY 23080-1349	A,D,E	RF
	23080-1349	• BEARING SUPPORT . . . . . (MOD H) ASSEMBLY, DRIVE END (SEE Figure 10003 FOR DETAILS) REPLS 23080-1341, REPLD BY 23080-380	A,C,D,E	RF
	23080-380	• BEARING SUPPORT . . . . . (MOD L) ASSEMBLY, DRIVE END (PRE- LOAD) (SEE Figure 10003 FOR DETAILS) REPLS 23080-1349 AND 23080-1341, Refer to SB 23080-01X-24-05	A,D,E	1
	23080-380	• BEARING SUPPORT ASSEMBLY. . . . . DRIVE END (PRE- LOAD)	B	1
	23080-380	• BEARING SUPPORT . . . . . (MOD L) ASSEMBLY, DRIVE END (PRE- LOAD)	C	1
		(ATTACHING PARTS)		
390	MS24693-S23	• SCREW		3
		---------- * ----------		

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
400	23072-1280	• PICKUP, Speed . . . . . REPLD BY 23072-1281	A,D,E	RF
	23072-1281	• PICKUP, Speed . . . . . REPLS 23072-1280, REPLD BY 23072-1400	A,D,E	RF
	23072-1400	• PICKUP, Speed . . . . . REPLS 23072-1281, Refer to SIL 23072-1400-01	A, D, E	1
	23072-1400	• PICKUP, Speed	B, C	1
410	MS35489-1	• GROMMET.		1
420	03-6010-10	• BEARING, Ball . . . . . (MOD A) SUPSD BY 03-6010-14	A,D,E	RF
	03-6010-14	• BEARING, Ball . . . . . (MOD B) SUPSDS 03-6010-10, SUPSD BY 03-6010-17, Refer to SB 23080-01X-24-01	A,D,E	RF
	03-6010-17	• BEARING, Ball . . . . . (MOD C) SUPSDS 03-6010-14, SUPSD BY 03-6010-18, Refer to SB 23080-01X-24-02	A,D,E	RF
	03-6010-18	• BEARING, Ball . . . . . (MOD D) SUPSDS 03-6010-17, Refer to SB 23080-XXX-24-01	A,D,E	1
	03-6010-18	• BEARING, Ball	B	1
	03-6010-18	• BEARING, Ball . . . . . (MOD D)	C	1
430	02-4231-02	• WASHER, Spring Wave . . . . . (MOD L) Refer to SB 23080-01X-24-05	A,D,E	1
	02-4231-02	• WASHER, Spring Wave	B	1
	02-4231-02	• WASHER, Spring Wave . . . . . (MOD L)	C	1
440	23080-1940	• SHIM, Steel, 0.003 inch . . . . . (MOD L) (0,076 mm) thick, Refer to SB 23080-01X-24-05	A,D,E	AR
	23080-1940	• SHIM, Steel, 0.003 inch (0,076 mm) thick	B	AR
	23080-1940	• SHIM, Steel, 0.003 inch . . . . . (MOD L) (0,076 mm) thick	C	AR
450	23080-1941	• SHIM, Steel, 0.020 inch . . . . . (MOD L) (0,508 mm) thick, Refer to SB 23080-01X-24-05	A,D,E	AR
	23080-1941	• SHIM, Steel, 0.020 inch (0,508 mm) thick	B	AR
	23080-1941	• SHIM, Steel, 0.020 inch . . . . . (MOD L) (0,508 mm) thick	C	AR

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
460	23072-314	• ARMATURE . . . . . . REPLD BY 23080-370		RF
	23080-370	• ARMATURE . . . . . (MOD G) REPLS 23072-314, Refer to SB 23080-XXX-24-04	A,D,E	1
	23080-370	• ARMATURE	B	1
	23080-370	• ARMATURE . . . . . (MOD G)	C	1
470	23046-1111	• RETAINER, Bearing		1
		(ATTACHING PARTS)		
480	MS24694-S3	• SCREW		4
		---------- * ----------		
490	03-6010-10	• BEARING, Ball . . . . . .(MOD A) SUPSD BY 03-6010-14	A,D,E	RF
	03-6010-14	• BEARING, Ball . . . . . .(MOD B) SUPSDS 03-6010-10, SUPSD BY 03-6010-17, Refer to SB 23080-01X-24-01	A,D,E	RF
	03-6010-17	• BEARING, Ball . . . . . .(MOD C) SUPSDS 03-6010-14, SUPSD BY 03-6010-18, Refer to SB 23080-01X-24-02	A,D,E	RF
	03-6010-18	• BEARING, Ball . . . . . .(MOD D) SUPSDS 03-6010-17, Refer to SB 23080-XXX-24-01	A,D,E	1
	03-6010-18	• BEARING, Ball	B	1
	03-6010-18	• BEARING, Ball . . . . . .(MOD D)	C	1
500	23080-301	• STATOR AND HOUSING ASSEMBLY . . (SEE Figure 10004 FOR DETAILS) REPLD BY 23080-306	A,D,E	RF
	23080-306	• STATOR AND HOUSING . . . . (MOD J) ASSEMBLY (SEE Figure 10004 FOR DETAILS) REPLS 23072-301, Refer to SB 23080-XXX-24-05	A,D,E	1
	23080-306	• STATOR AND HOUSING ASSEMBLY . . (SEE Figure 10004 FOR DETAILS)	B	1
	23080-306	• STATOR AND HOUSING . . . . (MOD J) ASSEMBLY (SEE Figure 10004 FOR DETAILS)	C	1

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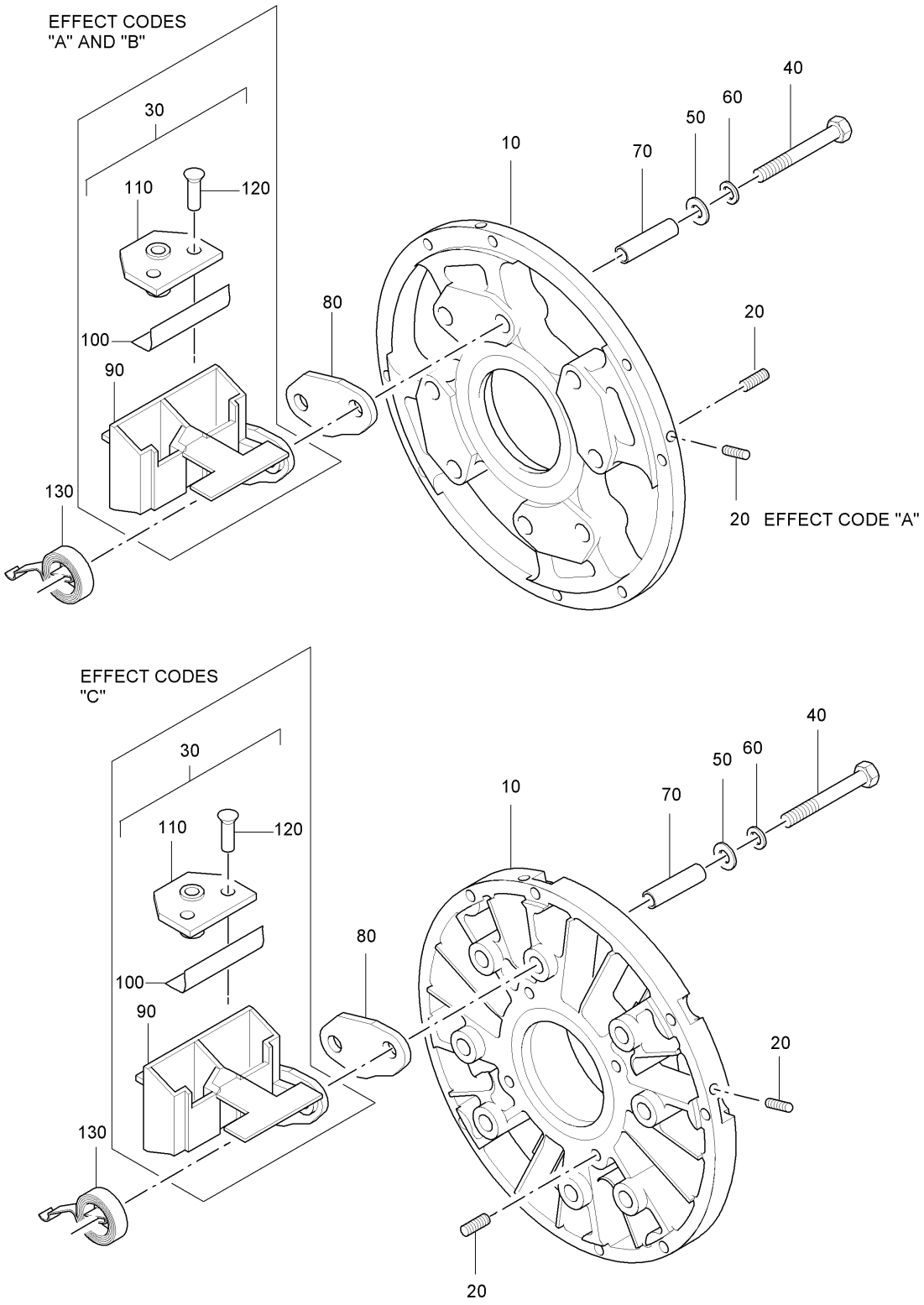

Figure 10002 - Bearing and Brush Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10002-				
	23065-366	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY (SEE IPL Figure 10001 FOR NHA)	A	RF
	23075-332	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY (SEE IPL Figure 10001 FOR NHA)	B	RF
	23080-360	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY (SEE IPL Figure 10001 FOR NHA)	C	RF
10	23072-1360	• END BELL, Anti-Drive End	A	1
	23072-1100	• END BELL, Anti-Drive End	B	1
	23080-3050	• END BELL, Anti-Drive End . . . . . REPLD BY 23080-3055	C	1
	23080-3055	• END BELL, Anti-Drive End . . . . . REPLS 23080-3050, SB 23080-360-24-01	C	1
20	MS21209C0815	• • INSERT, Helicoil	A	8
	MS21209C0815	• • INSERT, Helicoil	B	4
	MS21209C0815	• • INSERT, Helicoil . . . . . ALT: NAS1130-08L15D	C	8
30	23075-1202	• BRUSH HOLDER, Complete . . . . . (ATTACHING PARTS)		4
40	AN3-7A	• BOLT, Machine	A,B	8
	AN3-7A	• BOLT, Machine . . . . . SUPSD BY AN3-10A	C	RF
	AN3-10A	• BOLT, Machine . . . . . SUPSDS AN3-7A	C	8
50	05-374094	• WASHER, Non-metallic		8
60	AN960-10L	• WASHER, Flat		8
70	05-631145	• SLEEVING, Insulation		8
80	23014-1039	• BOARD, Insulating	A,B	4
	23085-1471	• BOARD, Insulating . . . . . ---------- * ----------	C	4
90	23075-1192	• • BRUSH HOLDER		1
100	23075-1230	• • SHEET, Insulating		1
110	23075-1400	• • BOARD, Terminal, Brush Lead . . . . . (ATTACHING PARTS)		1
120	MS20426AD3-5	• • RIVET . . . . . ---------- * ----------		2
130	23072-1130	• SPRING, Brush		8

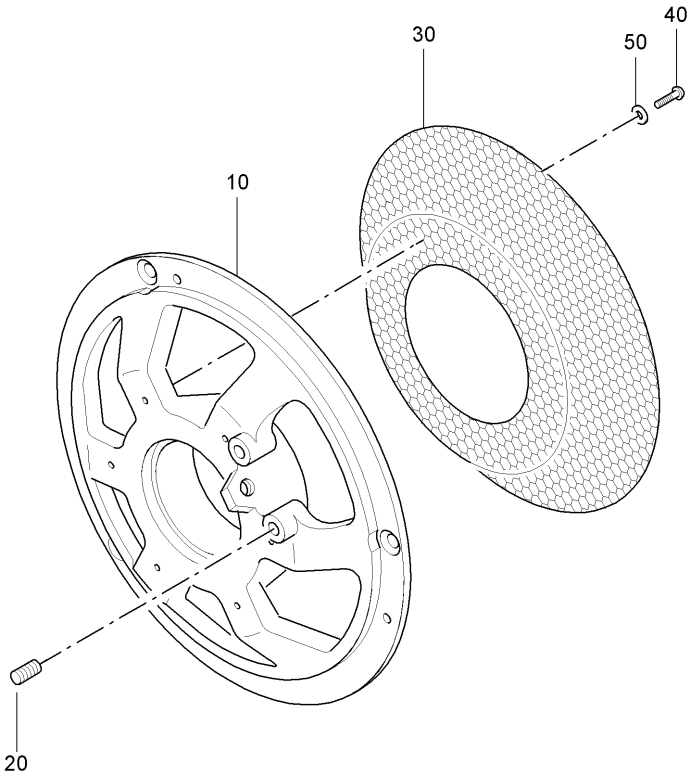

Figure 10003 - Drive End Bearing Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10003-				
	23080-1341	BEARING SUPPORT ASSEMBLY, ... DRIVE END, (SEE IPL Figure 10001 FOR NHA).	A	RF
	23080-1349	BEARING SUPPORT ASSEMBLY . . . . . DRIVE END, (SEE IPL Figure 10001 FOR NHA)	B	RF
	23080-380	BEARING SUPPORT ASSEMBLY . . . . . DRIVE END, (PRE- LOAD) (SEE IPL Figure 10001 FOR NHA) SB 23080-01X-24-05	C	RF
10	23080-1331	• END BELL, DRIVE END . . . . . REPLD BY 23080-1330	A	RF
	23080-1330	• END BELL, DRIVE END . . . . . REPLS 23080-1331	A	1
	23080-3124	• END BELL, DRIVE END	B	1
	23080-3141	• END BELL, DRIVE END . . . . . (PRE- LOAD) SB 23080-01X-24-05	C	1
20	MS21209C0815	• • INSERT, Helicoil	C	2
30	23072-1060	• SCREEN . . . . . (ATTACHING PARTS)		1
40	MS21318-15	• SCREW, Drive		6
50	AN960-4L	• WASHER, Flat		6
		---------- * ----------		

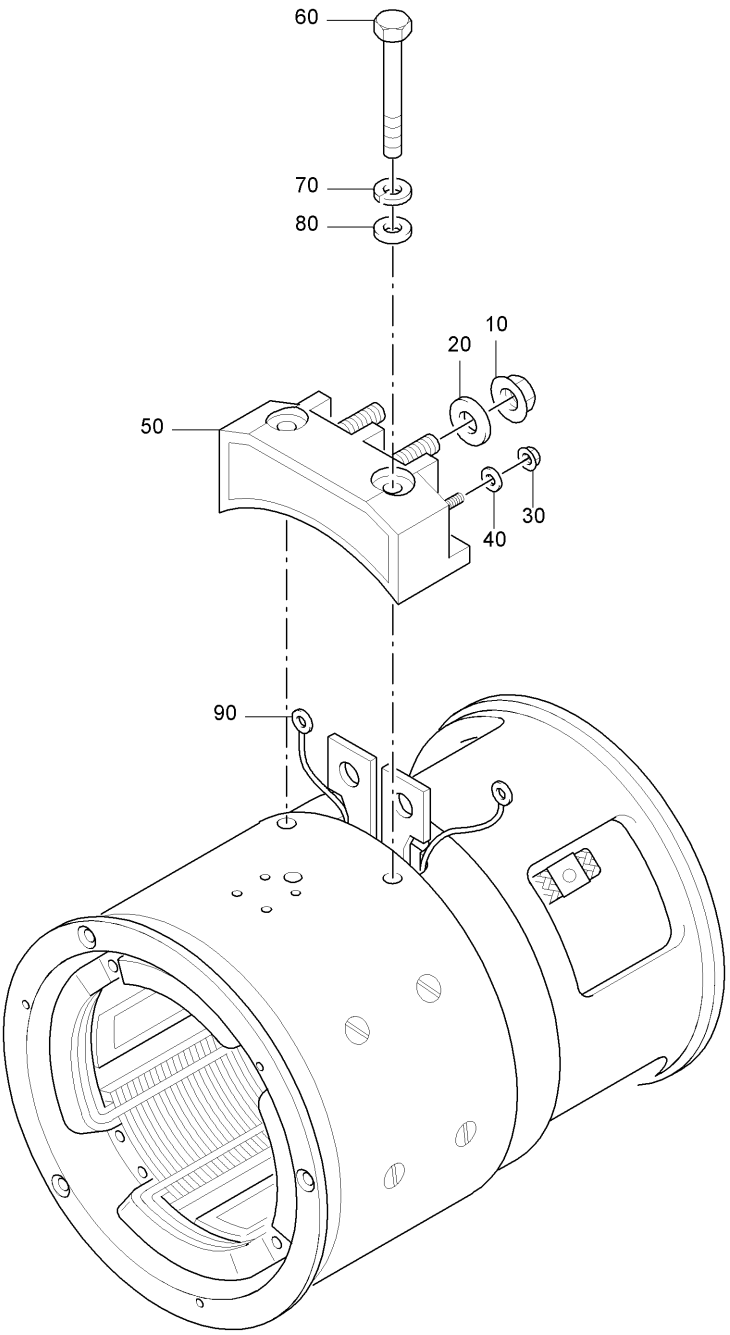

Figure 10004 - Stator and Housing Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10004-				
	23080-301	STATOR AND HOUSING ASSEMBLY . . . (SEE IPL Figure 10001 FOR NHA)	A	RF
	23080-306	STATOR AND HOUSING ASSEMBLY . . . (SEE IPL Figure 10001 FOR NHA)	B	RF
10	MS21042-6	• NUT, Self-locking		2
20	AN960C616	• WASHER, Flat		2
30	MS21042-3	• NUT, Self-locking		2
40	AN960C10	• WASHER, Flat		2
50	23069-1235	• BLOCK, Terminal		1
		(ATTACHING PARTS)		
60	AN3-11A	• BOLT, Hex Head.		2
70	MS35338-43	• WASHER, Lock		2
80	AN960C10	• WASHER, Flat	A	2
	AN960C10L	• WASHER, Flat	B	2
		---------- * ----------		
90	05-652015	• LUG, Terminal.		2

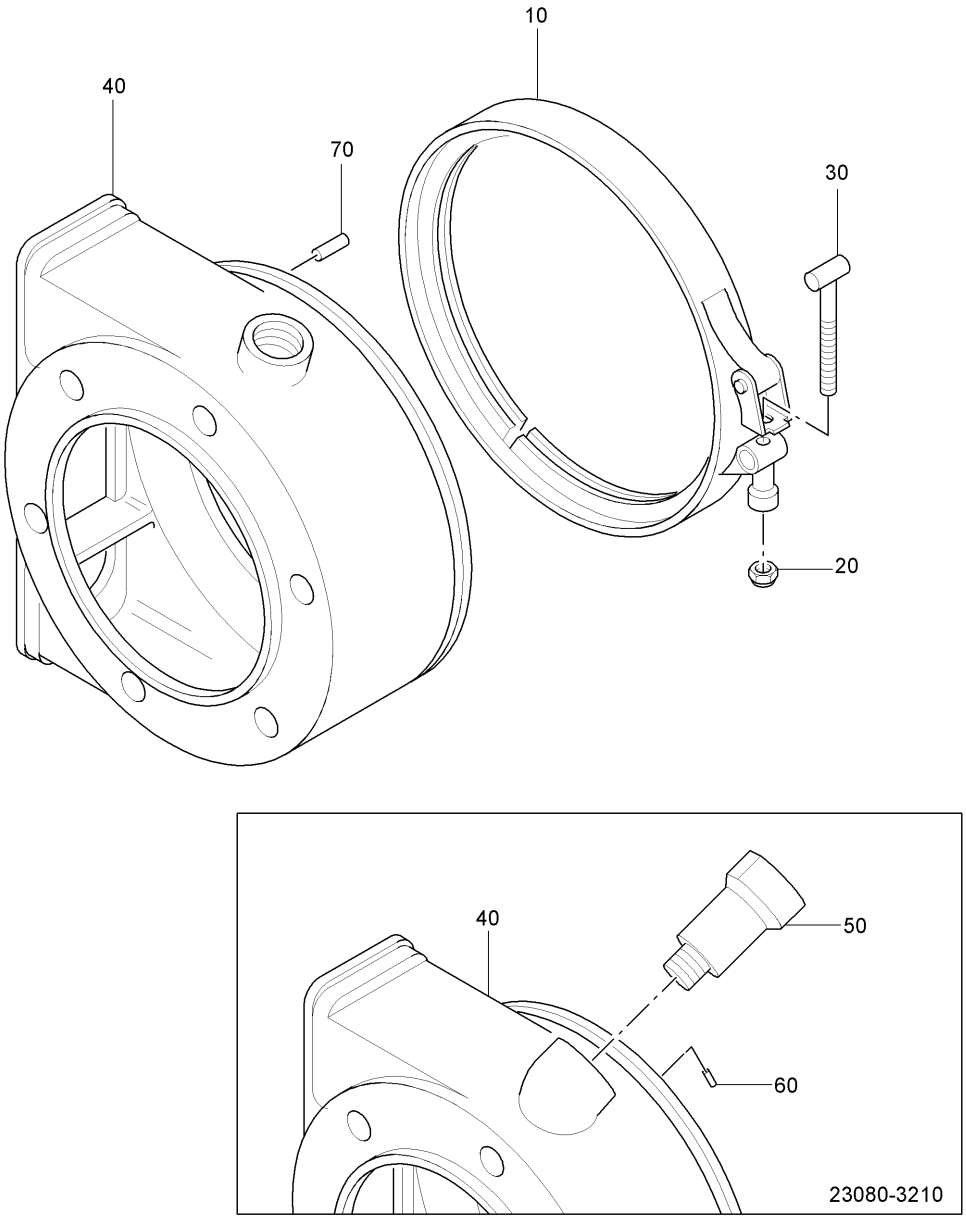

Figure 10005 - QAD Mounting Kit

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10005-				
	23080-523	KIT, QAD (Quick-Attach-Detach) . . . . . Mounting (SEE IPL Figure 10001 FOR NHA)	A	RF
	23080-505	KIT, QAD, Mounting . . . . . (SEE IPL Figure 10001 FOR NHA)	B	RF
10	23072-1125	• COUPLING, V-Retainer . . . . . ALT: 23072-1325		1
		(ATTACHING PARTS)		
20	MS21045-4	• • NUT, Self-locking, Hexagon . . . . . Used with 23072-1125		1
	MS21045-L4	• • NUT, Self-locking, Hexagon . . . . . Used with 23072-1325		1
30	23032-2802	• • T-BOLT . . . . . Used with 23072-1125		1
	23032-2803	• • T-BOLT . . . . . Used with 23072-1325		1
		---------- * ----------		
40	23080-3210	• ADAPTER, Mounting	A	1
	23080-1280	• ADAPTER, Mounting	B	1
50	23080-1631	• • FITTING, Drain	A	1
		(ATTACHING PARTS)		
60	MS171496	• • PIN, Spring	A	1
		---------- * ----------		
70	02-4412-04	• • PIN, Grooved, Headless		3

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SPECIAL PROCEDURES

1. Introduction

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REMOVAL

1. Introduction

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INSTALLATION

1. Introduction

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SERVICING

1. Introduction

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STORAGE

1. Storage

Materials required to pack the generator for storage or shipment are listed in Table 15001.

Description	Specification	Quantity
Bag, waterproof, vapor-proof	Commercially available. Bag must totally enclose instructions for installation and then be sealed.	1
Bag, waterproof, vapor-proof	Kraft-foil or suitable equivalent. Bag must totally enclose generator and then be sealed.	1
Box - domestic class, single wall, corrugated cardboard.	PPP-B-636 or suitable equivalent. Box must be large enough to totally enclose and restrain bagged and cushioned generator.	1
Box - WC5 overseas shipping container.	PPP-B-636 or suitable equivalent. Box must be large enough to completely enclose domestic class packaging.	1
Cardboard Tubing	Commercially available.	AR
Chemically Neutral Protective Paper	Commercially available.	AR
Grease	MIL-PRF-81322.	AR
Desiccant	MIL-D-3464E Type II, Kraft bag, 4 unit bag size Englehard Corporation Desiccate 25 or equivalent	AR
Lockwire	MS20995C32.	36 inch (915 mm)
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam. (Safran Power's recommended method: 3 inch (76,2 mm) thick minimum expanded foam surrounding machine on all sides.)	Commercially available.	AR

Table 15001 - Packaging Material

Description	Specification	Quantity
Polyethylene (Plastic) Wrap	Commercially available.	AR
Tag	Commercially available.	1 (Domestic) 2 (Internat'l)
Tape - waterproof, pressure sensitive.	Commercially available.	AR

Table 15001 - Packaging Material (Continued)

A. General information.

CAUTION: IF MACHINE STORAGE TIME IS MORE THAN 24 MONTHS WITH NO USE, IT IS RECOMMENDED THAT ITS BEARINGS BE REPLACED. IT MUST THEN BE RE-TESTED ACCORDING TO TESTING AND FAULT ISOLATION SECTION BEFORE BEING PLACED INTO SERVICE.

(1) Unit must have successfully completed tests specified in TESTING AND FAULT ISOLATION section of this manual before preparing unit for shipment or storage.

(2) Record following information to tag(s):

- Model Number
- Serial Number
- Mod Status
- Test Date (PASSED)
- Packing date

(3) Use packaging materials as specified in Table 15001.

B. Documentation.

Include all applicable documentation with unit:

- Testing Records
- Repair Reports
- Final Inspection/Check Records
- Packing List and Certificate of Conformance

C. Domestic Packaging.

(1) Place O-ring (10001-220) into a small plastic bag and attach to machine.

(2) For all units, except 23080-014, place four screws (10001-120) and 36 inch (915 mm) of lockwire into a small plastic bag and attach to machine (for attachment of air inlet in aircraft).

(3) Apply lubricating grease to drive spline according to MIL-PRF-81322 and wrap it in protective paper according to MIL-B-121A, Grade A, Type II.

(4) Place unit and desiccant into a waterproof and vapor-proof heat-seal bag and partially heat-seal it while forcing as much air as possible from bag.

(5) Insert vacuum tube into bag to draw remaining air out of bag.

(6) Withdraw vacuum tube quickly and complete heat-sealing of bag.

(7) Using machine's original shipping container if possible, place bagged machine into box surrounded with a minimum of 3 inch (76,2 mm) thick shock absorbing, cushioning material on all six sides.

(8) Securely and completely seal all flapped openings of box with tape.

(9) Tape tag to exterior surface of box. Make sure all information is visible.

D. Overseas Shipment On Surface Vessels.

(1) Accomplish domestic packaging of machine in accordance with Para. C.

(2) Place domestically packaged starter-generator into WC5 shipping container.

(3) Securely and completely, seal all flapped openings of shipping container with tape.

(4) Tape tag to exterior surface of shipping container. Make sure all information is visible.

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REWORK

1. Introduction

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