SAFRAN
Power

COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR
23077 SERIES

23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -006, -007, -009, -010

ORIGINAL ISSUE: JULY 1, 1976

REVISION 10: JUNE 12, 2019

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HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator Models 23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -006, -007, -009 and -010.

Attached to this transmittal letter is Revision No. 10 of the Component Maintenance Manual with IPL (original issue dated July 1, 1976).

REVISION 10, DATED JUNE 12/2019

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 Service Bulletin(s) and Service Information Letter(s) as listed in the Service Bulletin and Service Information List in the front of the manual. The content has been fully converted to provide customers with electronic delivery of the CMM on CD-ROM and is distributed in a “pdf” format compatible with the Adobe Acrobat Reader® that can be obtained from Adobe.

Significant changes in this CMM have been identified by change bars that are shown on the left-hand sides of pages.

Key items included in this revision:

- Incorporation of new product and process changes. This includes changes to testing, disassembly, checks, repairs, assembly, fits and clearances, and illustrated parts list.
- New contact information and company change to Safran Corporation.
- Incorporated TR 24-01.

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RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	July 1/76		
Revision 1	Sept 1/78		
Revision 2	Feb 1/79		
Revision 3	Jul 4/80		
Revision 4	Nov 15/81		
Revision 5	Jun 1/89		
Revision 6	Aug 11/97		
Revision 7	May 23/00		
Revision 8	Dec 28/00		
Revision 9	Feb 28/03		
Revision 10	Jun 12/19		

Retain this record in the front of the CMM. On receipt of revisions, insert affected pages into the manual. Record revision number, date issued, date inserted into the CMM, and initials on this page.

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RECORD OF TEMPORARY REVISIONS

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials
24-01	1017	Aug 14/03	Aug 14/03	GR	Jun 12/19	GR

Retain this record in the front of the CMM. On receipt of temporary revisions, insert affected pages into the manual. Record the temporary revision number, page number, date issued, date inserted into the CMM, and initials on this page. When temporary revisions are removed from the CMM, record the date removed and initials.

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SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
23077-00X-24-01	Superseded	1	04/29/1994				
23077-00X-24-02	Incorporated	3	12/23/1998				
23077-0XX-24-03	Incorporated	1	12/23/1998				
23077-0XX-24-04	Incorporated	1	12/23/1998				
23077-0XX-24-05	Incorporated	1	12/23/1998				
23077-0XX-24-06	Incorporated	--	11/24/1997				
23077-002-1-24-01	Incorporated	--	12/05/2002				
23077-005-24-01	Incorporated	--	11/30/1994				
23077-009-24-01	Superseded	1	04/29/1994				
23077-009-24-02	Incorporated	--	09/28/1992				
23077-009-24-03	Superseded	1	04/29/1994				
23077-009-24-04	Incorporated	--	11/29/1994				
23077-009-24-05	Incorporated	1	12/23/1998				
23077-009-24-06	Incorporated	1	12/23/1998				
23077-009-24-07	Incorporated	--	01/23/1997				
23077-010-24-01	Incorporated	1	10/06/1995				
23077-010-24-02	Incorporated	--	02/08/1995				
23077-01	Incorporated	--	2/20/1979				
23077-02	Superseded	1	11/30/1994				
23999-01	Incorporated	--	05/20/1978				

Retain this record in the front of the CMM. On receipt of service bulletins, record the service bulletin number, status (valid or invalid), revision number (if applicable) and the date issued. Unless invalidated, all service bulletins affecting the 23077 Series of DC Starter-Generators shall be kept with the CMM.

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SERVICE INFORMATION LETTER LIST

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued
02-5600-02	Valid	2	04/22/2002				
03-6010-XX-01	Valid	--	05/02/1995				
23075-120X-01	Superseded	1	05/22/1990				
23075-1230-01	Valid	--	02/13/1992				
23077-000-1-01	Limited	--	02/26/1996				
23077-009-01	Superseded	1	04/29/1994				
23077-009-02	Limited	--	01/09/1995				
23077-009-03	Limited	--	08/28/1995				
23077-010-01	Valid	--	02/13/1995				
23077-010-02	Limited	--	02/26/1996				
23080-3110-01	Valid	--	03/15/1994				
23701	Valid	1	06/19/2000				
23703	Valid	--	01/24/1997				
23704	Cancelled	1	09/05/2008				
GSIL 2006-01	Valid	--	09/26/2006				
GSIL 2006-02	Valid	1	02/10/2009				
GSIL 2006-03	Valid	--	09/15/2006				

Retain this record in the front of the CMM. On receipt of Service Information Letters, record the Service Information Letter number, status, revision number (if applicable) and the date issued. Unless invalidated, all Service Information Letters affecting the 23077 Series of DC Starter-Generators shall be kept with the CMM.

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for overhaul and service repair of the 23077 Series 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.

- 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.

The procedures given in this manual were verified by:

Section	Method Date
Testing and Fault Isolation	7/1/1976
Disassembly	7/1/1976
Assembly	7/1/1976

If an error, omission, or other technical discrepancy is found in this manual, fill out a copy of the Technical Publication Comment Form found at the back of this manual and send to Supervisor of Technical Publications, Safran Corporation or provide information to Technical Publications e-mail at twinsburg.techpubs@Safran.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 i.

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 CAN RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.**

Material	Used in
Acrylic Coating	ASSEMBLY, REPAIR
Anti-Seize Compound	ASSEMBLY
Chemical Film Dichromate	REPAIR
Corrosion Preventative	CLEANING
Decal Cement	ASSEMBLY
Detergent	CLEANING
Epoxy Bonding Cement	ASSEMBLY
Grease	ASSEMBLY
Isopropyl Alcohol	CLEANING, ASSEMBLY, DISASSEMBLY
Loctite Grade D	ASSEMBLY
Lubricating and Assembly Paste	ASSEMBLY
Machine Oil	REPAIR
Methyl Alcohol	ASSEMBLY
Red Insulating Enamel	ASSEMBLY
Sealing Compound	ASSEMBLY
Solvent	ASSEMBLY
Zinc Chromate Paste	REPAIR

Table i - Dangerous Materials

6. Non-Safran Corporation authorized components and processes policy

Safran Corporation authorizes the use of Safran Corporation 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 Corporation Quality Assurance incoming and in process inspection systems. Other than the type certification holder (airframe manufacturer), Safran Corporation Equipment Service Centers are the only authorized distributors of Safran Corporation 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 Corporation authorized parts, or any parts not having been submitted to Safran Corporation Quality Assurance inspection system will invalidate any and all factory warranties. All Safran Corporation warranties are automatically voided on any Safran Corporation 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 productliability for all units that have been modified in this fashion.

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

7. Abbreviations

The following abbreviations are used in this manual:

A	- Amperes
ADE	- anti-drive end
DE	- drive end
in.	- inch(es)
in-lb	- inch-pound(s)
IVD	- Ion vapor deposited
kPa	- kilopascal(s)
lb-ft	- pound - foot
lb-in	- pound - inch(es)
MS/s	- Mega Samples per second
N·m	- Newton meters
QAD	- Quick Attach/Detach

Ref. Des.	- Reference designator
rms	- root mean square
RPM	- Revolutions Per Minute
SPD	- Standard Practice Document
SI	- System Internationale (SI); i.e., English Measurement followed by Metric equivalents.
UUT	- Unit Under Test
Ω	- Ohm

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DESCRIPTION AND OPERATION

1. Introduction

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

The 23077 Series 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. When used as an engine starter, the starter-generator can be energized either by batteries or by ground-power units. The starter-generator utilizes a series starting field and should be started with the shunt field de-energized. 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. All 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.

For models in the 23077 Series, the generator's electrical system is rated at 28 volts DC at stated operating speeds shown in Table 1 under a maximum 300A continuous load condition. A detailed listing of all the 23077 Series DC Starter-Generators specifications follows in Table 1.

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 is required for installation but is not part of the generator configuration. The 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.

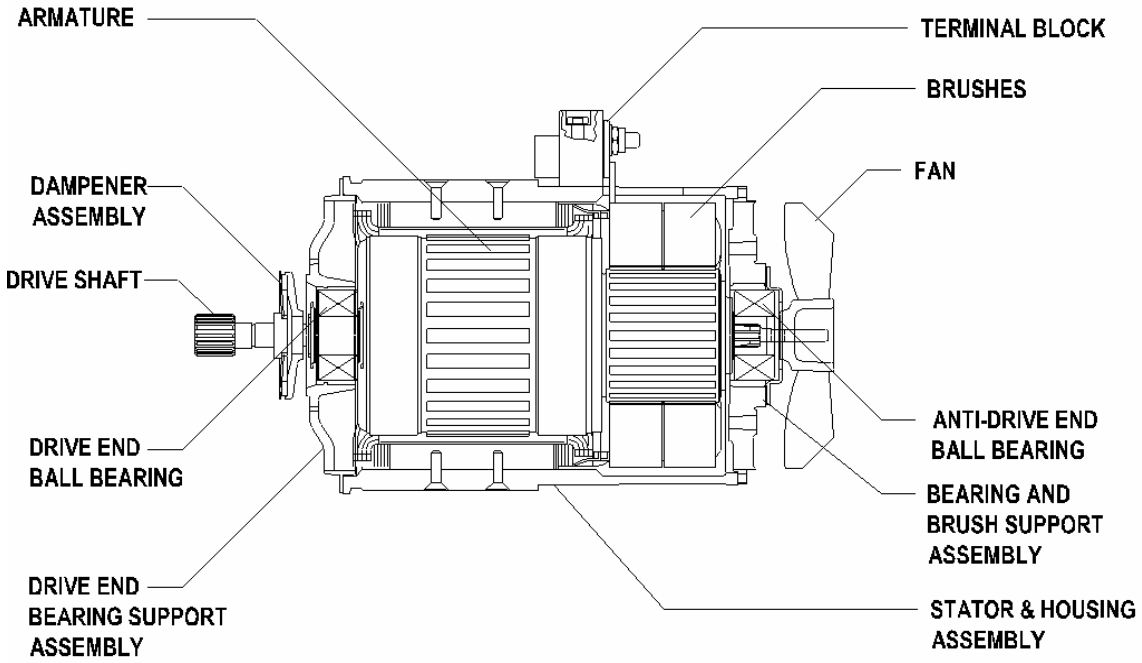

Figure 1 - Model 23077 Series DC Starter-Generator Features

2. Equipment Specifications

Details of equipment specifications are contained in this section.

Characteristic	Model Number(s)	Specification
Output rating	All models	9 kW
Generator Rating for continuous load within speed rating	23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009 and -010	300A, 30 VDC, 7,700 to 12,175 RPM
	23077-006 and -007	300A, 30 VDC, 12,175 RPM

Table 1 - Equipment Specifications

Characteristic	Model Number(s)	Specification
External starting power supply	23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009 and -010	1,700 A max.
	23077-006 and -007	30 V Max., 0.04 Ω resistor in starting circuit.
Cooling	All models	Self-cooled on ground. Combination self-cooled and blast air cooled in flight.
Air Inlet Diameter	23077-003, -004, -006 and -007	3.00 inch (76,2 mm)
	23077-000, -000-1, -000-2, -002, -002-1, -005, -009 and -010	4.75 inch (120,7 mm)
Length (less spline)	23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009 and -010	10.35 inch (262,9 mm)
	23077-006 and -007	11.17 inch (283,7 mm)
Direction of Rotation	All models	Counterclockwise (viewed from drive end)
Housing Diameter	All models	6.29 inch (159,8 mm) max.
Weight	23077-000-2	31.2 lbs. (14,15 kg) max. QAD kit: 1.4 lbs. (0,63 kg) max. Total: 32.6 lbs. (14,78 kg) max.
	23077-002, -002-1, -003 and -004	30.7 lbs. (13,81 kg) max. QAD kit: 1.4 lbs. (0,63 kg) max. Total: 32.1 lbs. (14,45 kg) max.
	23077-000, -000-1 and -005	31.5 lbs. (14,28 kg) max. QAD kit: 1.4 lbs. (0,63 kg) max. Total: 32.9 lbs. (14,92 kg) max.
	23077-006 and -007	32.3 lbs. (14,53 kg) max. QAD kit: 1.35 lbs. (0,61 kg) max. Total: 33.7 lbs. (15,14 kg) max.

Table 1 - Equipment Specifications (Continued)

Characteristic	Model Number(s)	Specification
Drive Spline and Mounting Flange	23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009 and -010	Drive Spline and QAD Mounting Features conform to AND10262-XII and mate with AND10262-XII-A drive pad.
	23077-006 and -007	Drive Spline conforms to MS18056 (0.75 inch nominal). Mounting flange conforms to MS18054.
Spline Teeth (Number)	All models	16
Spline Pitch Diameter	All models	0.800 inch (20,32 mm)
Drive Shaft Shear Torque	23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009 and -010	2000 in-lbs. (226 N·m) max.
	23077-006 and -007	700 in-lbs. (79,1 N·m) max.
Terminal Designations	23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009 and -010	Series Start: B+ Positive E- Negative A+ Shunt Field D Equalizer C+ Starting
	23077-006 and -007	Shunt Start: B+ Positive E- Negative A+ Shunt Field D Equalizer
Maximum Overhung Moment with QAD kit	23077-000, -000-1, -009	140 in-lbs. (15,82 N·m)
	23077-000-2, -002, -002-1, -003, and -004	134 in-lbs. (15,13 N·m)
	23077-005	138 in-lbs. (15.58 N·m)
	23077-006 and -007	135 in-lbs. (15,24 N·m)
	23077-010	143 in-lbs. (16,16 N·m)

Table 1 - Equipment Specifications (Continued)

3. Equipment Improvements and Modifications

The 23077 Series DC Starter-Generator may incorporate one or more modifications. A modification is indicated by a letter in the MOD status block on the nameplate or modification status label. Information regarding modifications are detailed in the service bulletins found in the SERVICE BULLETIN LIST in the front of this manual 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. Figure 2 and Figure 3 are schematic diagrams for the 23077 Series DC Starter-Generator models.

A. Starter Operation

Depending on the starter-generator model, the 23077 Series of DC Starter- Generator operates as either a shunt starter motor or a series starter motor to start the engine.

(1) Shunt Start

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

(b) During the engine start cycle as the rotational speed of the armature increases, the magnetic flux generated by the shunt field windings creates a back electromotive force (EMF) which opposes the voltage supplied by the starting power source. This causes the armature current and the starter output torques to decrease. A feature known as field weakening reduces the back EMF which improves the starter-generator performance by allowing the starter-generator to provide assisting torque at higher speeds.

(2) Series Start

During the engine start cycle the aircraft power bus applies DC voltage across terminals C+ and E- supplying current to the armature and stator windings. The starting power can be supplied by aircraft batteries or a ground source. Figure 3 is a schematic diagram of a typical series start DC starter-generator.

B. Generator Operation

Following starter operation, the GCU will build up 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 28 VDC.

NOTE: Figures 4 through 7 are outline drawings of the various 23077 Series models.

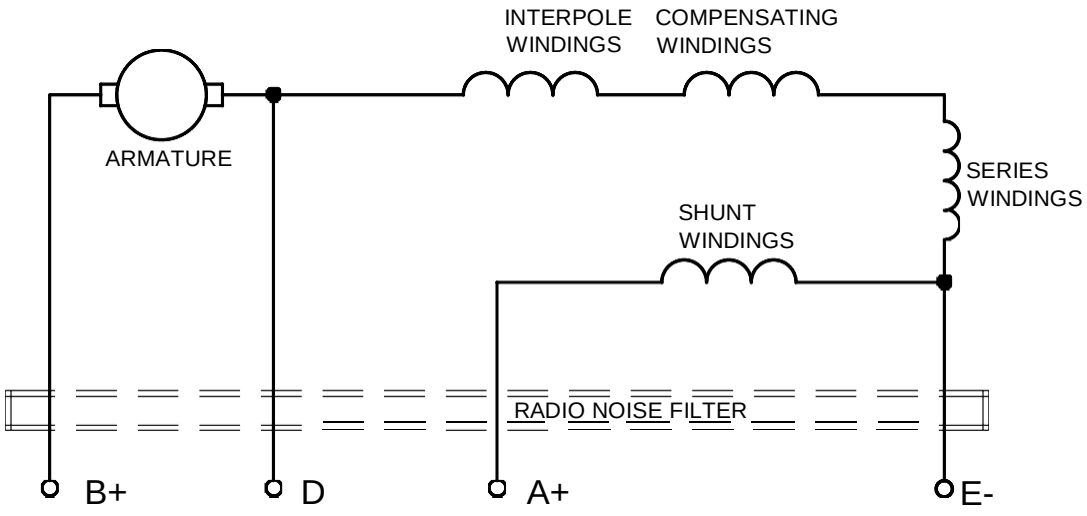

Figure 2 - Models 23077-006, -007 Schematic Diagram

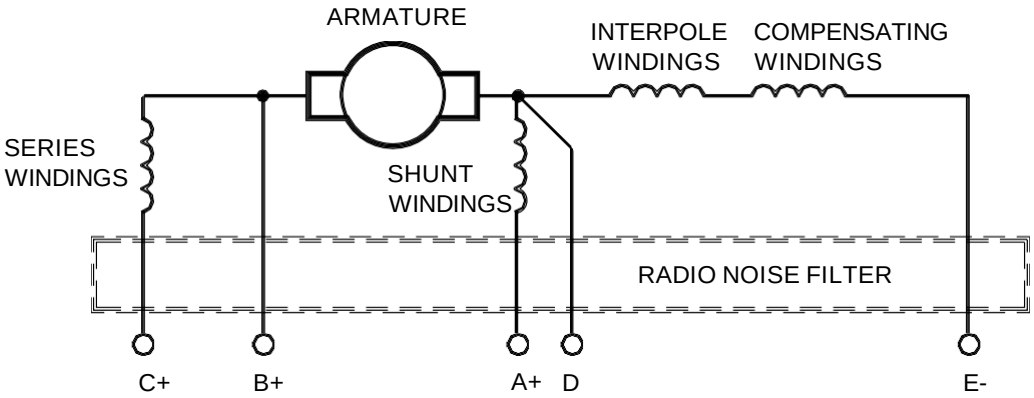

Figure 3 - Models 23077-000, -000-1, -000-2, -002, -002-1, -003, -004, -005, -009, -010 Schematic Diagram

5. MOD Status

See Table 2 below for the latest MOD level of each Starter-Generator model:

23077-000	23077-000-1	23077-000-2	23077-002	23077-002-1	23077-003	23077-004	23077-005	23077-006	23077-007	23077-009	23077-010	Description
-	-	-	-	-	-	-	-	-	-	A	-	03-6010-14, Bearings
A	A	-	A	A	A	A	A	A	A	-	-	03-6010-15, Bearings
-	-	-	-	-	-	-	-	-	-	B	-	03-6010-17, Bearings
B	B	-	B	B	B	B	B	B	B	C	-	03-6010-18, Bearings
C	C	-	-	-	-	-	C	-	-	D	A	23065-1662, End Bell
G	G	-	C	C	C	C	F	C	C	H	G	23065-1663, End Bell (Spring Loaded)
-	D	-	-	D	-	D	D	D	D	E	B	23065-380, Support Assembly
D	-	-	D	-	D	-	-	-	-	-	-	23065-381, Support Assembly
E	E	-	E	E	E	E	E	E	E	F	C	23077-330, Armature
-	-	-	-	-	-	-	-	-	-	-	D	03-6010-10, Bearing
-	-	-	-	-	-	-	-	-	-	G	-	23077-1281, Brush

Table 2 - MOD Status

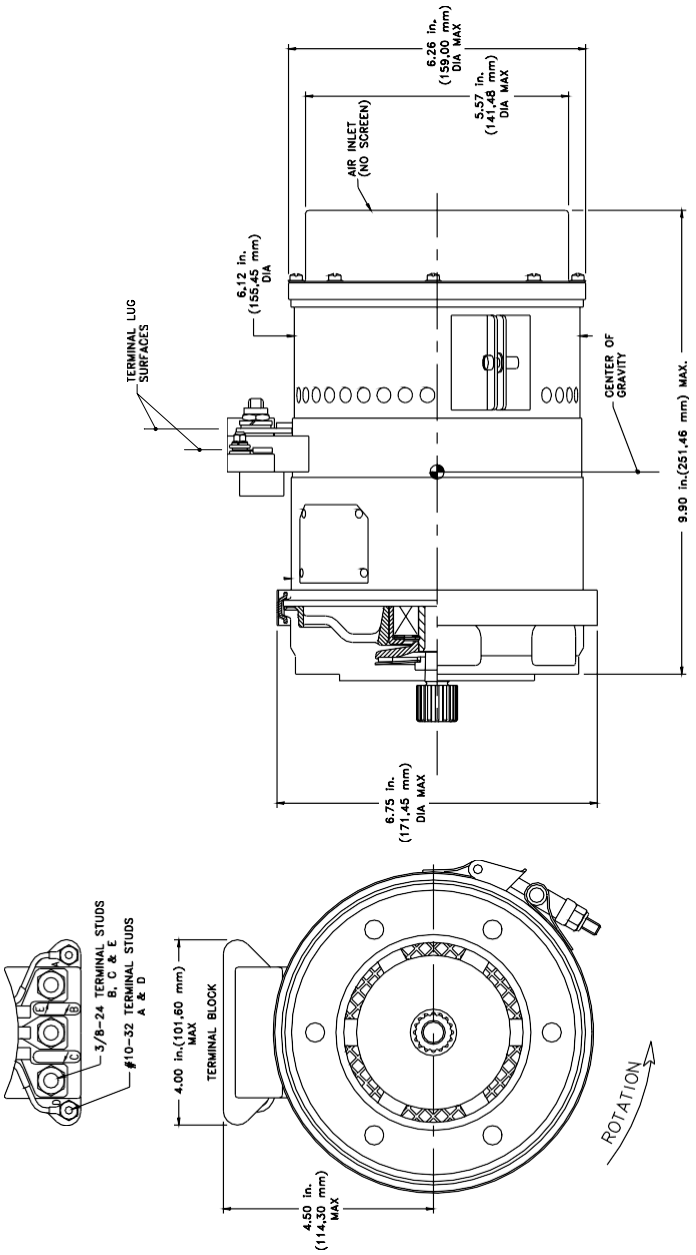

Figure 4 - Outline Drawing 23077-000, -000-1, -000-2, -005, -009, -010

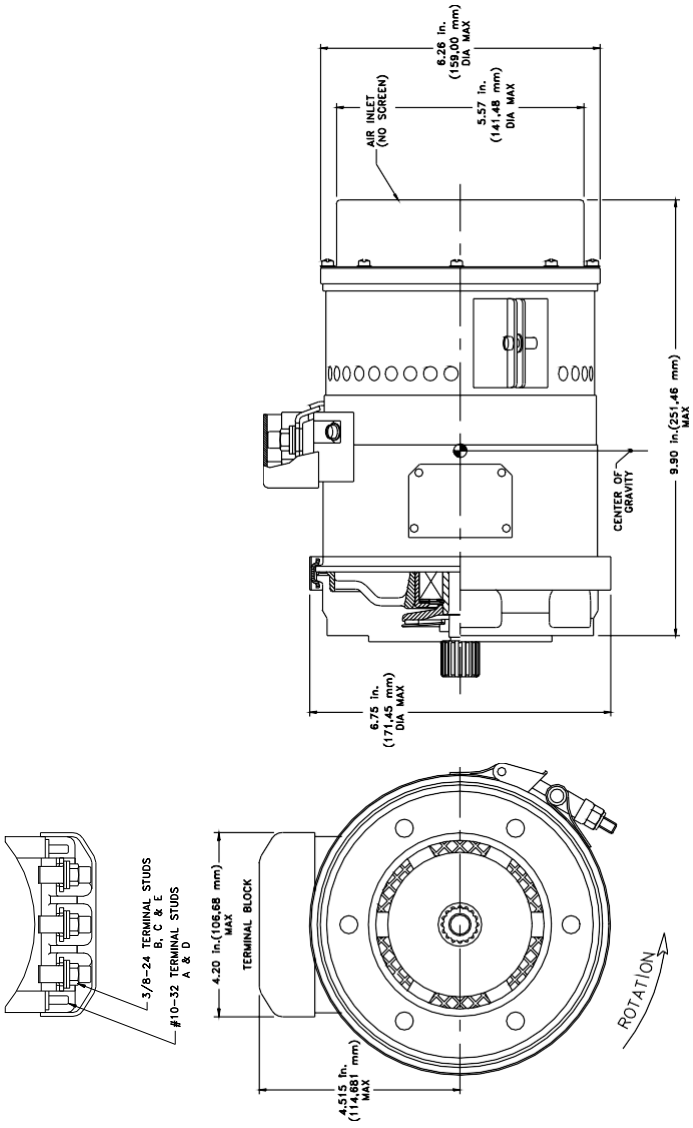

Figure 5 - Outline Drawing 23077-002, -002-1

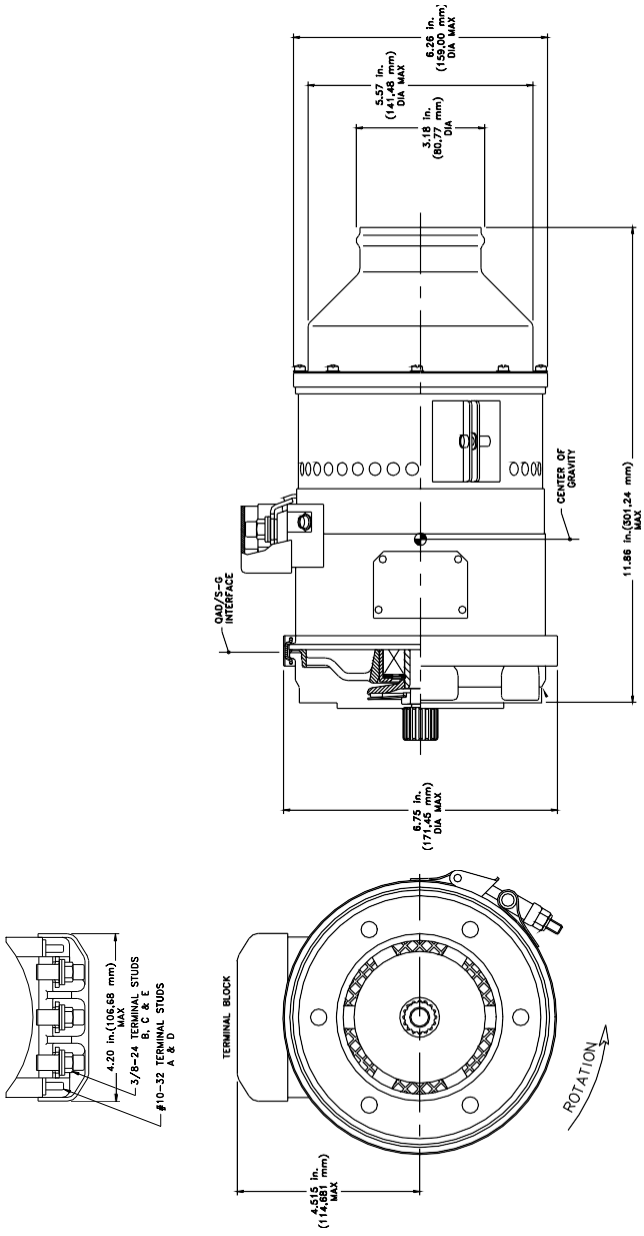

Figure 6 - Outline Drawing 23077-003, -004

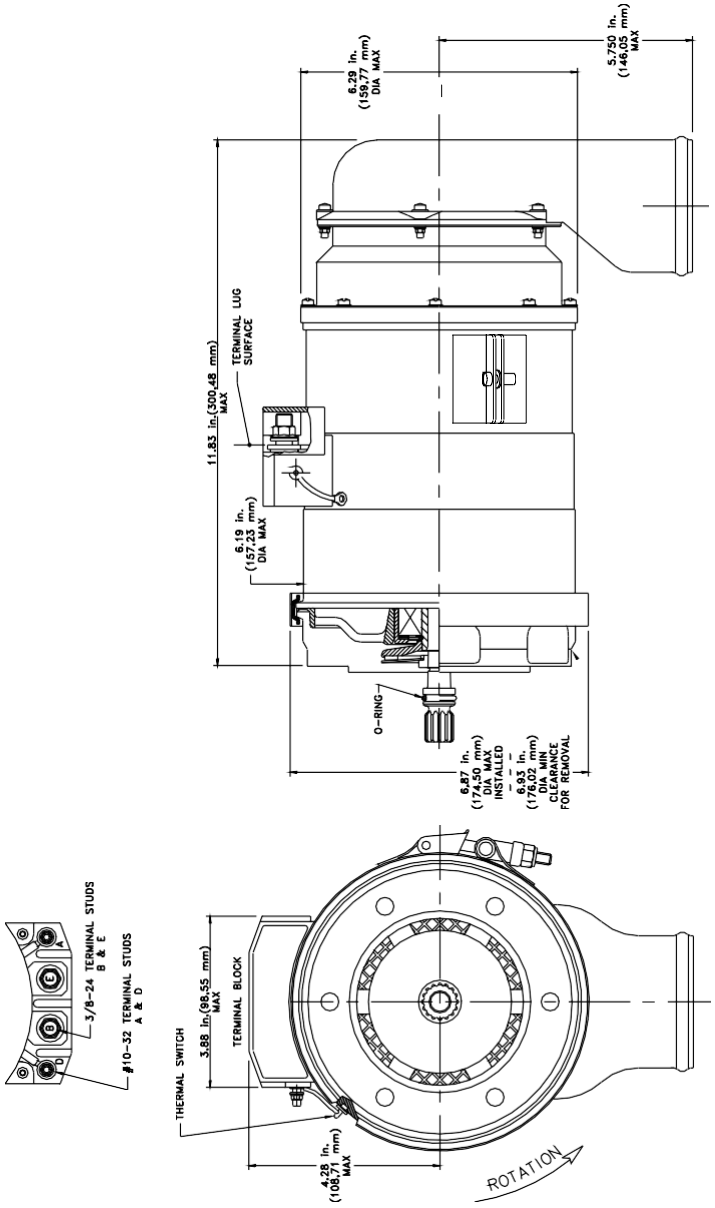

Figure 7 - Outline Drawing 23077-006, -007

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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 TO GENERATOR IS SHUT OFF BEFORE REMOVING OR REPLACING TEST EQUIPMENT, INSTRUMENTS OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE CIRCUIT" TESTING AND FAULT ISOLATION PROCEDURES.

The procedures provided in this section are performance tests and are classified as either verification tests or acceptance tests. A verification test is conducted to assist in fault isolation or to confirm the cause for removal before the repair or overhaul of the DC Starter-Generator. An acceptance test is conducted after the repair or overhaul of the unit. Record all test results on a photocopy of the data sheet(s) provided at the end of this section.

Verification Testing: A starter-generator requiring confirmation of the cause for removal or qualification for continued service must be inspected as detailed in Paragraph 3. of the CHECK section before testing can begin. A unit that passes initial inspections can be tested in accordance with this section to determine performance or to isolate a particular fault. When a fault is identified during testing, refer to the fault isolation tables in this section to determine the probable cause.

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

2. Test Conditions

Refer to Table 1001 for a list of performance test conditions. Unless otherwise specified, all of the parameters in Table 1001 apply to a test.

Parameter	Operating Condition
Ambient Temperature	50° to 104°F (10° to 40°C)
Barometric Pressure	Ambient pressure at sea level, 27 to 33 inch (690 to 840 mm) of mercury
Starter-Generator Mounting	Drive Shaft Horizontal
Combination Cooling: Self and Forced Air Cooled	Cooling air supplied through a 5.62 inch (142,7 mm) I.D. tube which is straight for a length of 3 ft. (0,9 m). Air pressure equal to 4 inch (10 cm) H_2O, measured 12 inch (30.5 cm) upstream of starter-generator air inlet.
	Air inlet duct to be straight, 3 inch dia. x 36 inch long (7.5 cm dia. x 91.5 cm long).

Table 1001 - Performance Test Conditions

Parameter	Operating Condition
Brush Seating	100% in direction of rotation, 75% in axial direction. Refer to Safran Corporation Standard Practice Document SPD 1006 for Brush Installation, Seating, and Run-in procedures.

Table 1001 - Performance Test Conditions (Continued)

3. Test Equipment

Refer to Table 1002 for a list of special tools, fixtures, and equipment needed for testing and fault isolation. Equivalent substitutes can 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 Corporation repair facility for all the procedures in this manual.

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Ref. Des.
Commutation Viewing Adapter	SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section	Figure 9001
DC Ammeter	Range: 0 to 10 Amps Accuracy: ±1% of reading	A_1
DC Voltage Regulator	Range: 0 to 36 VDC	Not Illustrated
DC Voltmeter	Range: 0 to 750 mV Accuracy: ±1% of reading	V_1
DC Voltmeter (Qty 2)	Range: 0 to 50 VDC Accuracy: ±1% of reading	V_2,V_3
DC Voltmeter	Range: 0 to 30 VDC Accuracy: ±1% of reading	V_4
Generator Drive Stand	Range: 5500 to 14,000 RPM at rated load and 15,000 at no load.	Not Illustrated
Dynamic Load System (optional equipment as alternate starter test to locked rotor)	Inertial load system in specified range (refer to Dynamic Test specifications) and capable of full dynamic test speed parameters (matched to drive spline)	Not Illustrated
Generator Load Switch	Rating: 30 V, 300 Amps	SW_1
High Potential Tester	Rating: 250 VAC rms, commercial frequency	Not Illustrated

Table 1002 - Test Equipment

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Ref. Des.
Manometer	Range: 0 to 10 inch (0 to 254 mm) H_2O Accuracy: ±5% of reading	Not Illustrated
Oscilloscope, Dual Tone	Digital: Bandwidth of 100 Mhz Sampling rate of 100 MS/s Analog: Bandwidth of 60 to 100 Mhz	Not Illustrated
Precision Shunt	Rating: 500 Amps at 500 mVDC	SH_1
Shunt Field Switch	Rating: 30 VDC, 10 Amps	SW_3
Dummy Terminal Block	Use a dummy terminal block with blown capacitors during dielectric testing to avoid damaging a serviceable block.	Terminal Block
Thermocouple (or other temperature measuring device)	Range: 65 to 300° F (18 to 150° C) Accuracy: ±1° F (±0.5° C)	Not Illustrated
Variable Load Bank	Range: 30 VDC, 0 to 300 Amps	Variable Load Bank
Voltage Regulator Switch	Rating: 30 VDC, 10 Amps	SW_2
V-Block (Foam Cushioned with strap)	Used to restrain generator during locked rotor test	Not Illustrated

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
Speed Tolerance	±50 RPM
DC Voltage	±0.1 Vdc

Table 1003 - Setpoint Tolerances

Parameter	Test Condition Setpoint Tolerance
Load Current Tolerance	±5 Amps DC
Terminal Voltage Tolerance	±0.2 VDC
DC Current	±2.5 A
Cooling Air Pressure	±0.2 inches-water
Torque	±1.0 lb-ft

Table 1003 - Setpoint Tolerances

6. Test Set Up

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

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

A. Perform an 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: STARTER-GENERATOR MUST BE SUPPORTED AT ALL TIMES.

(1) Make sure all brushes (100) are correctly seated according to procedures in SPD 1006.

C. Clean starter-generator.

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

(1) Refer to CLEANING section for details.

D. Attach dummy terminal block to starter-generator or remove terminal block grounding lead.

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

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

CAUTION: MAKE SURE THAT YOU USE A DUMMY TERMINAL BLOCK OR REMOVE THE TERMINAL BLOCK GROUNDING LEAD FOR ACCEPTANCE TESTING. THE TEST VOLTAGE CAN DAMAGE THE FILTER CAPACITOR IN THE TERMINAL BLOCK.

(1) Refer to ASSEMBLY section for details.

NOTE: If the grounding lead is removed, make sure to cover the lead with electrical tape before doing a dielectric test.

E. Attach air inlet assembly.

(1) Install air inlet or fan cover (55) on stator and housing assembly (235) in the correct orientation with screw (60) and washer (65).

F. Install the commutation viewing adapter.

(1) Remove air inlet or fan cover (55) and, if applicable, air inlet adapter (70).

(2) Remove brush access cover (85).

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.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.

(3) Put commutation viewing adapter on stator and housing assembly (235). See Figure 1001.

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

(4) Center brackets of commutation viewing adapter over one rib of stator and housing assembly (235).

(5) Insert screw into rivet nut on bracket of commutation viewing adapter and tighten screw to a torque of 25 to 35 lb-in (2,3 to 3,4 N · m).

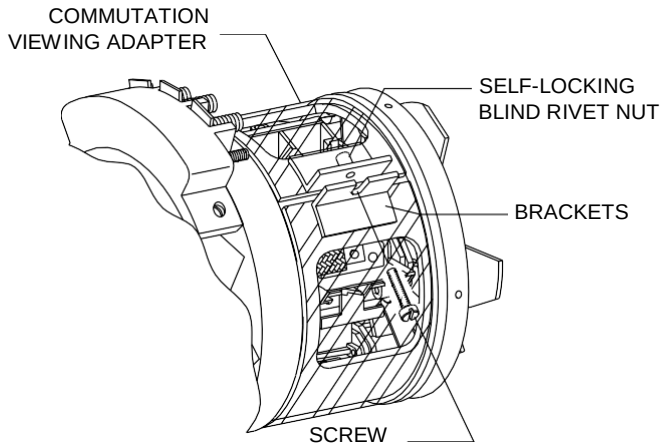

Figure 1001 - Installing Commutation Viewing Adapter

G. Install starter-generator on test stand.

NOTE: The starter-generator mounts to a mounting adapter plate that is attached to the drive stand. A V-band clamp secures the starter-generator to the mounting adapter plate.

NOTE: Some starter-generators are not supplied with QAD kits and must be ordered separately.

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 applicable spline adapter and mounting adapter plate onto drive stand.

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

(3) Ensure that drive stand and starter-generator mating splines are correctly engaged.

(4) Install V-band clamp (10005-5) and torque to 70 in-lbs (7,9 N-m).

H. Connect starter-generator to electrical test circuit.

(1) Turn all power off at starter-generator drive stand.

(2) Connect starter-generator to test circuit as shown in Figure 1002 or Figure 1003.

(3) If dummy terminal block was installed, assemble terminal block hardware to dummy terminal block. See Paragraph 4.B. in ASSEMBLY section for instructions.

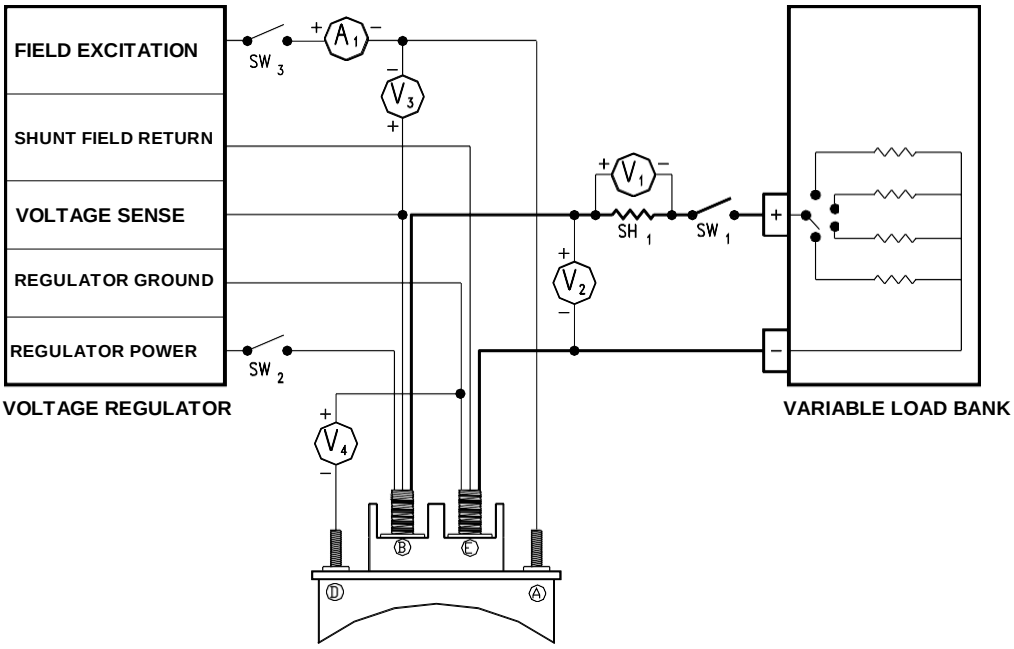

Figure 1002 - Generator Test Connection Diagram, Shunt Start Models

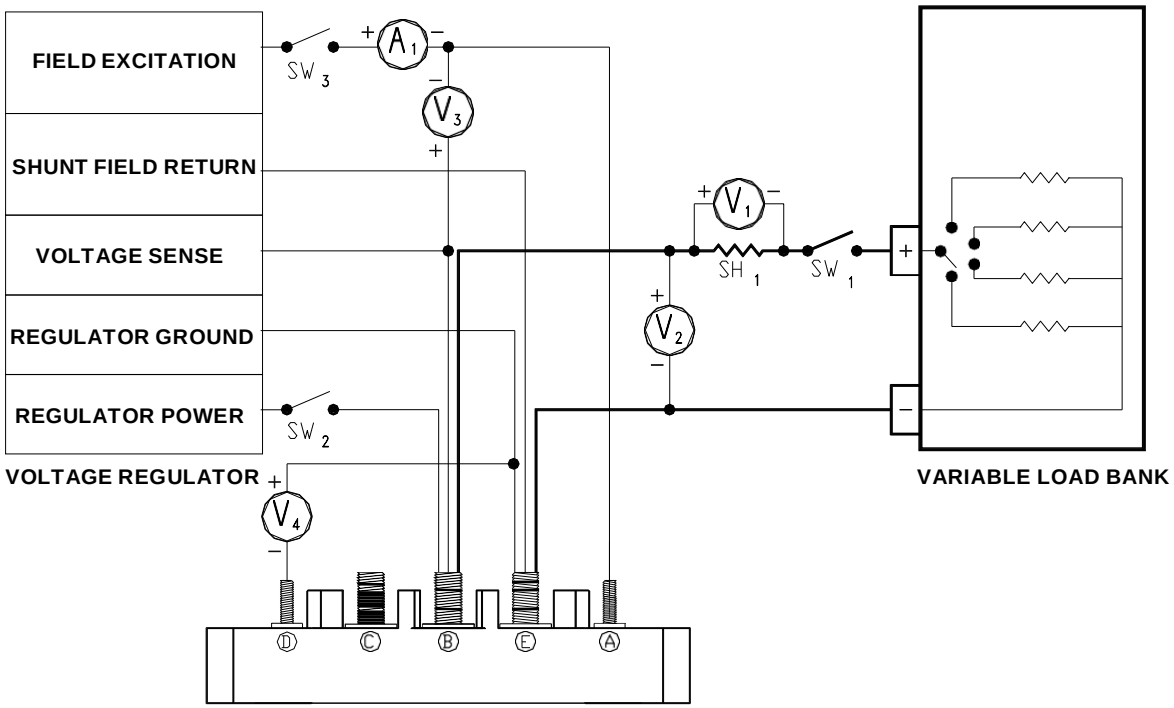

Figure 1003 - Generator Test Connection Diagram, Series Start Models

7. Test Procedure

This section provides acceptance test procedures and the sequence in which they are performed.

CAUTION: IF AN ACCEPTANCE LIMIT IS EXCEEDED BY EVEN A SMALL MARGIN, DO NOT CONTINUE FURTHER TESTING OF STARTER-GENERATOR. BE AWARE THAT TESTING OF A DC STARTER-GENERATOR BY ANY LIMIT AFTER IT HAS EXCEEDED THAT LIMIT CAN DAMAGE THE STARTER-GENERATOR.

A. Maximum Speed for Regulation Test (Models 23077-006, -007 only)

(1) Adjust starter-generator to 13,000 RPM, 30 VDC (V_2), with no load.

NOTE: Stabilization is not required.

(2) Measure and record the voltage between terminals B and A (V_3) and the field current at Terminal A (A_1).

(3) Calculate the resistance between terminals B and A by dividing the B and A voltage (V_3) by the field current (A_1).

(4) Acceptance limits:

(a) The calculated external field circuit resistance must not be greater than 35 Ω.

B. Continuous Operating Speed and Equalizing Voltage Test

(1) Install a thermocouple (or other temperature measuring device) to the outside of the stator and housing assembly in an area adjacent to a stator main pole.

(2) Operate starter-generator at 12,175 RPM, 30 VDC (V_2) and 300 A (V_1/SH_1) until the temperature is stabilized.

NOTE: Stabilization is reached when the temperature of the shunt field winding, as determined by its resistance, or the temperature of the frame rises no more than 2° F (1.1° C) in five minutes.

(3) Measure and record voltage between terminals D and E (V_4) and the air inlet temperature and frame temperature.

(4) Continue immediately with the minimum speed test.

(5) Acceptance limits:

(a) The voltage between terminals D and E (V_4) must be within voltage limits for the measured air inlet temperature. See Figure 1004 and Figure 1005.

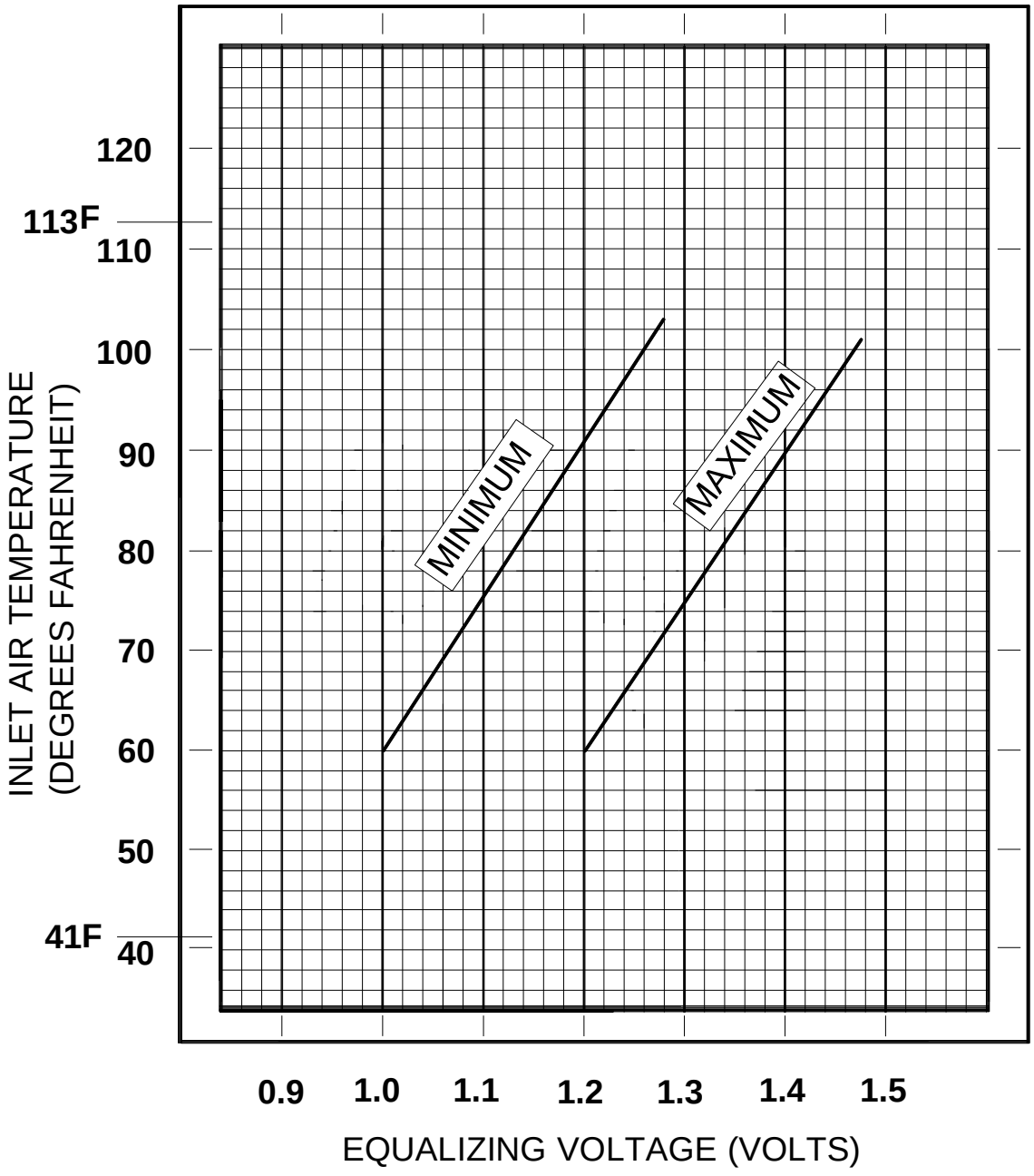

Figure 1004 - Models 23077-006 and -007 Equalizing Voltage Acceptance Limits

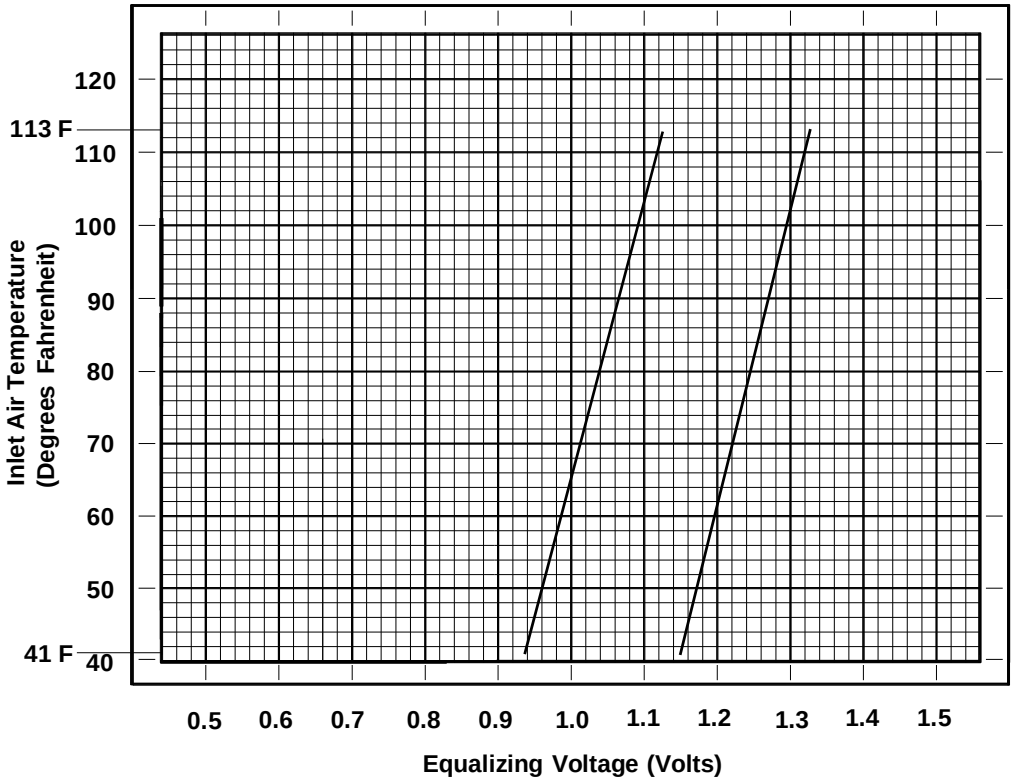

Figure 1005 - All Models Except 23077-006 and -007 Equalizing Voltage Acceptance Limits

C. Minimum Speed for Regulation Test.

(1) Adjust starter-generator to 7,700 RPM, 30 VDC (V_2), and 300 Amperes (V_1/SH_1).

NOTE: Stabilization is not required.

(2) Measure and record the voltage between terminals B and A (V_3) and the field current at Terminal A (A_1).

The field current must not be greater than 10 amperes.

(3) Calculate the resistance between terminals B and A by dividing the B and A voltage (V_3) by the field current (A_1).

(4) Acceptance limits:

(a) Field current must not be more than 10 Amps.

(b) The calculated external field circuit resistance between terminals B and A must not be less than 0.5 Ω.

D. Minimum Speed Test.

(1) Disconnect the air supply tube.

(2) Operate starter-generator to 7,200 RPM, 26 VDC (V_2), and 300 Amperes (V_1/SH_1) for 15 minutes.

(3) Measure and record the voltage between terminals B and A (V_3) and the field current at Terminal A (A_1).

The field current must not be greater than 10 amperes.

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

(5) Acceptance limits:

(a) Field current must not be more than 10 Amps.

(b) The calculated external field circuit resistance between terminals B and A must not be less than 0.5 Ω.

E. Overspeed Test

With starter-generator hot as a result of the previous test, operate at 14,000 RPM, no load with the field switch open for five minutes.

(1) Acceptance limits:

(a) There must be no evidence of mechanical degradation (excessive noise, vibration, or loosening of parts).

F. Compounding (Models 23077-006, -007 only)

(1) Operate starter-generator at 12,175 RPM, 30 VDC.

(2) Apply loads of 0, 75, 150, 225, and 300 Amperes.

(3) Measure and record the field current at Terminal A (A_1).

(4) Acceptance limits:

(a) Field current must rise with the increasing load.

G. Commutation Check.

(1) Operate starter-generator at 12,175 RPM, 30 VDC, and 300 Amperes.

(2) Record the commutation.

(3) 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 1006.

(4) Acceptance Limits:

(a) Acceptable (pinpoint) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush (100) 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 (100).

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush (100).

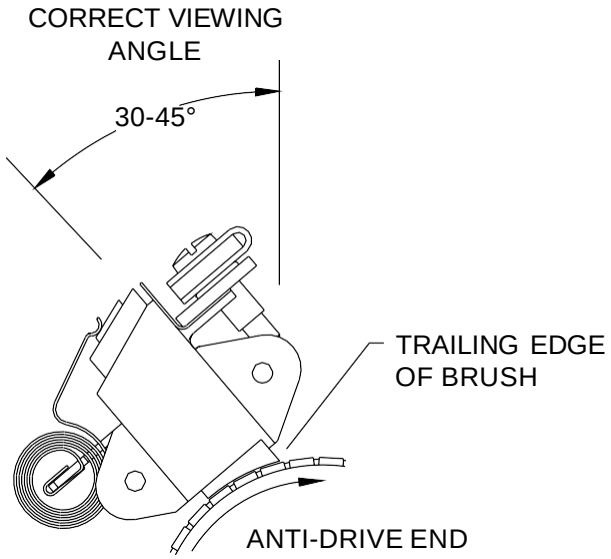

Figure 1006 - Commutation Viewing Angle

H. Dielectric Strength 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 PERFORM DIELECTRIC TESTING DURING MAINTENANCE INSPECTION OR TROUBLESHOOTING OF THE UNIT AS IT MAY CAUSE CUMULATIVE DEGRADATION OF THE ELECTRICAL CIRCUIT INSULATION. THIS TEST IS RECOMMENDED ONLY FOR ACCEPTANCE TESTING OF AN OVERHAULED UNIT THAT HAS BEEN THOROUGHLY CLEANED.

(1) Disconnect starter-generator from test circuit.

(2) Disconnect stator leads from attached terminal block (10004-25).

(3) Remove terminal block (10004-25) from starter-generator. Refer to DISASSEMBLY section.

NOTE: Not removing the terminal block during dielectric testing will result in damage to the capacitor.

(4) Install dummy terminal block on starter-generator or remove terminal block grounding lead. Refer to ASSEMBLY section.

(5) Remove commutator viewing adapter (Ref. Figure 9001).

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

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

(8) 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: GROUND THE STATOR HOUSING TO THE DRIVE SHAFT BY CONNECTING A JUMPER WIRE BETWEEN THESE TWO COMPONENTS. FAILURE TO DO SO MAY RESULT IN ARCING BETWEEN THE STATOR HOUSING AND THE DRIVE SHAFT AT THE SPEED PICKUP DURING DIELECTRIC TEST.

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.

(9) 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.

(10) Slowly decrease voltage to zero.

(11) Turn the power supply OFF.

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

(13) Acceptance Limits:

(a) Any arcing as evidenced by flashover (surface discharge), sparkover (air discharge), breakdown (puncture discharge) or leakage current more than 5 mA will be evidence of damp, dirty, weak or defective components.

I. Starter No Load Speed and Radial Vibration Test.

NOTE: This test is applicable to all models except 23077-006 and -007.

CAUTION: MAKE SURE STARTER-GENERATOR IS RESTRAINED DURING INITIAL STARTUP.

(1) Mount starter-generator in a resilient cradle (foam rubber cushioned V-Block) with drive shaft supported (centered). Reference Figure 9012.

(2) Restrain the V-block with a vise, and restrain the generator to the V-block with a strap.

(3) Connect a 0.2 Ohm, 10 W resistor between terminals A and B.

(4) Before turning on power supply, set power supply output to minimum. Turn on power supply.

(5) With no load, apply 26 VDC between terminals C and E.

(6) Record speed of starter-generator.

(7) Record amount of radial vibration deflection.

(8) Acceptance Limits:

(a) No load speed must be greater than 4,500 RPM.

(b) Total radial vibration must not be more than 0.001 inch (0.03 mm) deflection.

J. Shunt Start Locked Rotor Test. See Figure 1007.

NOTE: This procedure is applicable only to models 23077-006 and -007.

NOTE: This test is accomplished only during acceptance testing. The starter-generator must have been overhauled and have an armature with a resurfaced commutator. Reference Standards Practice Document 1001.

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

(2) Connect a 0.2 Ohm, 10 W resistor between terminals A and B.

(3) Connect a DC power supply, ammeter, and voltmeter to starter-generator terminals B and E as shown in Figure 1003.

CAUTION: SHUT POWER OFF IMMEDIATELY IF THE SUPPLY IS MORE THAN 700 AMPERES OR 12.0 VDC WITH ARMATURE IN A LOCKED CONDITION.

(4) With voltage output of DC power supply set to zero, turn power supply ON.

CAUTION: DO NOT APPLY VOLTAGE FOR MORE THAN 5 SECONDS. THE STARTER- GENERATOR CAN BE DAMAGED BY HIGH TEMPERATURES CAUSED BY A HIGH LOCKED ROTOR CURRENT.

(5) Quickly increase voltage between terminals B and E until output torque is 15.0 ft-lbs (20,3 Nm).

(6) Turn DC power supply OFF.

(7) Disconnect electrical test lead and remove starter-generator from test stand.

(8) Record B to E terminal voltage and line current.

(9) Acceptance Limits:

(a) B to E Voltage (V_2): 12.0 Vdc Maximum.

(b) Line Current (V_1/SH_1): 700 A Maximum.

(10) If current is high, greater than 700 A, repeat test with armature rotated to a different position.

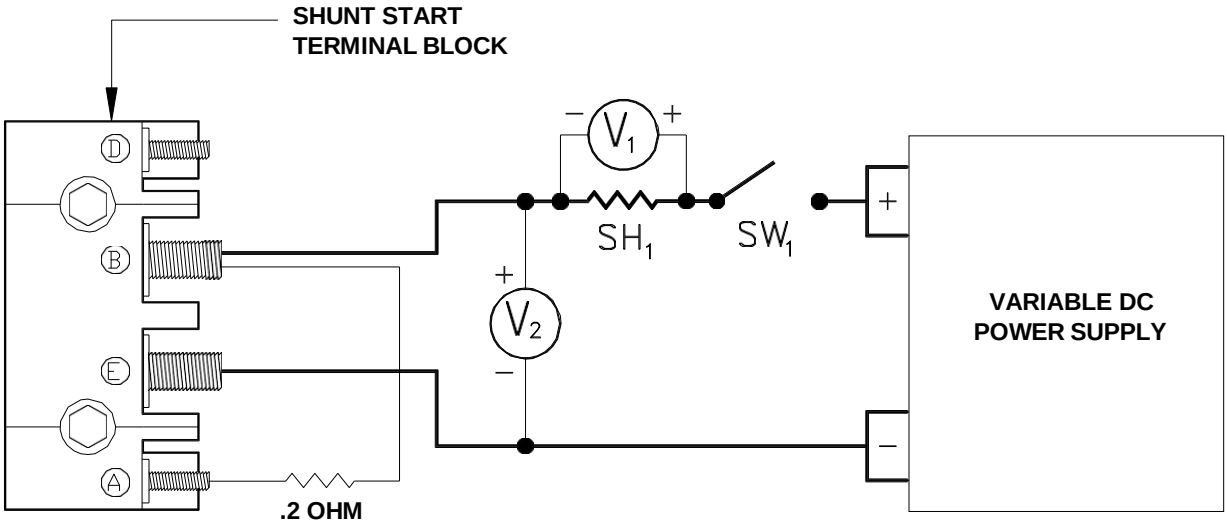

Figure 1007 - Shunt Start Locked Rotor Test Connection Diagram

K. Series Start Locked Rotor Test. See Figure 1008.

NOTE: This procedure is applicable only to models 23077-000, 23077-000-1, 23077-000-2, 23077-002, 23077-002-1, 23077-003, 23077-004, 23077-005, 23077-009 and 23077-010.

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

(2) Connect a 0.2 Ohm 10 W resistor between terminals A and B.

(3) Connect a DC power supply, ammeter, and voltmeter to starter-generator teminals C and E as shown in Figure 1004.

CAUTION: SHUT POWER OFF IMMEDIATELY IF SUPPLY IS MORE THAN 630 AMPERES OR 9.5 VDC WITH THE ARMATURE IN A LOCKED CONDITION.

(4) With voltage output of the DC power supply set to zero, turn power ON.

CAUTION: DO NOT APPLY VOLTAGE FOR MORE THAN 5 SECONDS. THE STARTER- GENERATOR CAN BE DAMAGED BY HIGH TEMPERATURES CAUSED BY A HIGH LOCKED ROTOR CURRENT.

(5) Quickly increase voltage between terminals C and E until output torque is 20.0 ft-lbs (27,1 N·m).

(6) Record C to E terminal voltage and line current.

(7) Turn DC power supply OFF.

(8) Disconnect electrical test lead and remove starter-generator from the test stand.

(9) Acceptance Limits:

(a) B to E Voltage (V_2): 9.5 Vdc Maximum.

(b) Line Current (V_1/SH_1): 630 A Maximum.

(c) The current must not be more than 630 Amperes and the voltage must be less than or equal to 9.5 VDC.

(10) If current is high, greater than 630 A, repeat test with armature rotated to a different position.

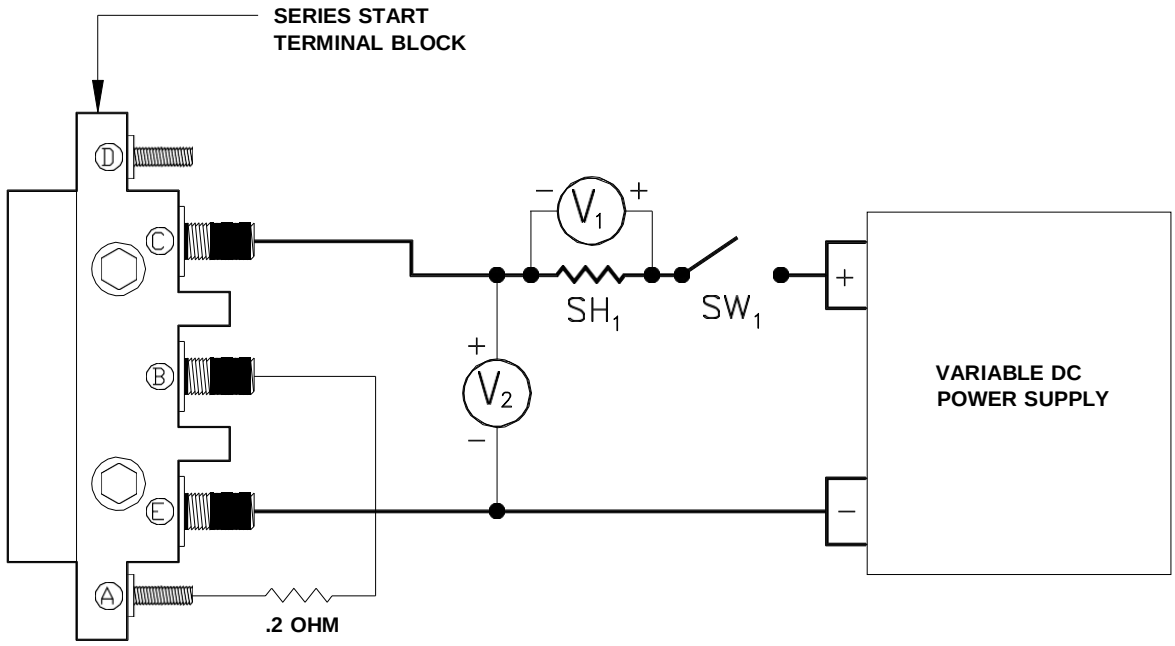

Figure 1008 - Series Start Locked Rotor Test Connection Diagram

L. Commutator Runout Check.

CAUTION: RUN THIS CHECK ONLY DURING ACCEPTANCE TESTING AND ONLY FOR STARTER- GENERATORS THAT HAVE BEEN OVERHAULED AND HAVE AN ARMATURE WITH A RESURFACED COMMUTATOR.

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) Firmly support starter-generator on an inspection plate.

(2) Rotate armature on its own bearings.

(3) Measure commutator runout with a dial indicator.

(4) Record maximum bar-to-bar runout between any two adjacent commutator bars.

(a) Runout is not more than 0.0002 inch (0,005 mm) for any two adjacent bars.

(b) If this test is failed, refer to fault isolation tables in this section.

(5) Record Total Indicator Runout (TIR) for the entire commutator.

(6) Acceptance Limits:

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

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

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 Table

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 action 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, Equalizing Voltage, and Minimum Speed Test		
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.
	Brush circuit(s) open.	Inspect all brush leads for an open circuit. If open circuit found, overhaul or repair starter-generator as necessary.

Fault	Probable Cause	Corrective Action
High Equalizing Voltage (V_4) (Continued)	Armature either 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 either 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.
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.
	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.

Fault	Probable Cause	Corrective Action
Low external field resistance (Continued)	Armature either 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 either 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. Equalizing Voltage, Minimum Speed, and Residual Voltage Test		
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.
	Brush circuit(s) open.	Inspect all brush leads for an open circuit. If open circuit found, overhaul or repair starter-generator as necessary.

Fault	Probable Cause	Corrective Action
High Equalizing Voltage (V_4) (Continued)	Armature either 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 either 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.
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.
	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.

Fault	Probable Cause	Corrective Action
Low external field resistance (Continued)	Armature either 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 either 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.
Residual voltage measurement is below minimum limit.	Insufficient housing magnetic properties.	REPLACE stator and housing assembly.
C. Output voltage reversed.	Field is incorrectly polarized.	Polarize field IAW Paragraph 14. in REPAIR section.
D. Minimum Speed for Regulation Test		
The field current limit is exceeded (A_1).	An excessive load was applied during testing.	Check applied load at load bank. Apply correct load
	Stator windings are shorted or grounded.	Clean stator and housing assembly IAW procedure in CLEANING section. Dielectric test stator and housing assembly IAW Paragraph 8.C. Replace stator and housing assembly if it fails the dielectric test.
	Armature is shorted or grounded	Clean armature IAW procedure in CLEANING section. Dielectric test components of armature assembly IAW Paragraph 8.B. Replace armature if it fails the dielectric test.

Fault	Probable Cause	Corrective Action
E. Overspeed Test		
Noisy Operation.	Bearings are defective and/or installed incorrectly.	Replace bearings.
	Cooling fan blades rubbing or out of balance.	Check fan blades and air inlet.
		Replace cooling fan if damaged.
		Repair or replace air inlet if damaged.
		NOTE: There are no authorized procedures to repair or balance a damaged fan.
	Drive shaft spline is worn.	Disassemble drive shaft from starter-generator.
		Inspect drive shaft IAW Paragraph 8.I. of the CHECK section.
		Repair or replace drive shaft as necessary.
	Rotor assembly striking against the stator and housing assembly.	Disassemble starter-generator. Check both parts for physical damage. Repair or replace damaged parts as necessary.
Starter-generator vibrates.	Bearings are defective and/or installed incorrectly.	Replace bearings.
	Armature assembly out of balance.	Disassemble starter-generator.
		Check armature assembly balance.
		Rebalance armature assembly IAW paragraph 9 of REPAIR section.

Fault	Probable Cause	Corrective Action
F. 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 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.

Fault	Probable Cause	Corrective Action
G. Starter-Generator Dielectric Test		
Starter-Generator insulation breakdown.	Bearing and brush support assembly is grounded.	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.
	Armature is 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 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.

Fault	Probable Cause	Corrective Action
H. Starter No Load Speed and Radial Vibration Test		
Low or no torque indicated.	Stator and housing assembly either 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 either 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.
Total frame vibration amplitude limit exceeded.	Drive shaft not centered.	Center drive shaft. Re-test starter-generator.
	Armature out of balance.	Check armature balance. Refer to SPD 1001. REPAIR or REPLACE armature as necessary.
	Defective or incorrectly installed bearings.	REPLACE bearings. Re-test starter-generator.

Fault	Probable Cause	Corrective Action
I. Starter Functional Test (Dynamic Starter Tests or Locked Rotor Test)		
Low or no torque. (Dynamic Starter Test, Speed-Torque)	Stator and housing assembly either 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 either 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.	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.
Low or no torque. (Dynamic Starter Test, Speed-Torque) (Continued)	Open brush circuit.	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.

Fault	Probable Cause	Corrective Action
Calculated efficiency is below minimum limit. (Dynamic Starter Test, Speed-Torque)	Windings hot from testing.	Allow the windings to cool. Repeat test.
	Field current is low.	Check field circuit for high resistance.
	Brushes (10001-100) are incorrectly seated or installed.	Refer to SPD 1006 for brush installation, seating, and run-in procedures.
Time to reach specified rpm is more than minimum limit. (Dynamic Starter Test, Inertial Load)	Windings hot from testing.	Allow the windings to cool. Repeat test.
	Field current is low.	Check field circuit for high resistance.
	Brushes (10001-100) are incorrectly seated or installed.	Refer to SPD 1006 for brush installation, seating, and run-in procedures.
Line current is more than limit. (Dynamic Starter Test, Inertial Load)	Windings hot from testing.	Allow the windings to cool. Repeat test.
	Field current is low.	Check field circuit for high resistance.
	Brushes (10001-100) are incorrectly seated or installed.	Refer to SPD 1006 for brush installation, seating, and run-in procedures.
J. Commutator Runout Check		
Bar-to-bar runout or total indicated runout exceeded.	Shifted commutator bars.	REPAIR commutator surface. REPLACE armature if not repairable.

Fault	Probable Cause	Corrective Action
Low or no torque. (Locked Rotor Test, Series Start Models)	Stator and housing assembly either 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 either 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.	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.
	Open brush circuit.	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.

Fault	Probable Cause	Corrective Action
Line current (V_1) or voltage between terminals C and E (V_2) exceeded. (Locked Rotor Test, Series Start Models)	Armature either 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 either 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.
Line current (V_1) or voltage between terminals B and E (V_2) exceeded. (Locked Rotor Test, Shunt Start Models)	Armature either 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 either 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.

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 either 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 either 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, REPLACE armature.

Table 1004 - 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. 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 1004 - Component Testing Fault Isolation Table (Continued)

VERIFICATION / FINAL ACCEPTANCE DATA SHEET

Model Number: 23077- Inspected by:

Serial Number: Date:

Inspection/Test	Requirement/Limit	Meas.	Accept	Reject
Visual inspection	Check for physical damage			
Maximum Speed for Regulation Test (Models 23077-006 and -007 only)	Voltage between terminals B and A, (V_3)	Vdc		
	Field current, (A_1)	A		
	Calculated external field resistance (must not be greater than 35 Ω)	Ω		
Continuous Operating Speed, Equalizing Voltage and Minimum Speed for Regulation Test	Measured equalizing voltage D and E (V_4)	Vdc		
	Temperature	°F		
	Frame temperature	°F		
	Field current (A_1) (10 A Max)	A		
	Voltage between terminals B and A (V_3)	Vdc		
	Calculated external field circuit resistance (0.5 Ω Min.)	Ω		
	Calculated equalizing voltage (D to E) (See Figure 1004 for models 23077-006/-007 or Figure 1005 for all other models)	Vdc		
Minimum Speed Test	B to A voltage (V_3)	Vdc		
	Field current (A_1) (10 amps Max.)	A		
	Calculated external field circuit resistance (0.5 Ω Min.)	Ω		
Overspeed Test	No sign of electrical or mechanical failure			
Compounding (Models 23077-006/-007 only)	Field current rises with increasing load	A		
		A		
		A		
		A		
Commutation Test	Not to exceed sparking			
Starter-Generator Dielectric Test	Leakage 5 mA Max.	mA		

Inspection/Test	Requirement/Limit	Meas.	Accept	Reject
Starter No Load Speed and Radial Vibration Test (All Models except 23077-006/-007)	No load speed must be greater than 4,500 rpm at 26 Vdc.	rpm		
	Radial vibration must not be more than 0.001 inch (0, 0254 mm) deflection.	inch mm		
Locked Rotor (Models 23077-006/-007)	Output torque 20.0 lb-ft (27,0 N·m).	lb-ft (N·m)		
	B-E voltage (12 VDC Max.)	Vdc		
	Line current (700 Amps Max.)	Amps		
Locked Rotor - (All models except 23077-006/-007)	Output torque 20.0 lb-ft (27,0 N·m).	lb-ft (N·m)		
	C-E voltage (9.5 VDC Max.)	Vdc		
	Line current (630 Amps Max.)	A		
Commutator Runout	Bar-to-bar runout 0.0002 inch Max (0,005 mm).	inch mm		
	Total indicated runout 0.0008 inch Max (0,020 mm).	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 23077 Series 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. Use ANSI/IPC J-STD-001 for soldering/desoldering. Tag electrical wires before removal.

NOTE: When a starter-generator is removed for service, the air outlet shroud and QAD mounting kit usually stay on the aircraft.

2. Disassembly Tools

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

Tools	Reference
#40 Drill Bit	Commercially Available
Anti-drive End Hub Support	Figure 9015
Armature Shaft Adapter, Anti-drive End	Figure 9003
Armature Shaft Adapter, Drive End	Figure 9002
Armature Support	Figure 9010
Bearing and Brush Support Assembly Support	Figure 9011
Bearing Puller	Commercially Available
Dampener Hub Driver	Figure 9004
Drive End Hub Support	Figure 9014
Horizontal Stator Support	Figure 9012
Inner Race Bearing Driver	Figure 9006
Outer Race Bearing Driver	Figure 9007
Spline Wrench	Figure 9016

Table 3001 - Disassembly Tools

Tools	Reference
Vertical Stator Support	Figure 9013
Wire Hook Tool	Not Illustrated

Table 3001 - Disassembly Tools

3. Disassembly Materials

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

NOTE: Equivalent substitutes can be used for the materials listed in Table 3002. Disassembly materials are not available from Safran Corporation. All items canbe 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 CAN RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source (CAGE Code)
Foam Cushion	N/A	Commercially Available
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 Starter-Generator

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

A. Remove the Q.A.D. mounting kit from the starter-generator.

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

NOTE: Procedure to remove QAD mounting kit, P/N 23065-504, P/N 23065-512 and P/N 23065-513 are identical. The procedure to remove QAD mounting kit, P/N 23065-504, is shown below.

(1) Loosen the self-locking hex nut (10005-10) from the T-bolt (10005-15) and remove the V-band clamp (10005-5).

(2) Remove the mounting adapter (10005-20).

B. Remove nameplate (10), information plate (20), modification status label (30) (if present), patent notification label (40), caution label (35) and FAA-PMA label (41) (if applicable) from stator and housing assembly (235).

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) Remove and discard the four screws (15) that attach the nameplate (10) to the stator and housing assembly (235).

(2) Remove the nameplate (10) from the stator and housing assembly (235). Keep it for reference when transferring the information to a replacement nameplate.

(3) Remove information plate (20) from stator and housing assembly.

NOTE: For models 23077-006 and 23077-007 only. Do not remove this item unless it is damaged or unreadable.

(a) Remove and discard two drive screws (25) that attach the information plate to the stator and housing assembly.

(b) Remove the information plate (20). Keep the information plate for reference when transferring the information to a replacement 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.

(4) Remove the modification label (30) (if present) from the stator and housing assembly (235) using an appropriate scraper and cleaning gum residue with isopropyl alcohol. Keep the modification label (30) for reference when transferring the information to a replacement modification status label or nameplate.

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.

(5) Remove and discard patent notification label (40), caution label (35) and FAA-PMA label (41) from stator and housing assembly (235) using an appropriate scraper and cleaning gum residue with isopropyl alcohol.

C. If applicable, remove the thermal switch assembly (170) from the terminal block. See Figure 3001.

NOTE: Do not remove the thermal switch unless it is damaged.

(1) Remove self-locking nut (175) that attaches thermal switch lead to terminal block.

(2) Remove the thermal switch lead from the terminal block.

(3) Remove and discard thermal switch assembly (170) from stator and housing assembly.

(4) Remove and discard lockwasher (180).

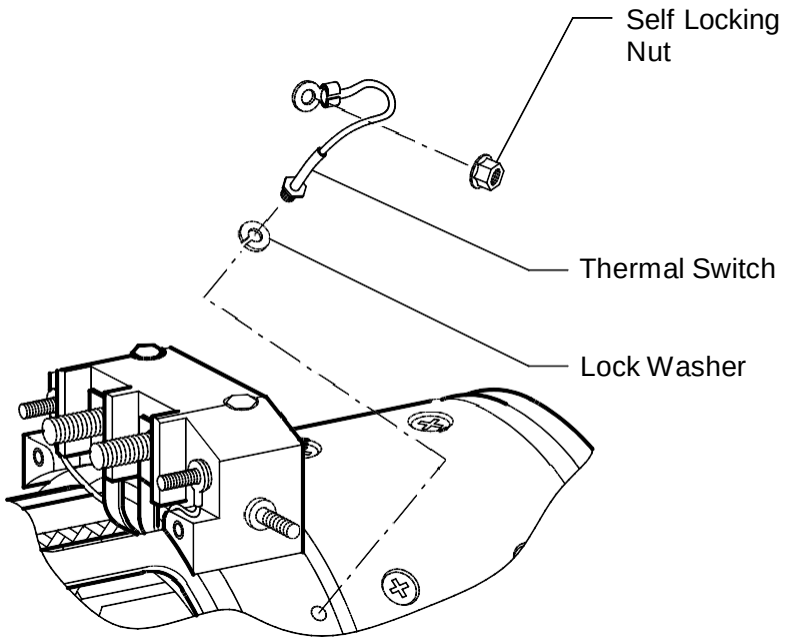


Figure 3001 - Thermal Switch Assembly

D. Remove terminal block cover (45) from the terminal block (For models 23077-002, -002-1, -003, -004, -006, and -007 only). See Figure 3002.

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

(1) Remove two screws (50) that attach the terminal block cover (45) to the terminal block (10004-25).

(2) Remove the terminal block cover (45) by pulling it off the terminal block (10004-25).

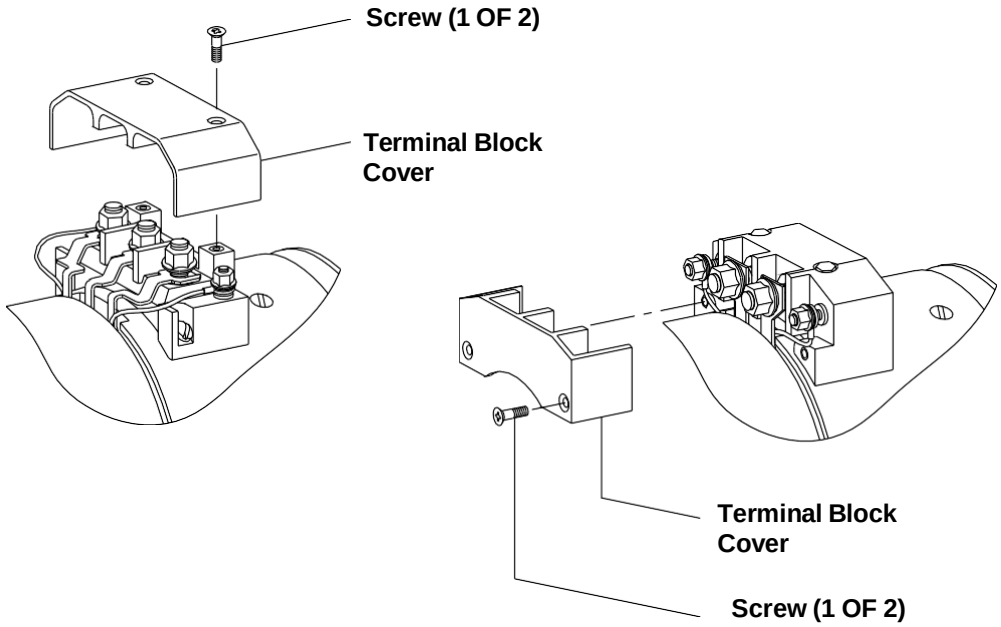


Figure 3002 - Removing Terminal Block Cover

E. Remove air inlet or fan cover (55) from starter-generator. See Figure 3003.

(1) Remove five screws (models 23077-006 and 23077-007) or eight screws (all other models) (60) and flat washers (65) that attach the air inlet to the starter-generator.

(2) Remove air inlet or fan cover (55).

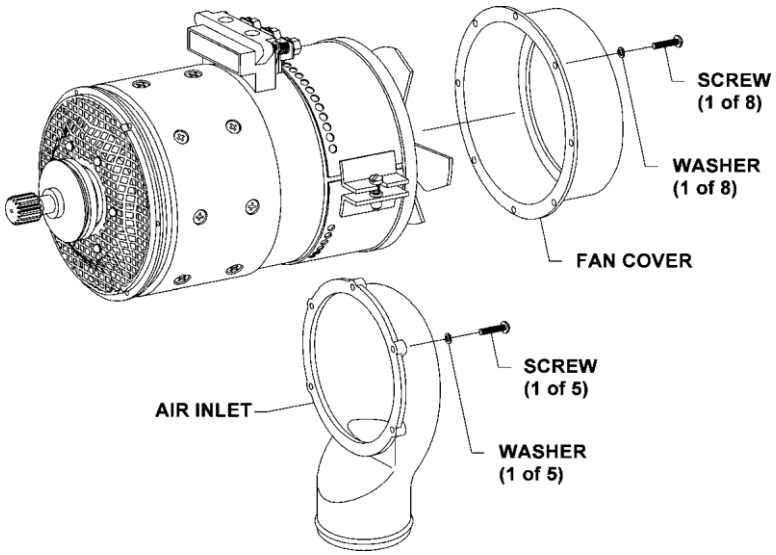


Figure 3003 - Removing Air Inlet Cover

F. Remove air inlet adapter (70) from starter-generator (Models 23077-006, -007 only). See Figure 3004.

(1) Remove eight screws (75) and flat washers (80) that attach air inlet adapter to starter-generator.

(2) Remove air inlet adapter (70).

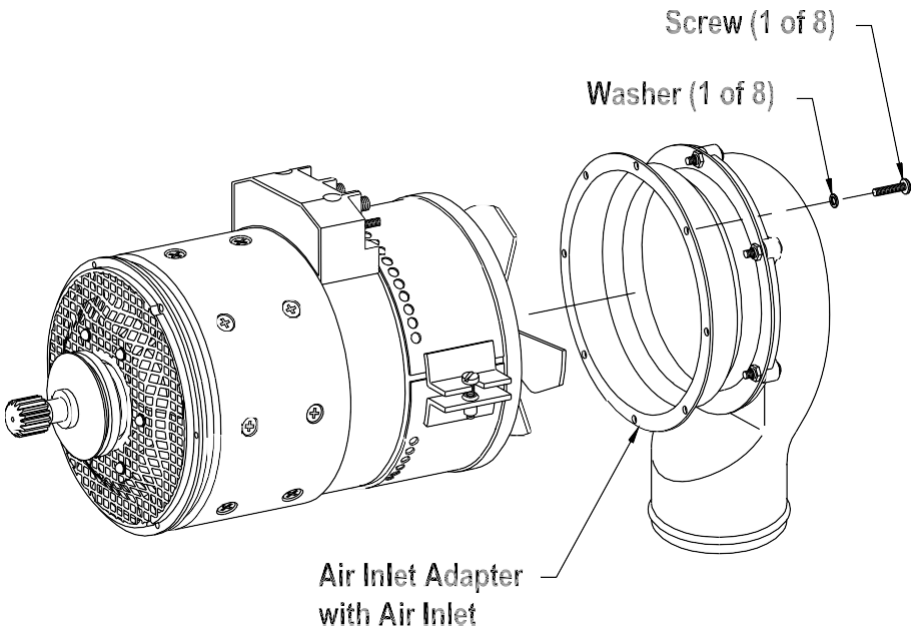


Figure 3004 - Removing Air Inlet Adapter

G. Remove brush access cover (85) from stator and housing assembly (235).

(1) Remove or sufficiently loosen screw (95) that secures the brush access cover (85) to the stator and housing assembly (235).

(2) Remove brush access cover (85).

H. Remove the brushes (100) from bearing and brush support assembly (160). See Figure 3005.

NOTE: Identification of brush holder assemblies and brush sets is not necessary during overhaul since all used brushes are discarded.

(1) Remove the screw (105) that secure the brush leads to the brush holder assembly (Figure 10002-25).

CAUTION: RAISE AND LOWER THE BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO REMOVE THE BRUSH SETS FROM THE BRUSH HOLDER.

(2) Use a wire hook tool to lift the two brush springs (Figure 10002-75) away from a brush set. Remove the brush set from the brush holder assembly.

(3) Slowly return brush springs to a resting position on the brush holder assembly.

(4) Identify the brush set with the number on the brush holder from which it was removed.

(5) Repeat steps 4.H.(1) through 4.H.(4) for each remaining brush holder assemblies.

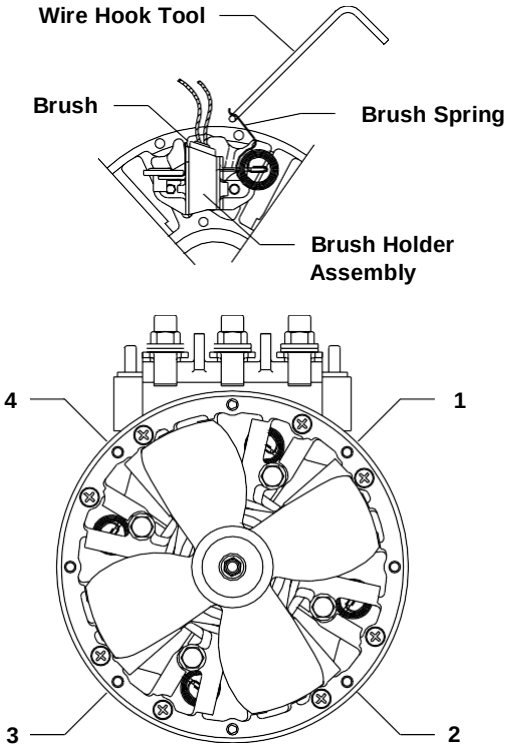


Figure 3005 - Brush Set Locations and Numbers

I. Remove the fan (110) from the drive shaft (125).

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

(2) Remove self-locking nut (115).

(3) Remove flat washer (120).

(4) Slide the fan (110) off of the drive shaft (125).

J. Remove the drive shaft (125) with the attached dampener hub (135), dampener plate (140), and friction ring (145) from armature shaft (205). See Figure 3006.

CAUTION: EXCESSIVE FORCE WHEN TAPPING THE DRIVE SHAFT CAN DAMAGE THE THREADS.

(1) Lightly tap the anti-drive end of the drive shaft (125) with a plastic or leather mallet to disengage it from the armature shaft.

(2) Pull the drive shaft (125) out of the drive end of the starter-generator.

WARNING: FRICTION RING CAN CONTAIN ASBESTOS, REFER TO MSDS FOR PRECAUTIONS.

(3) Remove the friction ring (145) from the drive shaft (125).

(4) Remove the dampener plate (140) from the dampener hub (135).

(5) On models 23077-006 and 23077-007 remove and discard the O-ring (130) from the drive shaft (125A).

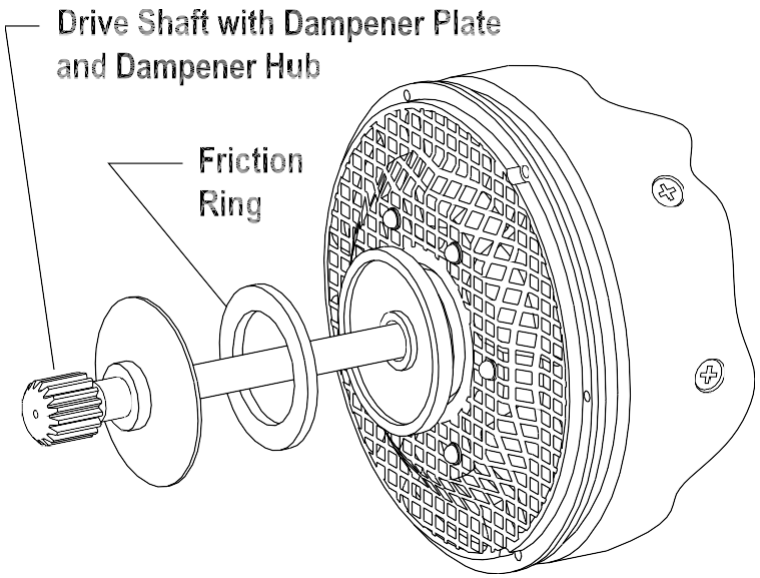


Figure 3006 - Drive Shaft Removal

K. Remove the dampener hub (135) from the drive shaft (125). See Figure 3007.

NOTE: Do not remove the dampener hub unless the hub or shaft is damaged.

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

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

(2) Set a dampener hub driver on the drive shaft on the flat side of dampener hub (135).

(3) Insert the drive shaft (125) through the center of the drive end hub support until the dampener hub driver is seated on the drive end hub support.

(4) Press the drive shaft down into the drive end hub support until the dampener hub (135) disengages from the drive shaft (125).

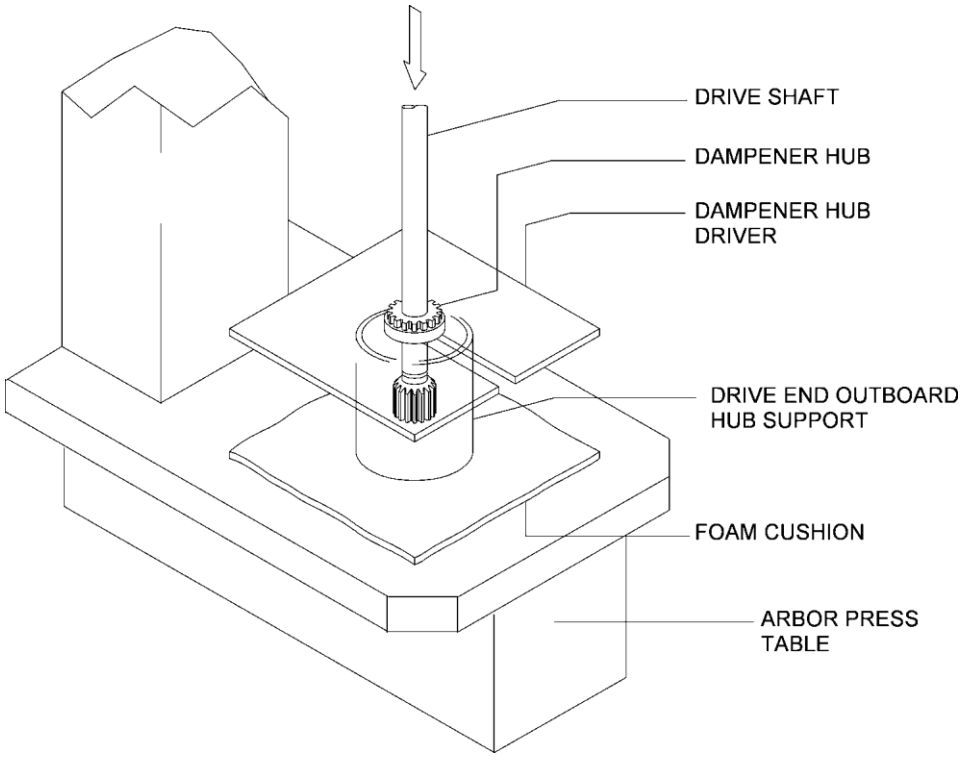


Figure 3007 - Dampener Hub Removal

L. Remove dampener backplate (150), retaining ring (155) and spacer (230) or baffle disc (225A) from armature shaft (205). See Figure 3008.

CAUTION: MAKE SURE YOU USE THE DRIVE END ARMATURE SHAFT ADAPTER DURING THIS PROCEDURE. THIS WILL PREVENT DAMAGE TO THE COMPONENTS.

(1) Put an armature shaft adapter in the drive end of the armature shaft.

CAUTION: PUT TAPE ON THE BEARING PULLER JAWS. THIS WILL PREVENT DAMAGE TO THE DAMPENER BACK PLATE DURING REMOVAL.

(2) Remove the dampener backplate (150) from the armature shaft (205) using a suitable bearing puller.

(3) Use external snap ring pliers to remove and discard retaining ring (155).

(4) Remove and retain spacer (230) or baffle disc (225A).

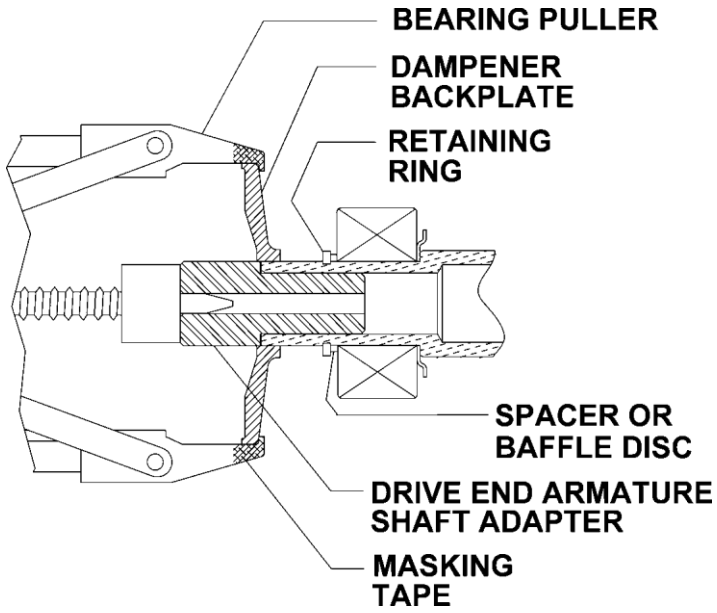


Figure 3008 - Removing Dampener Backplate

M. Remove the bearing and brush support assembly (160) and the attached armature (205) from the stator and housing assembly (235). See Figure 3009.

(1) Set starter-generator drive end down on a horizontal stator support.

CAUTION: MAKE SURE YOU USE THE DRIVE END ARMATURE SHAFT ADAPTER TO REMOVE THE BEARING AND BRUSH SUPPORT ASSEMBLY AND ATTACHED ARMATURE. THIS WILL PREVENT DAMAGE TO THE ARMATURE SHAFT.

(2) Remove eight screws (165) that attach the bearing and brush support assembly (160) to the stator and housing assembly (235).

(3) Put the drive end armature shaft adapter into the armature (205) shaft.

(4) Tap on the drive end armature shaft adapter with a rubber or plastic mallet until the bearing and brush support assembly (160) disconnects from the stator and housing assembly (235).

(5) Carefully remove the bearing and brush support assembly (160), with the attached armature, from the stator and housing assembly (235).

NOTE: The drive end ball bearing and drive end bearing shield or baffle disc (inboard) will stay on the armature shaft when removed from the stator and housing assembly.

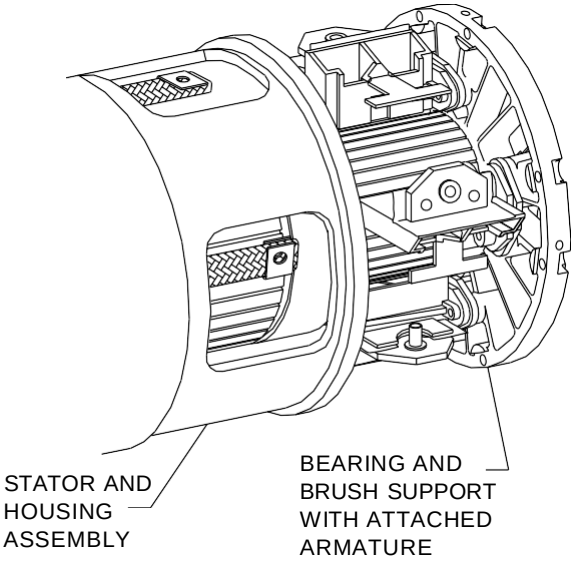


Figure 3009 - Removing the Bearing and Brush Support Assembly with Attached Armature

N. Remove drive end bearing support assembly (185) from stator and housing assembly (235). See Figure 3010.

(1) Set the stator and housing assembly (235) on a horizontal stator support.

(2) Remove three screws (190) that attach the drive end bearing support assembly (185) to the stator and housing assembly.

CAUTION: DO NOT USE EXCESSIVE FORCE WHEN TAPPING BEARING AND BRUSH SUPPORT ASSEMBLY OR DAMAGE TO THE MATING FLANGE OF THE STATOR AND HOUSING ASSEMBLY MAY RESULT.

(3) Lightly tap the outer diameter of the drive end bearing support assembly (185) with a plastic or leather mallet to loosen it from the stator and housing assembly (235).

(4) Remove the drive end bearing support assembly (185) from the stator and housing assembly (235).

(5) For pre-load models, remove the spring wave washer (195) and shim(s) (200) (if present) from drive end bearing support (330).

NOTE: The spring wave washer (195) can be reused if it passes the inspection criteria given in the CHECK section.

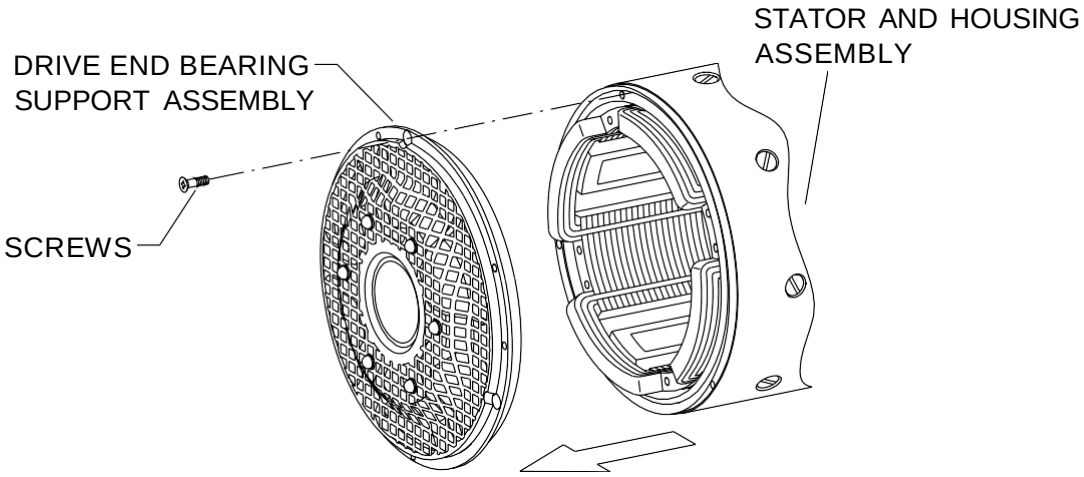


Figure 3010 - Removing Drive End Bearing Support Assembly

O. Remove the armature (205) from the bearing and brush support assembly (160). See Figure 3011.

CAUTION: MAKE SURE YOU USE A FOAM CUSHION UNDER BEARING AND BRUSH SUPPORT ASSEMBLY. THIS WILL PREVENT DAMAGE TO THE ARMATURE.

(1) Put a foam cushion and bearing and brush support assembly (160) support on an arbor press table.

(2) Put the bearing and brush support assembly (160) with the attached armature onto a bearing and brush support assembly support.

CAUTION: MAKE SURE YOU USE THE ANTI-DRIVE END ARMATURE SHAFT ADAPTER TO PUSH THE ARMATURE FROM THE BEARING AND BRUSH SUPPORT ASSEMBLY. THIS WILL PREVENT DAMAGE TO THE ARMATURE SHAFT.

(3) Insert an anti-drive end armature shaft adapter into the end of the armature (205) shaft.

CAUTION: BEFORE YOU PUSH OUT THE ARMATURE, HOLD IT TIGHTLY WITH YOUR HANDS SO IT IS NOT DAMAGED WHEN YOU PUSH IT OUT OF THE BEARING AND BRUSH SUPPORT ASSEMBLY.

(4) While supporting the armature assembly (205) securely with one hand, carefully press the armature shaft down and away from the bearing and brush support assembly (160).

(5) Carefully remove the armature (205) from inside of the bearing and brush support assembly support (160).

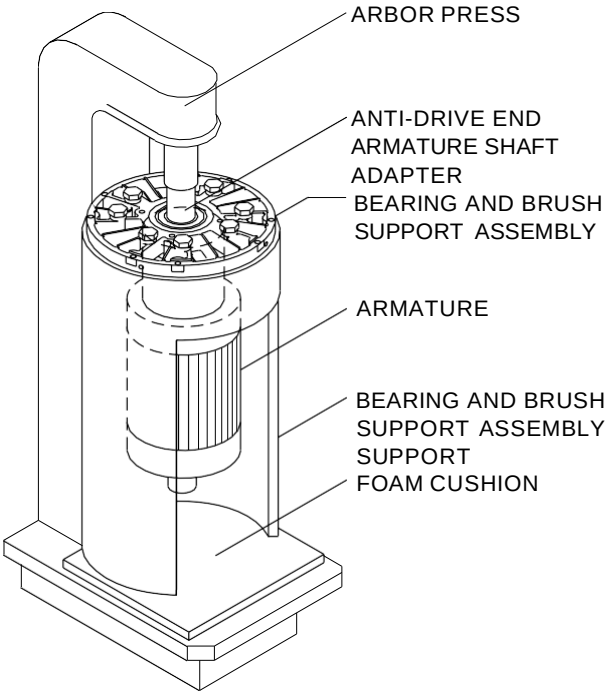


Figure 3011 - Removing the Armature from Bearing and Brush Support Assembly

P. Remove bearing retainer (210) from the bearing and brush support assembly (160).

(1) Remove four screws (215) that attach the bearing retainer (210) to the bearing and brush support assembly (160).

(2) Remove the bearing retainer (210).

Q. Remove the anti-drive end ball bearing (220) from the bearing and brush support assembly (160). See Figure 3012.

CAUTION: MAKE SURE YOU USE THE BEARING AND BRUSH SUPPORT BEARING HUB SUPPORT TO PUSH OUT THE BEARING. THIS WILL PREVENT DAMAGE TO THE BEARING AND BRUSH SUPPORT ASSEMBLY.

(1) Set an anti-drive end hub support on an arbor press table.

(2) Set the bearing and brush support assembly (160) on the anti-drive end hub support assembly with the outboard side down.

(3) Set an inner race bearing driver on the inner race of the ball bearing (220) installed in the bearing and brush support assembly (160).

(4) Carefully press the bearing (220) from the bearing and brush support assembly (160).

(5) Remove the bearing (220) from inside the anti-drive end hub support. Discard the bearing (220).

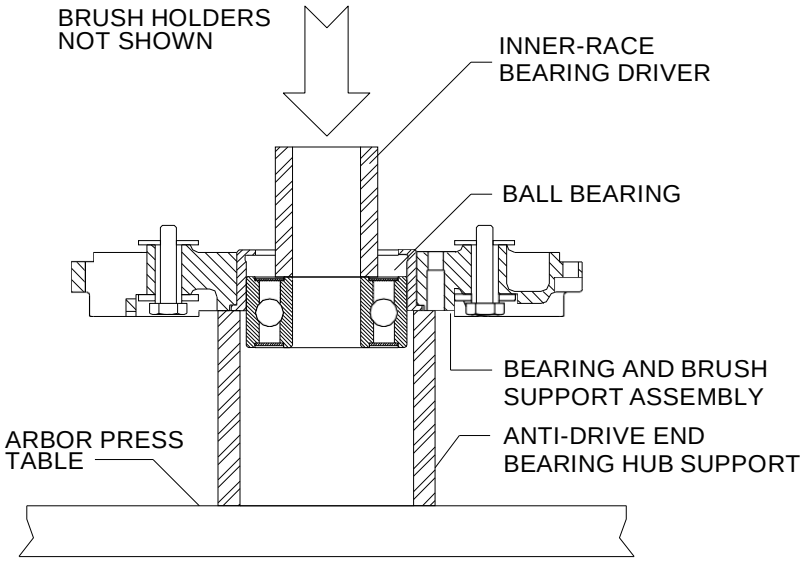


Figure 3012 - Removing the Anti-Drive End Bearing from Bearing and Brush Support Assembly

R. Remove the drive end ball bearing (221) and baffle disc (225) from the drive end of the armature shaft. See Figure 3013.

CAUTION: USE THE ARMATURE SHAFT ADAPTER WHEN REMOVING THE BEARING TO PREVENT PERMANENT DAMAGE TO THE ARMATURE SHAFT.

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

(2) Remove the bearing (221) from the armature shaft using a suitable bearing puller.

(3) Discard the bearing (221).

(4) Remove and retain the baffle disc (225) from the armature shaft.

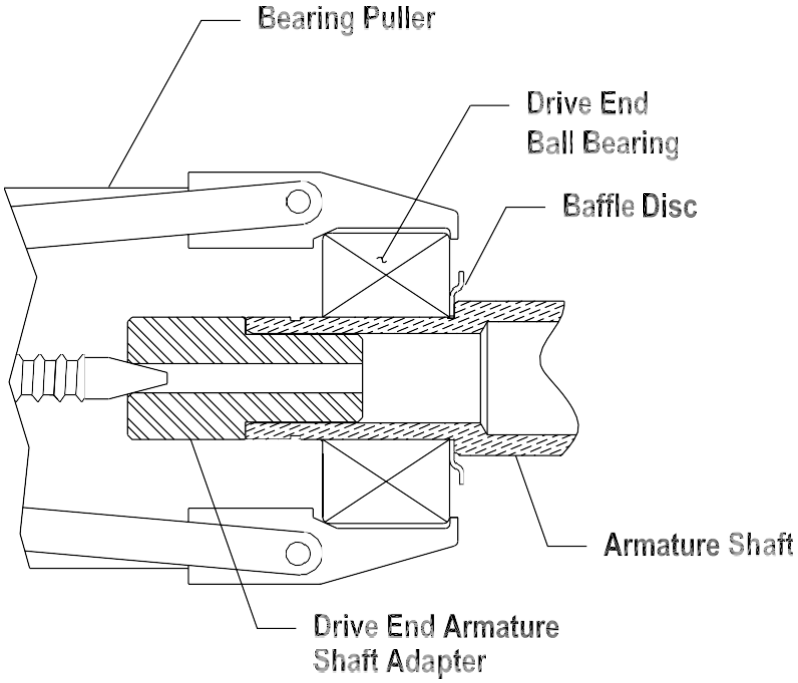


Figure 3013 - Removing Bearing from Drive End of Armature Shaft

5. Disassembly of Bearing and Brush Support Assembly

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

NOTE: Do not disassemble the bearing and brush support assembly further than required to examine, repair, or replace parts determined to be unserviceable.

A. Remove complete brush holder assemblies (15) from anti-drive end end bell (5). See Figure 3014.

(1) Remove two bolts (35), two insulating washers (40), flat washers (45), complete brush holders (15) and insulating board (55) from the anti-drive end end bell (5).

(2) Remove two insulating sleeves (50) from mounting holes in anti-drive end end bell (5).

(3) Discard insulating washers (40), insulating sleeves (50) and insulating board (55).

(4) Repeat steps 5.A.(1) through 5.A.(3) for remaining complete brush holders.

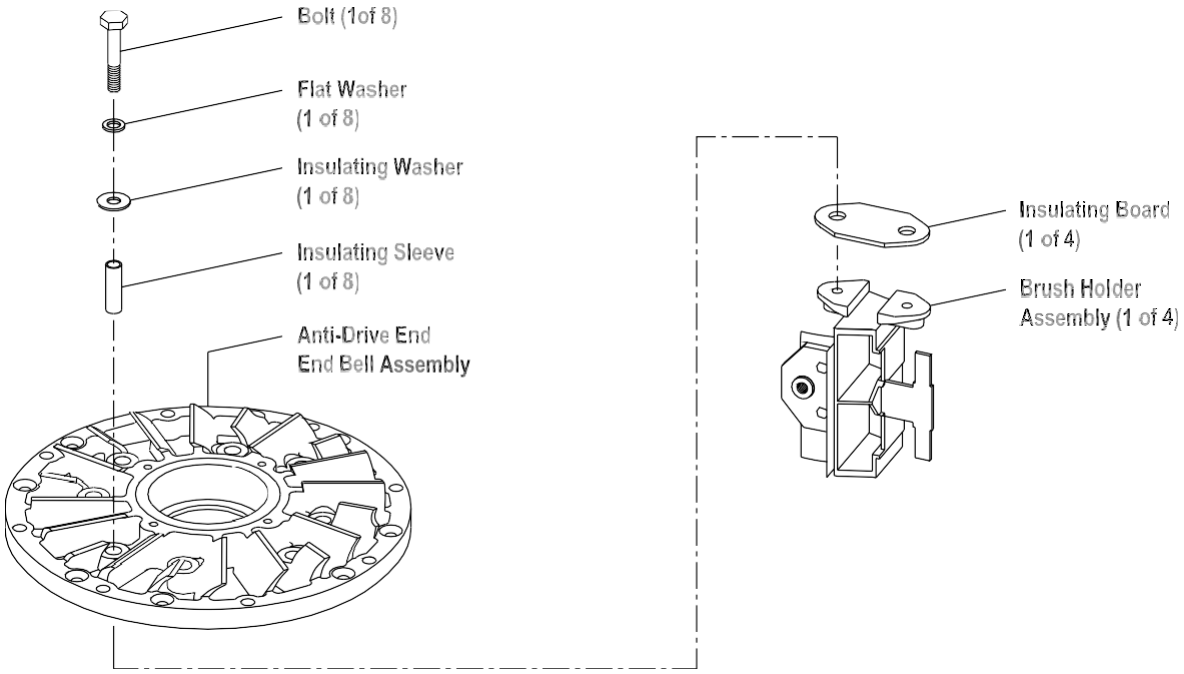


Figure 3014 - Removing Brush Holder Assemblies

B. Remove the brush springs (75) from the brush holder assemblies (15). See Figure 3015.

(1) Remove any of the eight brush springs (75) that need to be replaced from the brush holder assemblies (15).

(2) Discard the damaged brush springs (75).

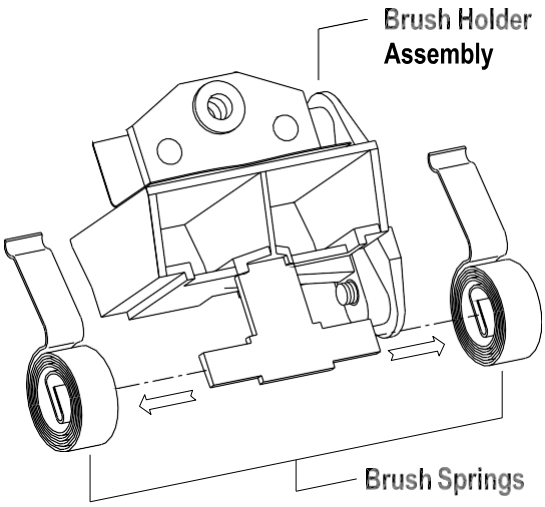


Figure 3015 - Removing Brush Springs from Brush Holder Assembly

C. Disassemble each complete brush holder (15) assembly.

NOTE: Do not disassemble complete brush holders unless necessary.

Refer to the REPAIR section for the complete brush holder (15) disassembly.

6. Disassembly of the Drive End Bearing Support Assembly.

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

NOTE: Do not disassemble the drive end bearing support assembly further than required to examine, repair or replace parts determined to be unserviceable.

A. Remove the screen (10) from the drive end end bell (5).

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

(1) Remove and discard the attaching drive screws (15) and flat washers (20).

(2) Remove and discard the screen (10).

7. Disassembly of the Stator and Housing Assembly.

NOTE: Refer to IPL Figure 10004 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

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

A. Remove the lead of the thermal switch (10001-170) from the terminal block (25). See Figure 3016.

NOTE: For models 23077-006 and 23077-007 only. The thermal switch may already have been removed if it was damaged.

(1) Remove the self-locking nut (10001-175) from the terminal block (25).

(2) Remove the thermal switch lead from the terminal block (25).

(3) Isolate the thermal switch lead with electrical insulating tape or equivalent.

(4) Secure the thermal switch lead to the stator housing so it is not damaged.

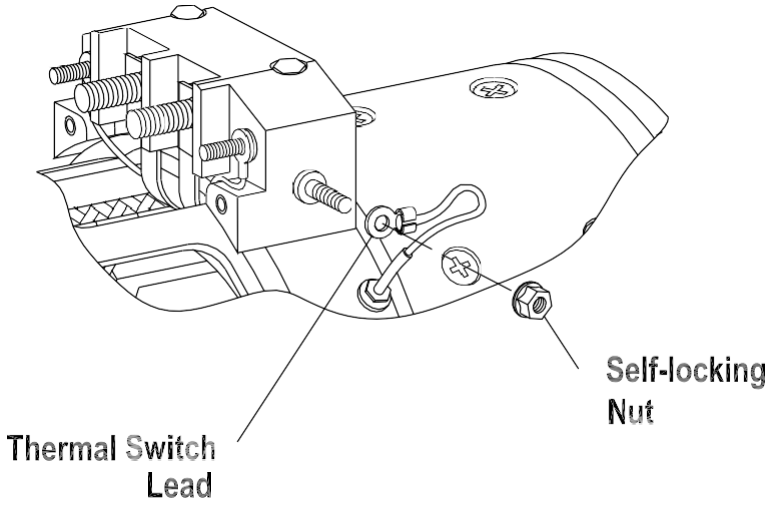


Figure 3016 - Removing Thermal Switch Lead

B. Removal of miscellaneous hardware from the terminal block (25). See Figure 3017.

NOTE: Items (5), (10), (15) and (20) could remain with aircraft.

(1) Remove the self-locking nuts (5) and flat washers (10) from the terminal studs B, E, and, if present C.

(2) Remove the self-locking nuts (15) and flat washers (20) from terminal studs A and D.

(3) Discard all self-locking nuts and flat washers.

(4) Remove two terminal lugs (45) and if applicable one terminal lug (45A).

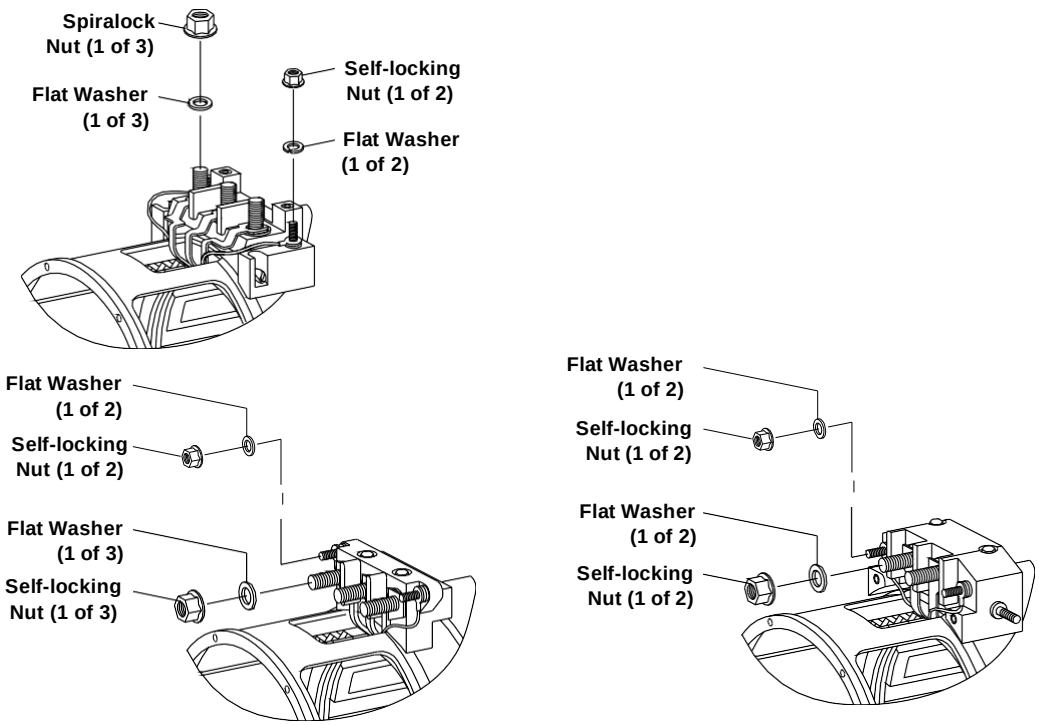


Figure 3017 - Miscellaneous Hardware Removal

C. Remove the terminal block (25) from the stator housing. See Figure 3018.

(1) Remove the screws or bolts (30), spring lockwashers (35) and flat washers (40) that attach the terminal block to the stator housing.

(2) Remove the small stator leads from terminal studs A and D.

(3) On models 23077-002, 23077-002-1, 23077-003, and 23077-004:

(a) Carefully bend back the large stator leads just enough to release terminal studs B, E, and C from the large stator leads.

(b) Slide the terminal block out from under the large stator leads.

(4) On all other models, slide the terminal block out from under the large stator leads.

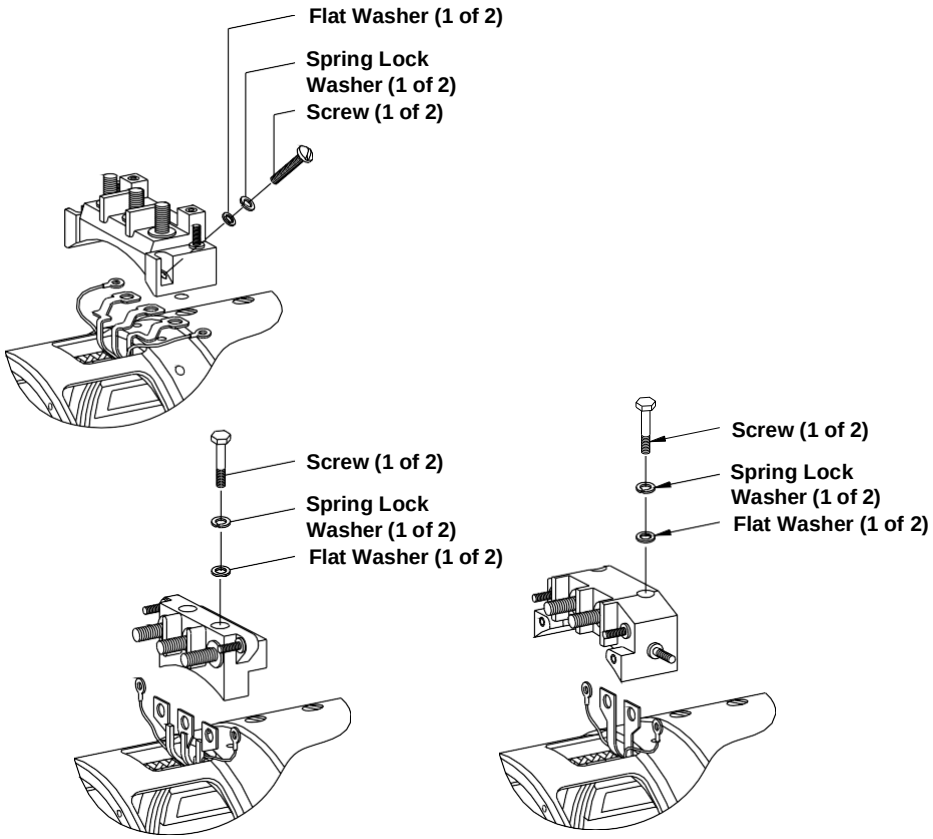


Figure 3018 - Removal of Terminal Block from Stator Housing

CLEANING

1. Introduction

This section provides the cleaning procedures for the 23077 Series DC Starter-Generator.

2. Cleaning Materials

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

NOTE: Equivalent substitutes can be used for the materials listed in Table 4001.

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-NF or 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 30 PSIG (207 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.
	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	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-NF or 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-NF or 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.

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) Examine each part for carbon particles by wiping with isopropyl alcohol on a clean 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.

4. Corrosion Prevention

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, you must examine all primary components to find out 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 CAN 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.

NOTE: Equivalent substitutes can be used for the tools and materials listed in Table 5001.

Tool Description	Reference
1/4 inch drive, 6 point deep well socket (attaches probe to torqometer	Commercially Available
Alcohol, Isopropyl	Commercially Available
Brush, non-metallic, soft bristle	Commercially Available
CDHT - Compression Digital Hand Tester or equivalent	Larson Systems Inc. Minneapolis, MN 55449-4425 Ph: 763-780-2131 www.larsonsystems.com (VOPWK9) or Commercially available
Cleaning pads/wiping cloths, lint-free, soft fabric	Commercially Available
Dial Indicators	Commercially Available
Dielectric (Hi-Pot) Tester	Table 1002

Table 5001 - Inspection Tools

Tool Description	Reference
Dynamic Balancer	Safran Corporation Standard Practice Document (SPD 1001)
Growler	Commercially Available
Magnifier, 7X to 10X	Commercially Available
Ohmmeter	Commercially Available
Pull Scale	Commercially Available
Surface Plate	Commercially Available
V-blocks	Commercially Available

Table 5001 - Inspection Tools (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 other side of the winding that is spanned by the growler.

3. General Information

Check Acceptance Limit Measurements for individual components are found in 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. Examine starter-generator:

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 starter-generator electrical components:

(1) Examine the starter-generator in a brightly lit work area IAW paragraph 3.B.

D. Examine starter-generator attaching hardware:

(1) 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. Perform NDT inspections as follows:

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

(2) Unless otherwise specified, do liquid penetrant inspections IAW ASTM-E1417-99, 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. Replacing Service Parts and Common Hardware

A. Overhaul

During overhaul, all bearings, brushes, O-rings, and locking hardware shall be discarded regardless of condition. Replace all damaged, deformed, corroded or apparently defective hardware.

B. Service Repair

(1) During repair, inspection or servicing, replace all locking hardware regardless of condition if removed during disassembly. Replace all damaged, deformed, corroded or apparently defective hardware.

(2) Replace bearings if removed during disassembly.

(3) Replace brushes if inspection determines necessary.

7. Inspection of starter-generator Parts and Assemblies

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 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, 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: rotor assembly 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: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

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-band Clamp (10005-5).

NOTE: The V-band clamp usually stays on the aircraft when the starter-generator is removed for service. Check and inspection of the part is not required if not present.

(1) Examine the V-band clamp in accordance with the procedures found in section 3.A.

(a) DISCARD the clamp if cracks, corrosion, dents, nicks, or scratches exist.

(2) Examine the T-bolt (10005-15) in accordance with the procedures found in Paragraph 3.A.

(a) REPAIR T-bolt with two or less damaged thread turns. DISCARD if damage exceeds that.

(b) DISCARD the self-locking nut if removed.

B. QAD Mounting Adapter 10005-20. See Figure 5001.

NOTE: The mounting adapter usually stays on the aircraft when the starter-generator is removed for service. Check and inspection of the part is not required if not present.

(1) Examine the QAD Mounting Adapter (10005-20) in accordance with the procedures found in Section 3.A.

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

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

(2) Visually examine mating surfaces for eroded surface coatings and pitting.

(a) DISCARD mounting adapter if pilot flange and/or pilot bore diameter is not within the limits in the FITS AND CLEARANCES section.

(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 in accordance with section 5.A.(2).

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) Examine the adapter for damaged or missing guide pins.

(a) REPLACE guide pin(s) if damaged or missing.

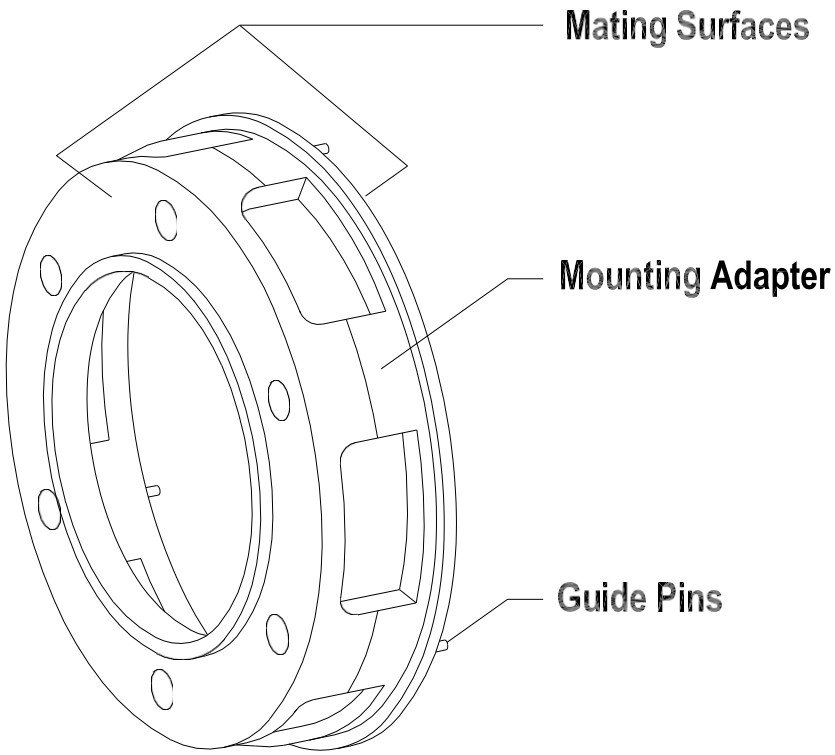


Figure 5001 - Inspecting Mounting Adapter

C. Nameplate (10) and Information Plate (20).

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 parts in accordance with the procedure found in section 3.A.

(a) If damaged, transfer information from the old plate to a replacement plate.

(b) DISCARD the old plate.

(2) Make sure the information on the plate is legible.

(a) If illegible, transfer information from the old plate to a replacement plate.

(b) DISCARD the old plate.

(3) Make sure drive screws are in place and tight.

(a) REPLACE and DISCARD loose drive screws.

(b) REPLACE missing drive screws.

D. Terminal Block Cover (45).

(1) Examine the part in accordance with the procedures found in section 3.A.

(2) DISCARD the terminal block cover if it is damaged.

E. Air Inlet or fan cover (55). See Figure 5002.

Examine the part in accordance with the procedures found in section 3.A.

(1) DISCARD the part if cracks exists, if damage extends to the mounting or inlet flange, or fretting corrosion exists.

(2) REPAIR the part if minor nicks, dents, scratches, gouging, scoring or glazing is found.

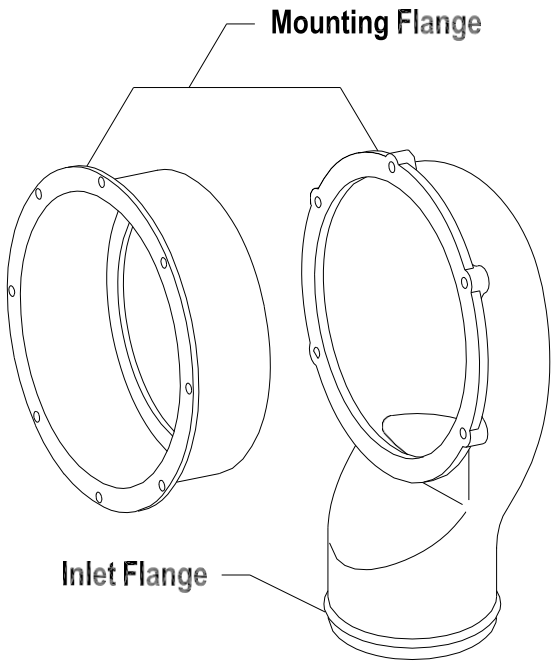


Figure 5002 - Inspecting Air Inlet

F. Air Inlet Adapter (70).

Examine the part in accordance with the procedures found in section 3.A.

(1) DISCARD the part if cracks, fretting corrosion, gouging, scoring, or glazing on the mating surfaces exist.

(2) DISCARD the air inlet adapter if more than two threads are damaged on any of the threaded nuts. REPAIR if damage is two or less threads.

G. Brush Access Cover (85). See Figure 5003.

(1) Examine the part in accordance with the procedures found in section 3.A.

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

(b) REPAIR the part if damage is minor.

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

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

(3) Examine the screw (95) threads IAW the procedures found in section 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) Make sure that the rivet nut (90) on the bracket is tightly attached.

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

(5) Examine the rivet nut (90) threads IAW the procedures found in section 3.A.

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

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

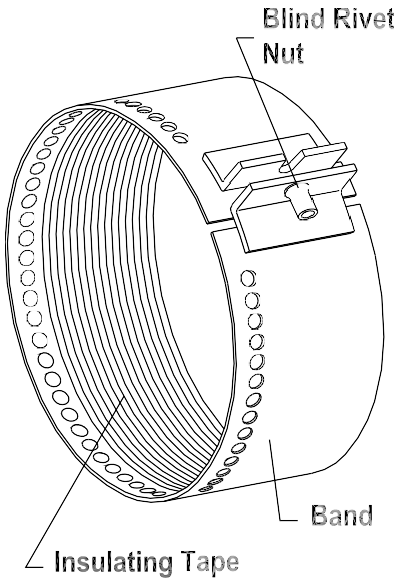


Figure 5003 - Inspecting Brush Access Cover

H. Brushes (100). See Figure 5004.

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.

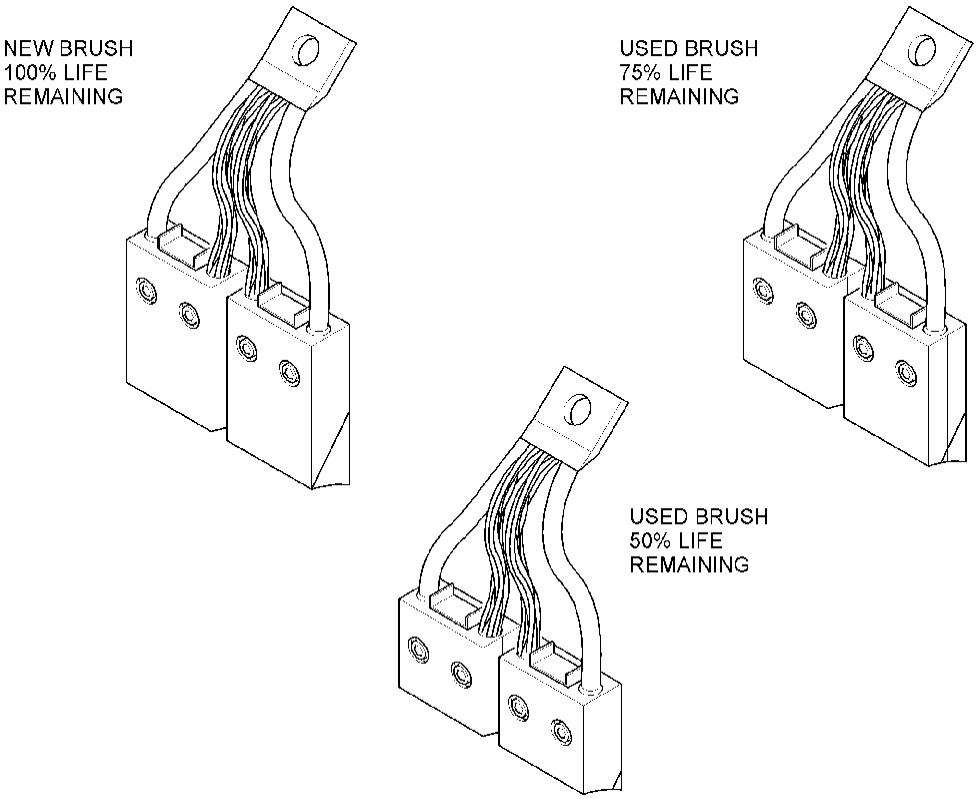


Figure 5004 - Brush Wear (Typical Shown)

I. Fan (110). See Figure 5005.

(1) Examine the part in accordance with the procedures found in section 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 in accordance with section 5.A.(2).

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.

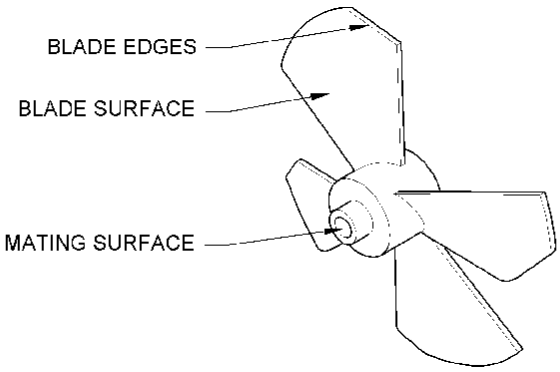


Figure 5005 - Fan

J. Drive Shaft (125) and Dampener Hub (135).See Figure 5006.

(1) Examine the part in accordance with the procedures found in section 3.A.

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

(b) REPAIR the drive shaft and dampener hub if nicks, and scratches exist.

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

(a) DISASSEMBLE drive shaft and dampener hub if damaged. DISCARD the damaged part if out of limits.

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

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

(4) Perform a magnetic particle inspection IAW procedures found in 5.A.(1).

(a) DISCARD the drive shaft (270) and dampener hub (310) if damage is found.

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

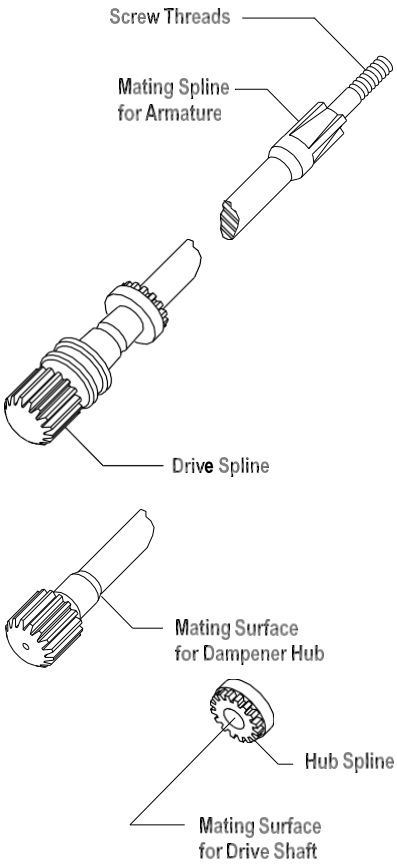


Figure 5006 - Inspecting Drive Shaft and Dampener Hub

K. Friction Ring (145). See Figure 5007.

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. 02-5600-06, it must be discarded because it contains asbestos.

(2) Examine the part in accordance with the procedures found in section 3.A.

(a) DISCARD the part if damage is found.

(3) Measure the Friction Ring

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

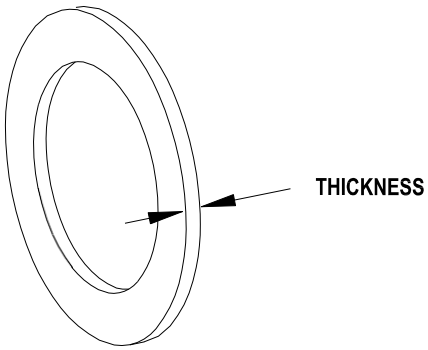


Figure 5007 - Inspecting Friction Ring

L. Dampener Plate (140). (See Figure 5008).

(1) Examine the part in accordance with the procedures found in section 3.A.

(a) DISCARD the part if cracks exist.

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

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

(a) DISCARD the part if damaged.

(3) Measure the dampener plate thickness.

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

(4) Measure the distance between pins of the spline teeth.

(a) 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 5.A.(1).

(a) DISCARD the part if damaged.

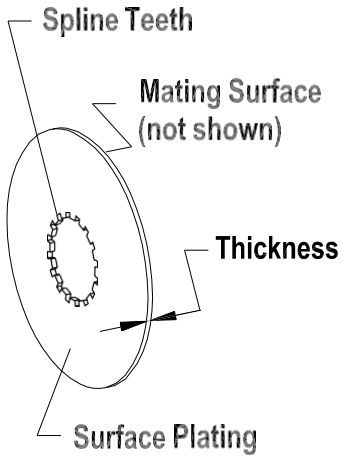


Figure 5008 - Inspecting Dampener Plate

M. Dampener Backplate (150) See Figure 5009.

(1) Examine the part in accordance with the procedures found in section 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 5.A.(1).

(a) DISCARD if damage is found.

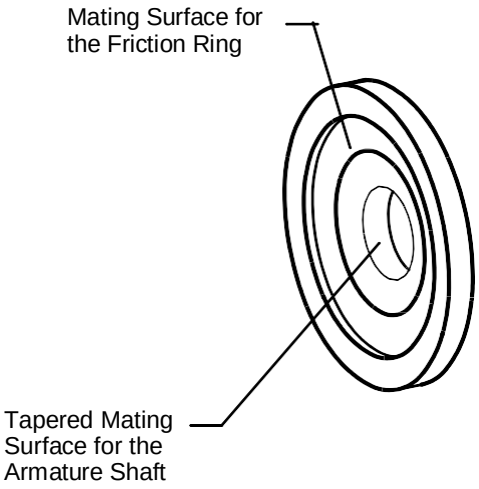


Figure 5009 - Inspecting Dampener Backplate

N. Bearing and brush support assembly (160). See Figure 5010 through Figure 5012.

(1) Examine the part in accordance with the procedures found in section 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 (marked 1, 2, 3, and 6 on figure) 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.A.(2).

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.”

(a) DISASSEMBLE the bearing and brush support assembly (160) if damage is found.

(b) REPAIR if diameter does not meet the limits in the FITS AND CLEARANCES section. Refer to Safran Corporation SPD 1000. See Figure 6006 for machining dimensions.

(5) Examine the helicoil inserts (10002-10) at locations 3 and 4 for damage.

(a) REPAIR helicoil if damage is found.

(b) REPAIR any damaged parts.

(6) Hand tighten a machine screw into the rivet nut in the complete brush holder (10002-10) to make sure that the self-locking feature is functional. The machine screw must bind in the rivet nut before it is fully engaged.

(a) REPAIR the complete brush holder (10002-20) if the rivet nut is damaged.

(b) REPAIR the complete brush holder (10002-20) if the self-locking feature does not function correctly.

(7) Examine the brush holders (10002-20), the brush spring supports and the center supports for cracks, warping, and discoloration caused by electrical arcing.

(a) DISCARD the complete brush holder (10002-20) if damage is found.

(8) Measure the brush spring pressure using a pull scale with harness.

NOTE: When measuring brush spring pressure, 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 the average from the measurements.

(c) DISCARD any brush spring that is not within the limits in the FITS AND CLEARANCES section.

(9) Do a dielectric test as follows:

NOTE: The bearing and brush support assembly must be clean before you do the dielectric check.

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 ELECTRICAL SHOCK.**

CAUTION: FAILURE TO TURN OFF DIELECTRIC 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 MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

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

(b) Connect the negative test lead to an uncoated surface of the bearing and brush support.

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

(d) Slowly adjust the output voltage (at a rate not more than 100 V/sec.) to 250 V rms, commercial frequency. Decrease the voltage to zero.

(e) Set the high potential tester power OFF.

(f) Remove the leads.

(g) Acceptance Limits:

1 Arcing, as seen by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current more than 2 mA will be caused by damp, dirty, weak or defective components.

If bearing and brush support assembly is unsatisfactory during the dielectric test, clean bearing and brush support assembly, and do the test again.

2 If bearing and brush support assembly is still unsatisfactory after cleaning, disassemble the bearing and brush support assembly, replace all insulating materials (i.e., washers, sleeves, plates), and do the test again.

If bearing and brush support assembly is still unsatisfactory, replace it.

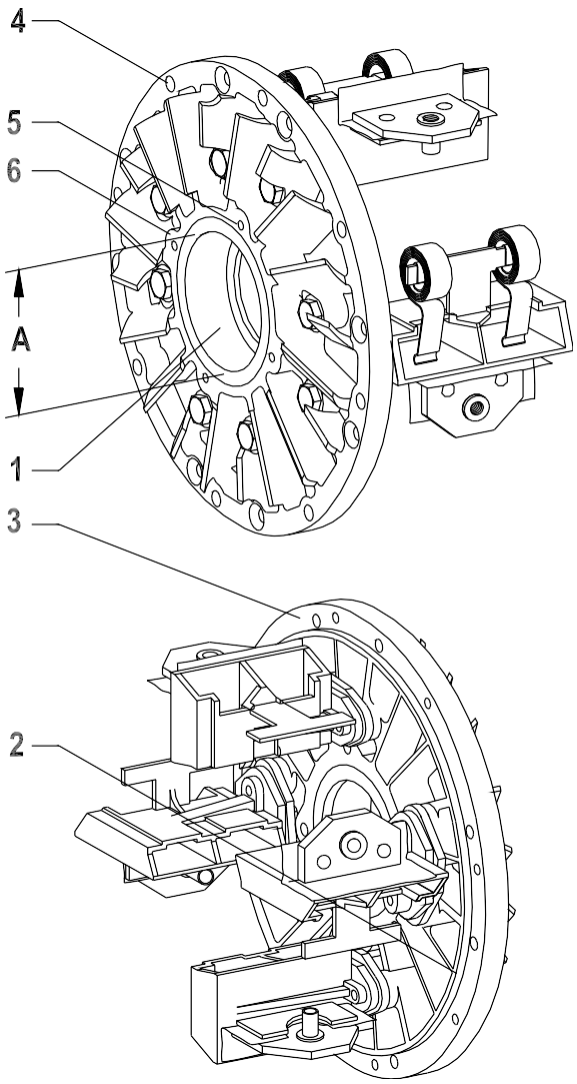


Figure 5010 - Inspecting Bearing and Brush Support Assembly

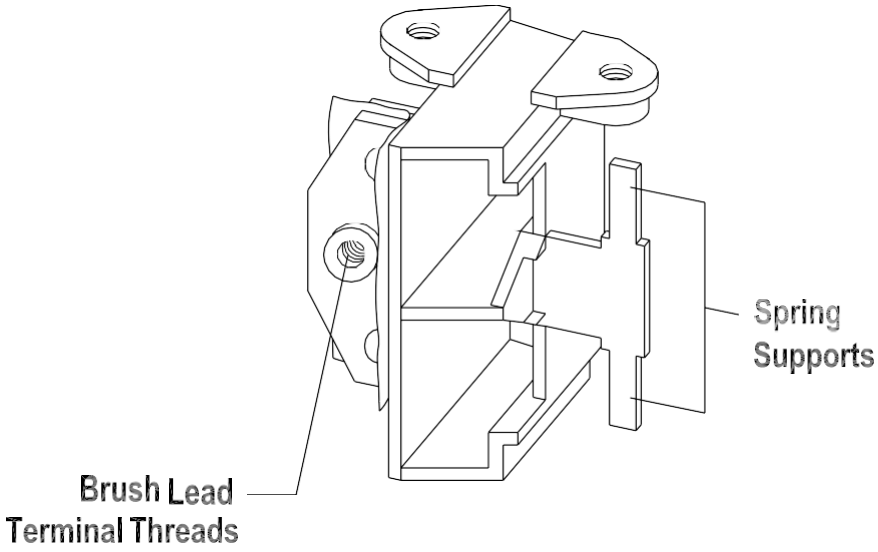


Figure 5011 - Checking Brush Holder Assembly

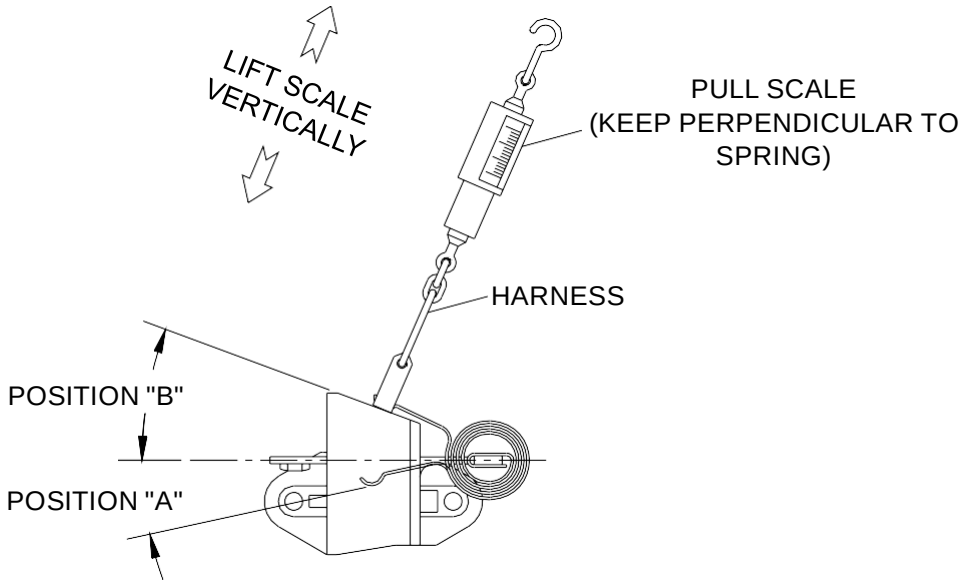


Figure 5012 - Testing Brush Spring Pressure

O. Drive End Bearing Support Assembly. See Figure 5013.

(1) Examine the part in accordance with the procedures found in section 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.A.(2).

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 the bearing liner diameter.

(a) REPAIR if part does not meet requirements of FITS AND CLEARANCES section.

(5) Examine screen (10003-10) for major dents or fractures.

(a) DISCARD screen if damage is found.

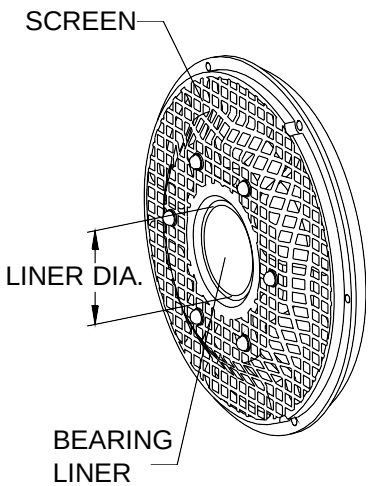


Figure 5013 - Inspecting Drive End Bearing Support Assembly

P. Spring Wave Washer (195). See Figure 5014.

(1) Visually examine all surfaces for evidence of corrosion, cracks, galling, glazing or scoring.

(a) DISCARD the spring washer 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 5014.

(a) DISCARD if the load listed below 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)

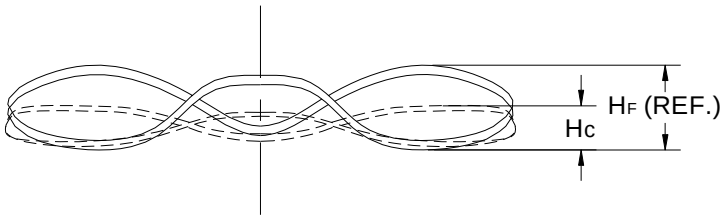


Figure 5014 - Spring Wave Washer Load Inspection

Q. Armature (205). see Figure 5015.

CAUTION: USE OF GLYPTOL ON EITHER THE ARMATURE OR STATOR WINDINGS IS STRICTLY PROHIBITED. UNITS HAVING GLYPTOL COATING ON EITHER OF THESE PARTS SHALL HAVE THESE PARTS REPLACED PRIOR TO RETURNING THE UNITS TO SERVICE. GLYPTOL MAY BE USED ON INTERNAL SURFACES OF THE HOUSING ONLY, AND ONLY WHERE OTHER COATINGS ARE NOT REQUIRED.

(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 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 in accordance with the procedures found in section 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 journal diameters A and C as shown in Figure 5015.

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

(b) REPLACE armature if damage is not repairable.

(5) Measure the commutator diameter B as shown in Figure 5015.

(a) REPLACE armature if the diameter (before recut) does not meet limits in the 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.

(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 (before recut) is below limits in FITS AND CLEARANCES section.

(b) REPLACE armature if damage is not repairable.

(10) After the commutator is refinished, measure commutator bar-to-bar and total indicator reading (TIR) run-out in a full circumference. Support the armature (205) on two “V” blocks.

(a) Measure commutator bar-to-bar run-out.

1 Resurface armature if bar-to-bar run-out is more than the limits in the FITS AND CLEARANCES section.

(b) Measure commutator TIR run-out.

1 Resurface armature if TIR is more than the limits of the FITS AND CLEARANCES section.

(11) Check armature balance at two planes using a dynamic balancer. Refer to SPD 1001.

(a) REPAIR armature if balance does not meet limit in FITS AND CLEARANCES section.

(12) 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 (205) if a short exists.

(13) 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 DIELECTRIC TESTER POWER BEFORE CONNECTING OR DISCONNECTING HIGH VOLTAGE ELECTRICAL LEADS CAN CAUSE SERIOUS DAMAGE TO THE ARMATURE.

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

(a) With power OFF, connect positive test lead of high potential tester to armature (205) shaft.

(b) 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 volts/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.

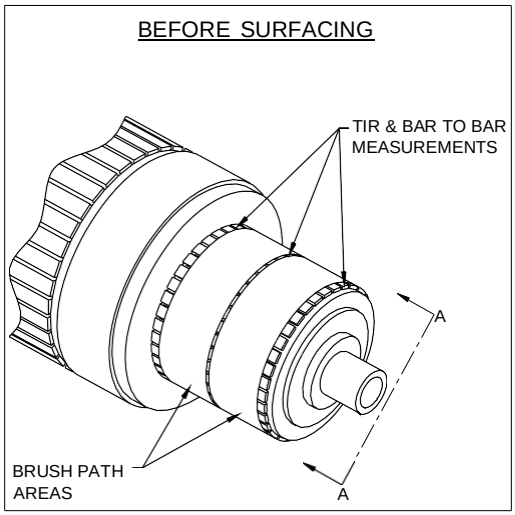
(h) Repeat dielectric test between retaining bands and commutator bars.

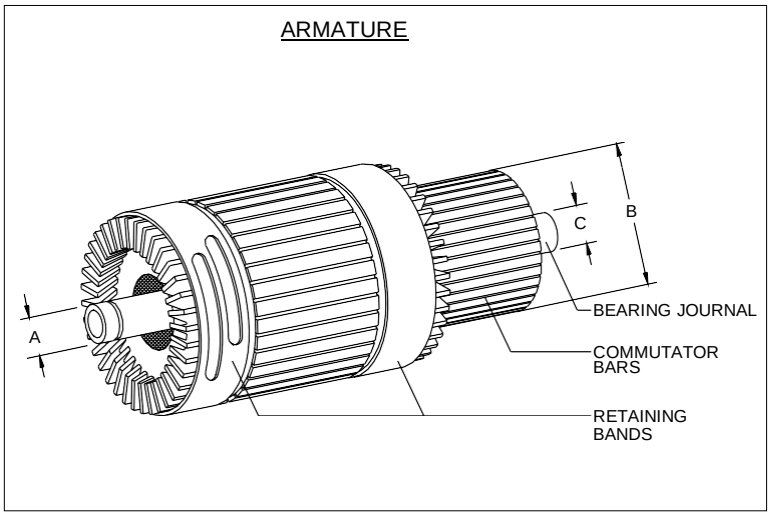
(i) Acceptance Limits:

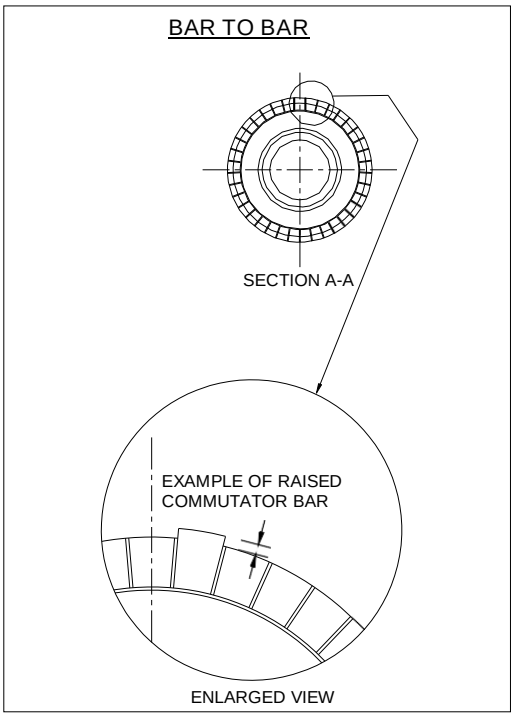
1 Any arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current is more than 2 mA it is evidence of damp, dirty, weak or defective components and constitutes a failure.

If armature (205) fails dielectric test, clean armature (205) and repeat dielectric test.

2 If armature (205) fails dielectric test after cleaning, replace armature.







BEFORE COMMUTATOR SURFACING

BAR TO BAR:
0.0008 IN. (0,020 MM)

Ø WEAR LIMIT (MEASUREMENT "B"):
2.50 IN. (63,5 MM) MIN.

Figure 5015 - Armature Check

R. Bearing Retainer (210). See Figure 5016.

(1) Examine the part in accordance with the procedures found in section 3.A.

(a) DISCARD the part if damaged.

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

(a) DISCARD the part if damaged.

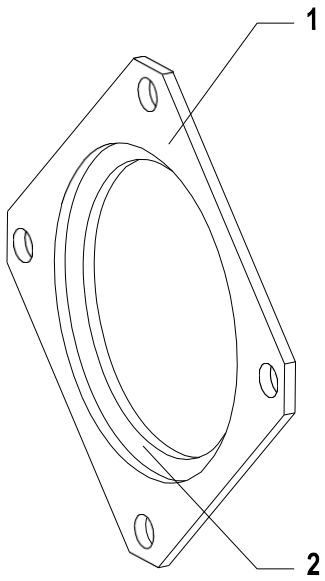


Figure 5016 - Inspecting Bearing Retainer

S. Baffle Disc (225). See Figure 5017.

(1) Examine the part in accordance with the procedures found in section 3.A.

(a) DISCARD the part if damaged.

(2) Carefully examine mating surfaces 1, 2, and 3 for gouging, scoring, or glazing.

(a) DISCARD the part if damaged.

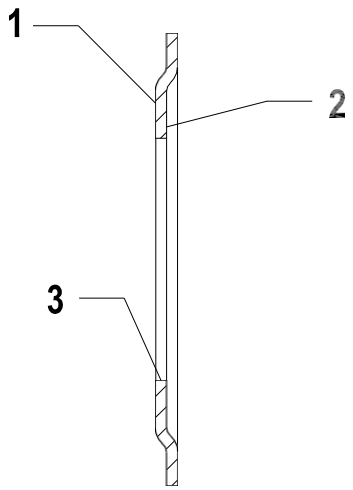


Figure 5017 - Inspecting Baffle Disc

T. Spacer (230).

(1) Examine the part in accordance with the procedures found in section 3.A.

(a) DISCARD the part if damaged.

U. Stator and Housing Assembly (235). See Figure 5018.

CAUTION: USE OF GLYPTOL ON EITHER THE ARMATURE OR STATOR WINDINGS IS STRICTLY PROHIBITED. UNITS HAVING GLYPTOL COATING ON EITHER OF THESE PARTS SHALL HAVE THESE PARTS REPLACED PRIOR TO RETURNING THE UNITS TO SERVICE. GLYPTOL MAY BE USED ON INTERNAL SURFACES OF THE HOUSING ONLY, AND ONLY WHERE OTHER COATINGS ARE NOT REQUIRED.

(1) Examine the part in accordance with the procedures found in section 3.A. and 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 five percent of the brush lead, REPLACE the stator and housing assembly (235).

(b) If stator lead damage is found, REPLACE the stator and housing assembly (235).

(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 DIELECTRIC 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 MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

CAUTION: USE A DUMMY TERMINAL BLOCK, OR DISCONNECT STATOR LEADS FROM ATTACHED TERMINAL BLOCK BEFORE TEST.

(a) Jumper all stator leads together.

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

(c) 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 volts/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 is more than 2 mA it is evidence of damp, dirty, weak or defective components and constitutes a failure.

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

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

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

1 REPLACE the stator and housing assembly if an open circuit exists.

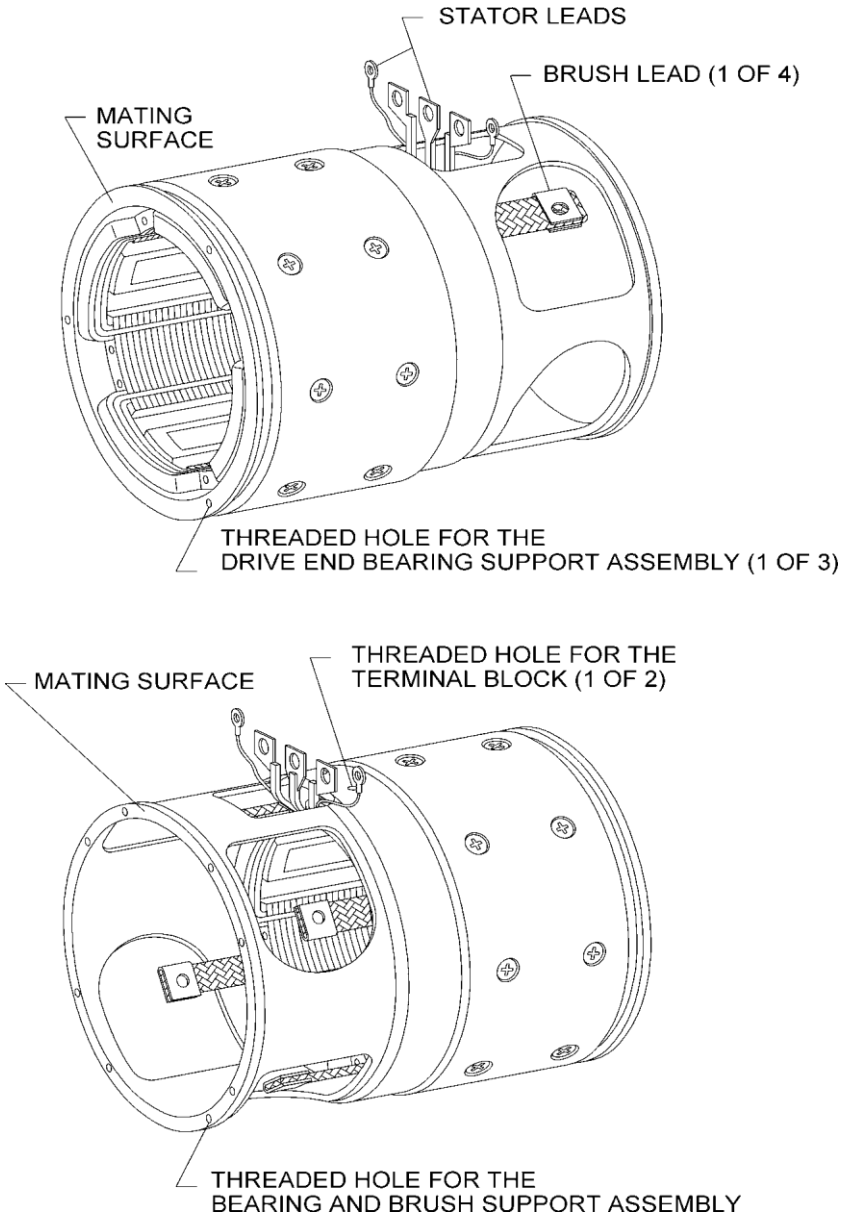


Figure 5018 - Inspecting Stator and Housing Assembly

V. Terminal Block (10004-25). See Figure 5019.

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

(1) Examine the part in accordance with the procedures found in section 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) Using an LCR (inductance, capacitance and resistance) meter, measure the capacitance values between terminals B and E, B and ground and C (if applicable) and ground.

(a) Measure terminals B to E at 110 to 130 Hz, 77° F (25° C) ± 10%.

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

(b) To check whether the capacitor is holding a charge, connect an ammeter in series with capacitor and voltage source.

1 Gradually apply voltage at the rated value of the capacitor listed in the FITS AND CLEARANCES section across terminals B to E and measure current.

a DISCARD the part if there is more than 1µA of leakage.

(c) Discharge the capacitor after testing is completed using a current limiting resistor.

(d) Repeat steps (a) thru (c) for B to ground.

(e) Repeat steps (a) thru (c) for C (if applicable) to ground.

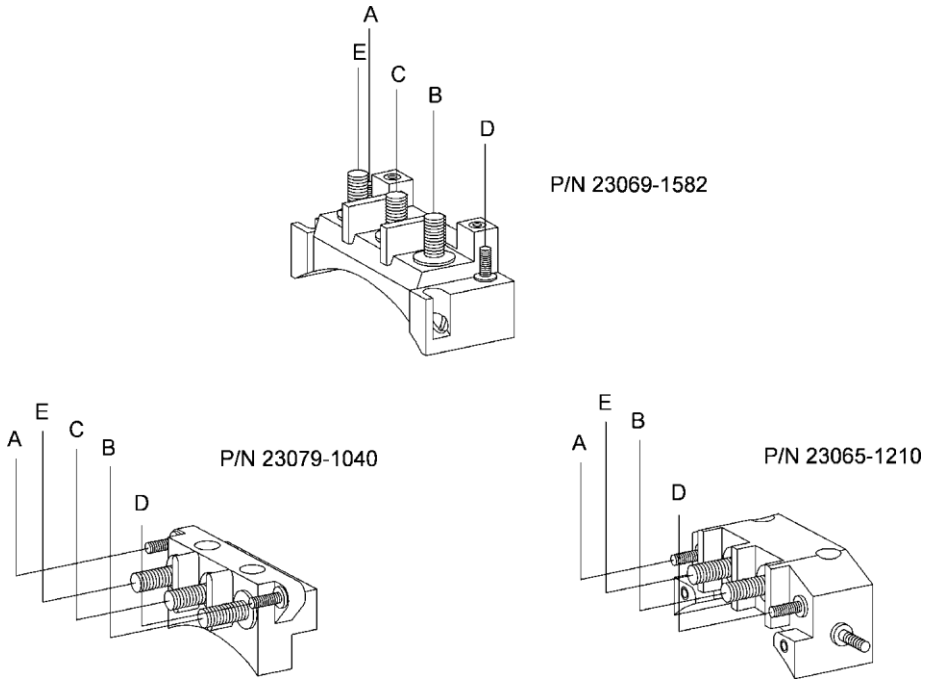


Figure 5019 - Inspecting Terminal Block

W. Thermal Switch (170).

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

(a) REPLACE thermal switch if damaged.

(2) Examine insulation sleeving for cracks or tears.

(a) REPLACE thermal switch if damaged.

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

(a) REPLACE thermal switch 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 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 322 to 338° F (161,1 to 170° C) and opens when temperature drops to 292 to 308° F (144,4 to 153,3° C).

9. Terminology.

Table 5002 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 5002 - 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 current-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 5002 - Terminology (Continued)

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REPAIR

1. Introduction

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

This section provides authorized repair instructions for Model 23077 Series Starter-Generators. Repairs are limited to:

- repairing damaged surfaces
- repairing damaged threads
- replacing helical coil inserts
- replacing terminal lugs
- 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 rivet nut.

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

In addition to specific repairs authorized by Safran Corporation in this manual, standard repair procedures for starter-generators are described in the following Safran Corporation 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, Lead Formation, 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 can be used for the tools listed in Table 6001.

Tools	Reference
Anti-Drive End Armature Shaft Adapter	Figure 9003
Commutator Turning Fixture	Figure 9008
Drive End Armature Shaft Adapter	Figure 9002
Drive End Inboard Hub Support	Figure 9014
Flash Field Switch	Rating: 30 VDC, 10 A
Helical Coil Insert Removal and Installation Tool	Commercially Available
India Stone	Commercially Available
PlusNut® Fastener Header P/N C1000-832	
Rivet Alignment and Press Fixture	Figure 9009
Six Volt Battery or Equivalent DC Power Source	Commercially Available
Solder Equipment	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 can be used for the materials listed in Table 6002. Repair materials are not available from Safran Corporation. 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/Material Specification	Source
Alcohol, Isopropyl	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
Chemical Film Solution Alodine 1200	Chemical Film Solution MIL-C-5541, Class 3	Henkel Surface Technology Madison Heights, MI 48071 www.henkel.ca (V1N6B3)
Coating, Zinc Phosphate	TT-C-49, Type 1	Commercially Available
Enamel, Polyurethane Gloss Black (GR5)	Gloss Top Coat Polyurethane MIL-PRF-85285, Type 1, Color 17038	PRC - De Soto International Incorporated 5454 San Fernando Road' P.O. Box 1800 Glendale, CA 91209 Ph: (818) 240-2060 FAX: (818) 549-7771 www.prc-desoto.com (V0LZE0)
EnSolve, Cleaning Solvent	Ensolve Cleaning Solvent	Enviro Tech International, Inc. Alameda, CA 94501 www.ensolv.com (V0S8S8)
Oil, Machine	N/A	Commercially Available
Pads, Cleaning	Lint-free cotton	Commercially available

Table 6002 - Repair Materials

Item	Description/Material Specification	Source
Primer, Epoxy Yellow	Primer, Epoxy-Polyamide IAW MIL-P-23377F, Type 1, Color Yellow (P6)	PRC - De Soto International Incorporated 5454 San Fernando Road' P.O. Box 1800 Glendale, CA 91209 Ph: (818) 240-2060 FAX: (818) 549-7771 www.prc-desoto.com (V0LZE0)
Primer, Zinc Chromate	TT-P-1757 Composition G, Color Yellow.	Commercially Available
Sandpaper	400/600 grit (non-aluminum oxide only)	Commercially Available
Tape, Insulating	P/N SG13-06R 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 corroded or damaged surfaces of parts that have qualified for repair according to the CHECK section inspection guidelines.

A. Repair Procedure

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

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

5. 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 SPD 1003.

NOTE: Follow the quality assurance guidelines listed in SPD 1003 for the use of plastic media blasting equipment.

B. Restoration of surface coatings.

Repair the surface coatings of parts and assemblies that have been damaged or removed as given in the procedures in Safran Corporation SPD 1002.

Clean all parts per CLEANING section of this CMM.

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
10001-85	Brush Access Cover	Refinish/Paint	Chemical Film touch-up or Wash Primer and paint
10001-55	Air Inlet or Fan Cover	Refinish/Paint	Chemical Film touch-up or Wash Primer and paint
10001-150	Dampener Back Plate	Refinish phosphate	Re-phosphate IAW TT-C-490 or Phosphate touch-up
10001-235	Stator and Housing Assembly. Housing can be refinished.	Refinish/Paint	Chemical Film touch-up or Wash Primer and paint
10003-5	Drive end end bell	Refinish/Paint	Chemical Film touch-up IAW MIL-C-5541, Class 3
10002-5	Anti-drive end end bell	Refinish/Paint	Chemical Film touch-up IAW MIL-C-5541, Class 3
10005-20	Mounting Adapter	Refinish/Paint	Chemical Film touch-up or Wash Primer and paint

Table 6003 - Surface Coating Specifications

C. FAA-PMA Identification.

On models 23077-000-1, 23077-002 and 23077-004 if the “FAA-PMA” marking has been covered with a new coat of paint, apply a new FAA-PMA marking using white marking ink with approximately 1/4 inch (6 mm) high letters about 1/4 inch (6 mm) above the caution label and reading in the same direction as the caution label.

Models 23077-005 and 23077-009 require a new FAA-PMA label to be applied above the caution label if the original label has been damaged.

6. Thread repair

CAUTION: DO NOT USE A THREAD CUTTING DIE. UN-REPAIRABLE DAMAGE CAN RESULT FROM USING A THREAD-CUTTING DIE.

A. Procedure

(1) Repair damaged threads with a thread chaser.

(2) Remove any remaining sharp edges or burrs with an india stone.

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

7. Helicoil insert replacement. See Figure 6001.

A. Procedure

(1) Remove damaged helical coil insert with helical coil insertion/removal tool.

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

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 a thin coat of zinc chromate primer to the outer surface of the replacement helicoil insert.

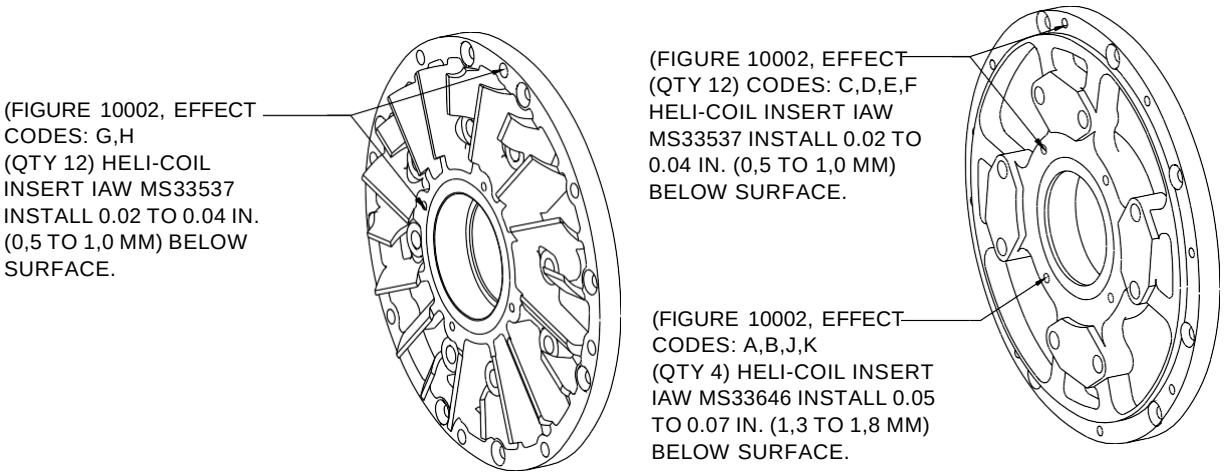


Figure 6001 - Helicoil Insert Replacement

(4) Install the helicoil insert to a depth of 0.02 to 0.04 inch (0,5 to 1,0 mm) below the part surface while the primer is still wet.

(5) Break off the helicoil 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 to bare metal.

8. Terminal Lug Replacement

A. Remove and replace damaged terminal lugs as follows:

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

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

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

9. Brush Access Cover. See Figure 6002.

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the IPL illustration, unless otherwise specified.

A. Replace the insulating tape.

(1) Remove all signs of the insulating tape and clean the inside surface of the brush access cover (85). Refer to the CLEANING section.

(2) If the plating on the inner surface of the brush access cover (85) is damaged, repair the surface.

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

(4) Starting at one of the two sides of the access cover band, align the sides of the tape roll with the side of the access cover band.

NOTE: For brush band P/N 23065-1055, use special care to not block venting holes with insulating tape.

(5) Apply the fiberglass tape directly from the roll to the inner surfaces of the access cover band. Installed tape must be 0.06 inch (1,5 mm) from the access cover band edges and ends. The tape can overlap the access cover band edges by 0.2 inch (0,5 mm) on one side only. However, overlap is not permitted at the access cover band ends.

(6) Cut off unwanted tape at the access cover band ends.

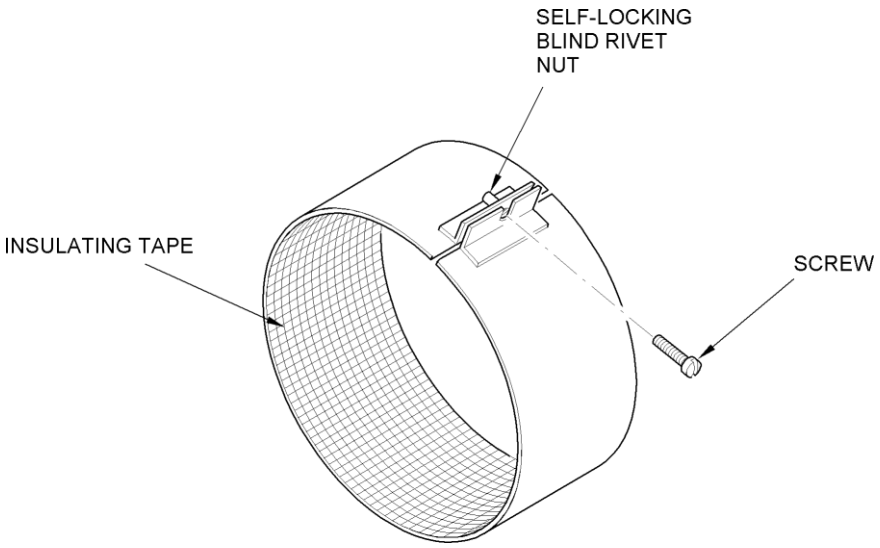


Figure 6002 - Brush Access Cover

B. Replace self-locking rivnut (90). See Figure 6003.

(1) Remove self-locking rivnut (90) from brush access cover (85) by drilling a 0.250 inch (6,35 mm) hole through nut. The inboard and outboard sides of nut will become loose and fall off.

NOTE: A PlusNut® Fastener Header Tool is necessary for repair procedure.

(2) Turn the ½ inch nut in a counterclockwise direction until the stud is fully extended. Engage all threads on the stud in the rivet nut (90) until the nut is tight against the tool face.

(3) Put the fastener header tool into the hole in the brush access cover(85).

(4) Use a ¾ inch (19 mm) open ended wrench on the tool body while holding the tool stable with a ¾ inch (19 mm) socket wrench on ½ inch nut. Hold the tool perpendicular to hole and turn the tool clockwise.

NOTE: Do not tighten the rivnut (90) too much. The threads can be damaged.

(5) Turn the nut until you feel resistance. The rivet should be physically reformed. If the rivet is loose, tighten the nut until rivet is tight. Loosen the nut by turning it counterclockwise.

(6) Remove the fastener header tool from the nut by turning counterclockwise.

(7) Torque test the rivet to 60 in-lbs. (6,8 N·m) the rivet must not move.

(8) Repair the chemfilm and/or paint, as necessary. Refer to SPD 1002.

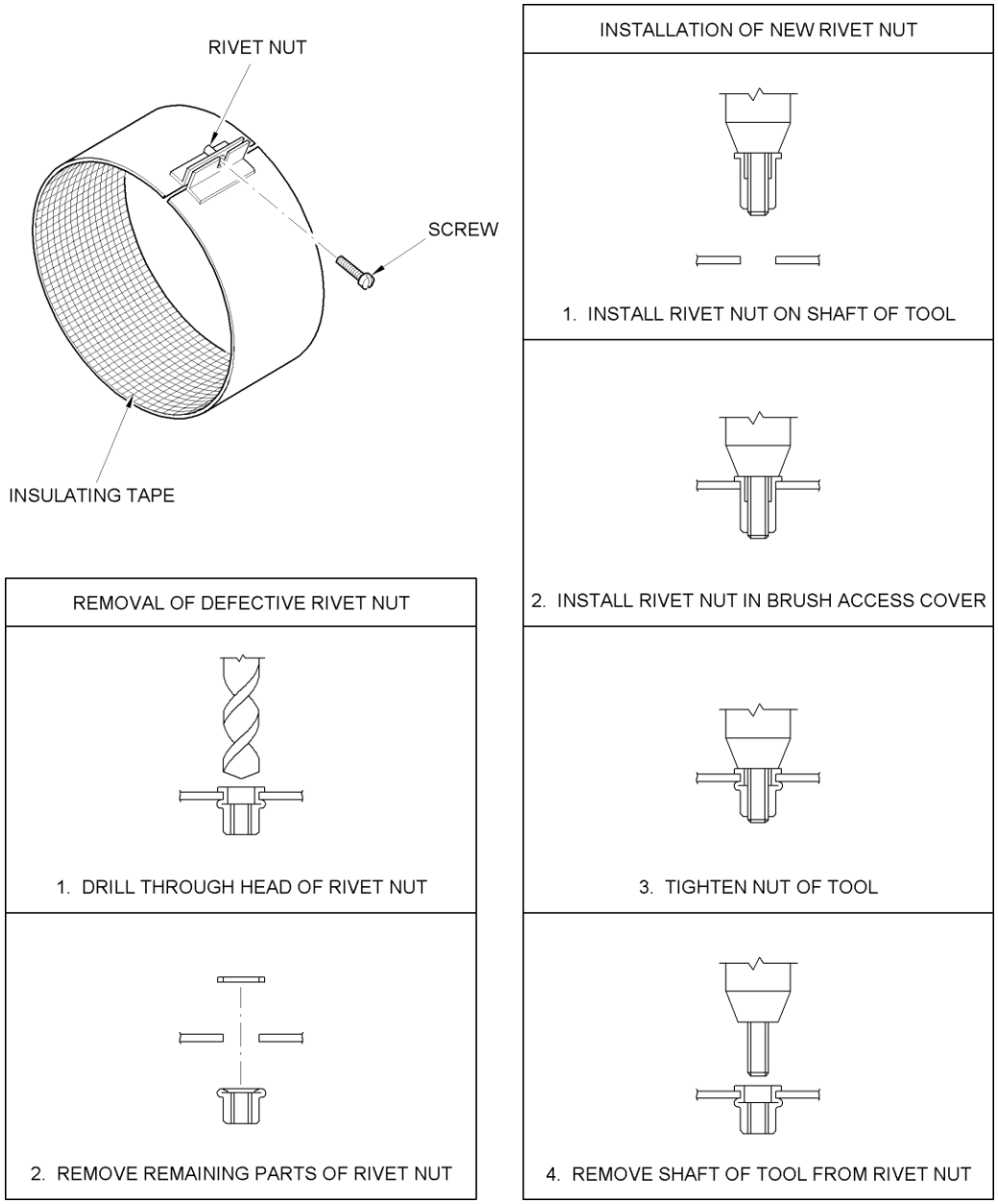


Figure 6003 - Attaching Rivnut® Fastener

10. Repair of Brush Holder

NOTE: In this section numbers in parentheses ( ) refer to the numbers in Figure 10002 of the ILLUSTRATED PARTS LIST.

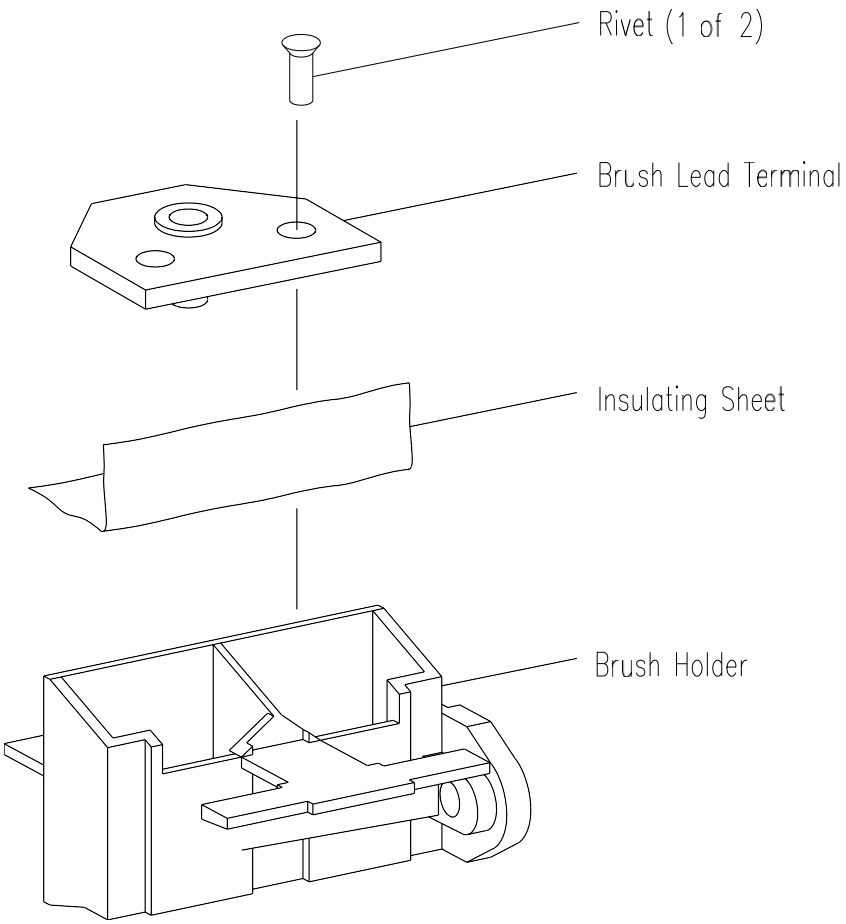


Figure 6004 - Complete Brush Holder

A. Disassembly of complete brush holder (15). See Figure 6004.

(1) Using a #40 drill bit, remove 2 rivets (70) from terminal board (60).

(2) Remove and discard brush lead terminal board and insulating sheet (65).

(3) Repeat steps (a) and (b) for each brush holder.

B. Assembly of Complete brush holder (15). See Figure 6005.

(1) Secure rivet alignment fixture to press table.

(2) Secure rivet press tool to arbor press.

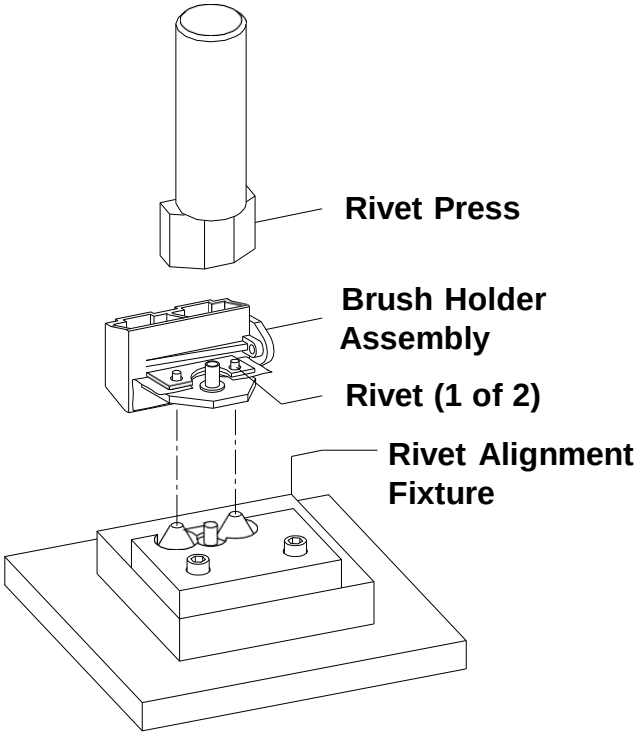


Figure 6005 - Brush Holder Rivet Alignment

(3) Place insulating sheet (65) and brush lead terminal board (60) onto the brush holder and insert 2 rivets (70) through the holes.

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

(4) Set the brush holder (15) upside down onto rivet alignment fixture and align the rivets with the 2 cones on the fixture.

(5) Press rivets. The diameter of the rivet head shall be a minimum of 1.5 times the diameter of the rivet.

(6) Do this procedure again for the remaining complete brush holder (15) assemblies.

11. Bearing Liner and Journal Restoration (See Figure 6006, Figure 6007 and Figure 6008)

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

A. Restoration

Refer to SPD 1000 for detailed instructions. Components not in compliance with the dimensions as applicable, must be reworked or replaced.

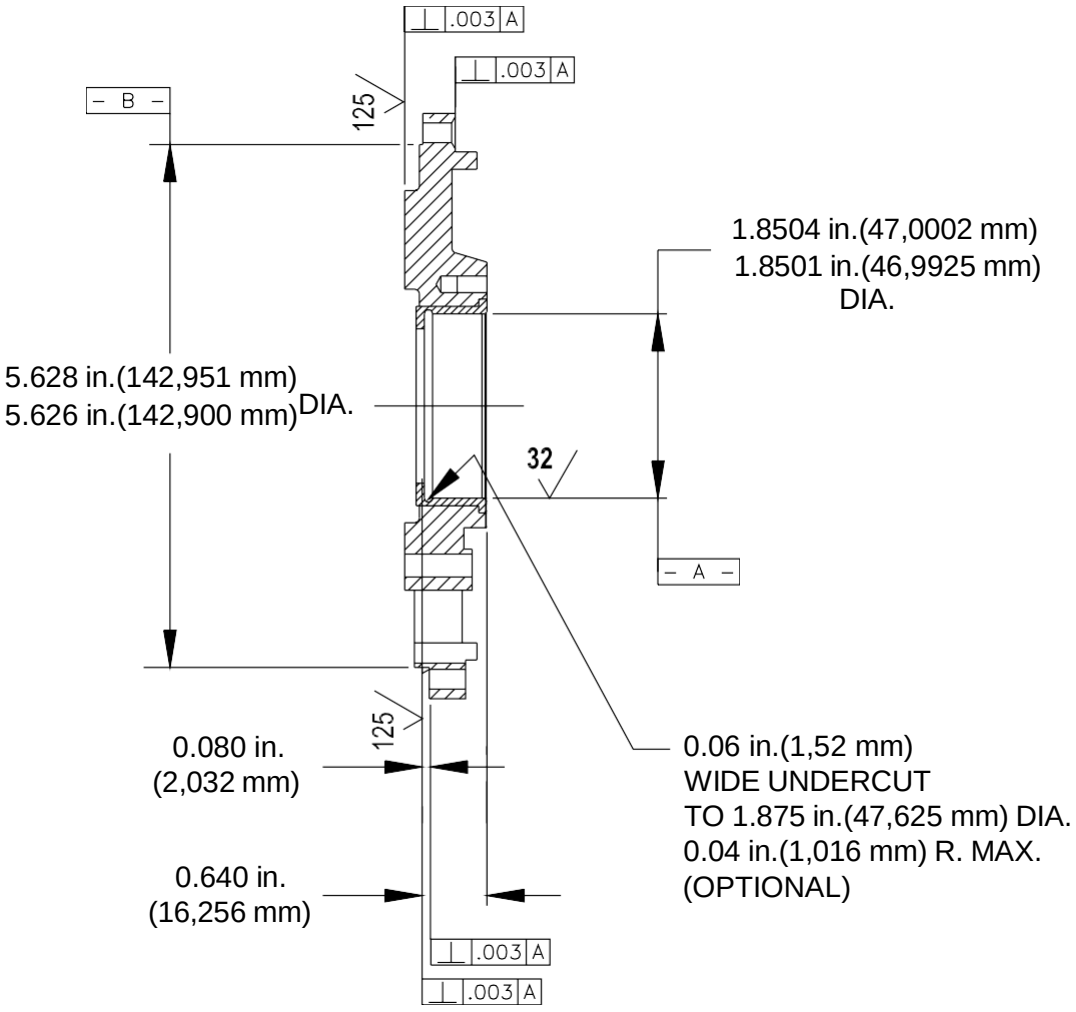


Figure 6006 - Anti-Drive End End Bell Bearing Liner Machining Specifications
(IPL 10002, Effect Codes: A, B, C, D, E, F, G, H)

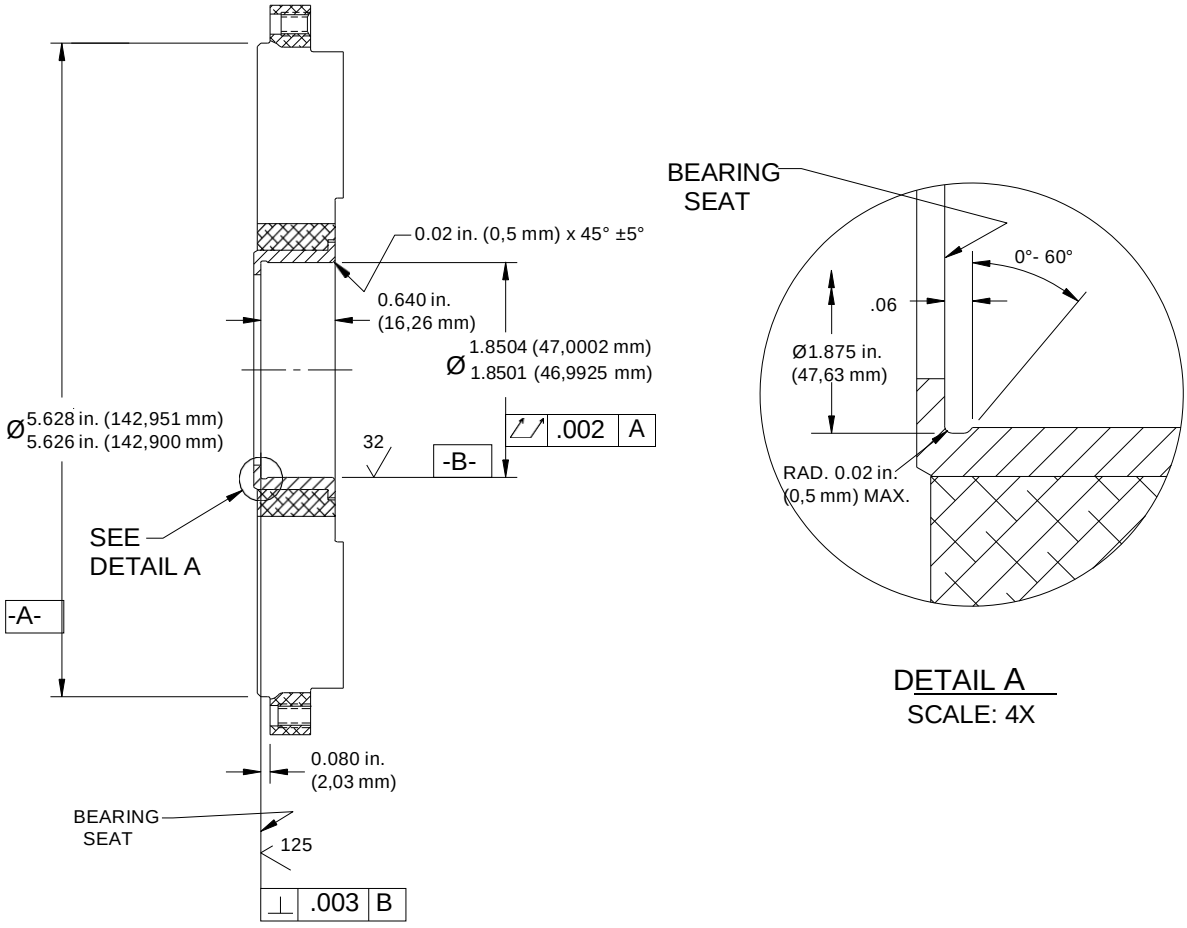


Figure 6007 - Anti-Drive End End Bell Bearing Liner Machining Specifications
(IPL 10002, Effect Codes: J, K)

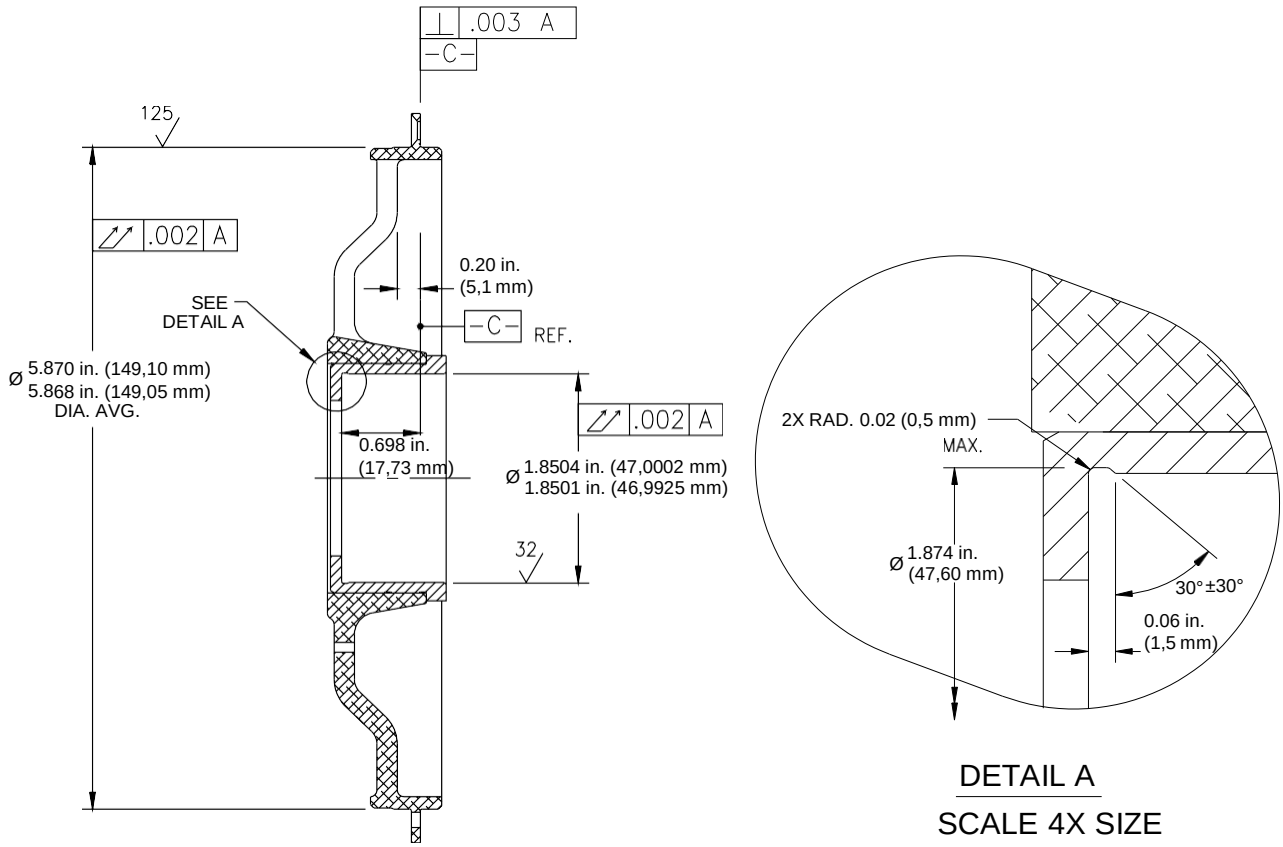


Figure 6008 - Drive End End Bell Bearing Liner Machining Specifications
(Pre-Load Models, IPL 10002, Effect Code: C)

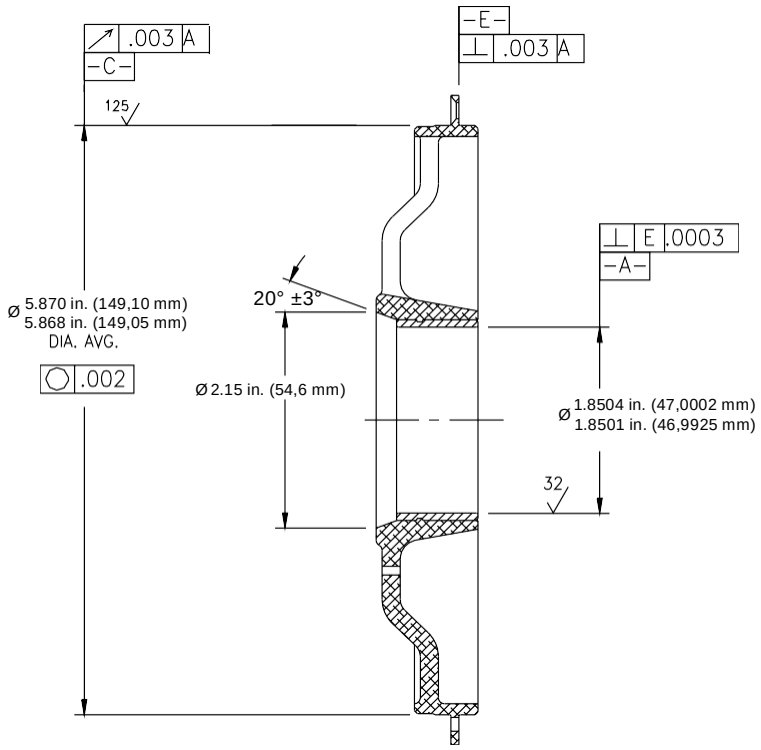


Figure 6009 - Drive End End Bell Bearing Liner Machining Specifications
(Non-Preload Models, IPL 10002, Effect Codes: A, B)

12. Commutator Refinishing

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

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 into the commutator turning fixture.

(2) Position the drive end of the armature (205) shaft at the lathe chuck head and the commutator turning fixture in the tail stock.

B. Repair procedure

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 μin. rms (1,6 to 2,5 μ rms). The finish surface must go from the end of the full undercut to the outboard end of the commutator.

NOTE: We recommend the feed rate is 0.006 to 0.007 in./rev (0,13 mm) at a surface speed of 1000 to 1500 surface feed/min. (305 to 457 surface m/min.).

WARNING: WHEN YOU USE COMPRESSED AIR, ADJUST THE PRESSURE TO 30 PSIG (207 kPa) MAX. PUT ON EYE PROTECTION TO PREVENT INJURY.

(2) Clean the armature (205) surfaces with compressed air, 30 psig (207 kPa) max.

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

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

NOTE: The beginning of mica undercut must be 0.010 to 0.030 inch (0,25 to 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.

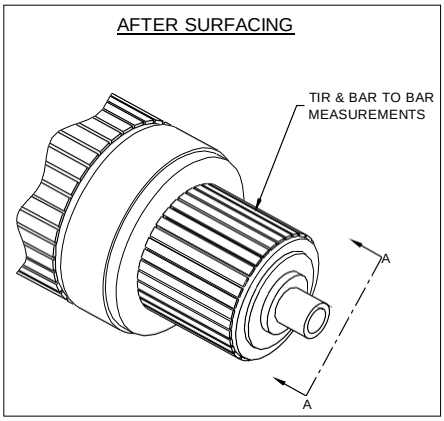
(6) Remove the undercut residue from between the commutator bars with a soft bristle brush.

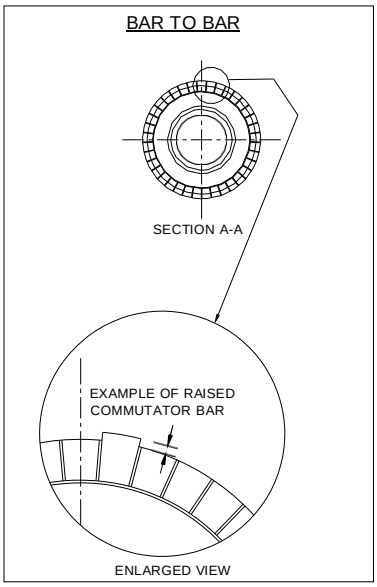
WARNING: WHEN YOU USE COMPRESSED AIR, ADJUST THE PRESSURE TO 30 PSIG (207 kPa) MAX. PUT ON EYE PROTECTION TO PREVENT INJURY.

(7) Clean the armature (205) surfaces with compressed air, 30 psi (207 kPa) max.

(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 (205) on two “V” blocks.

(a) 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: 0.035 to 0.045 IN. (0.89 to 1.14 MM) MAX.

µ FINISH:
64 TO 100 µin. rms

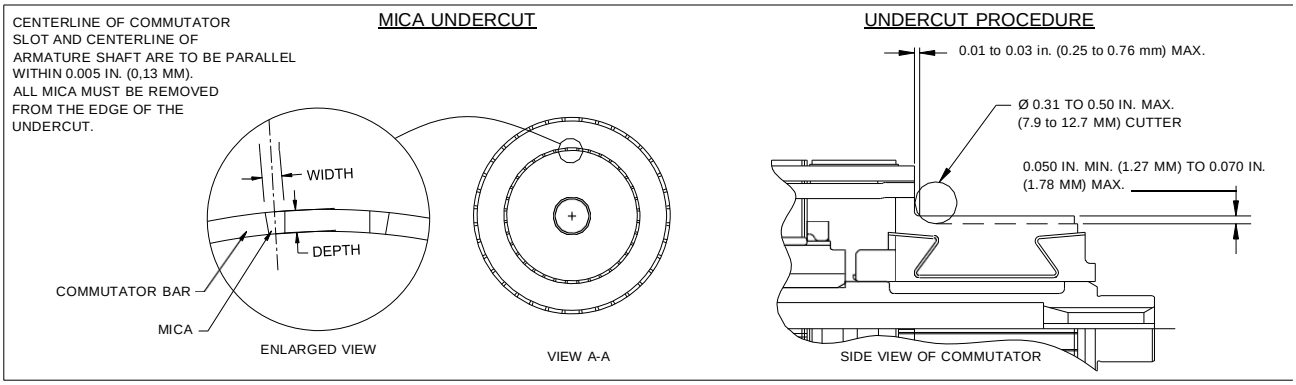


Figure 6010 - Armature Repair

13. Balancing the Armature

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

Balance the armature (205) to the limits given in FITS AND CLEARANCES and using the procedure in Safran Corporation Standard Practice Document (SPD) 1001.

14. Polarizing the Output Voltage

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

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: MAKE SURE ONLY ONE POWER SUPPLY IS CONNECTED TO THE STARTER-GENERATOR. THE STARTER-GENERATOR CAN BE DAMAGED IF IT IS POLARIZED DURING OPERATION.

(1) Connect a six volt DC wet cell battery (or 6 volt DC power supply) and bump switch in series with the starter-generator field, as shown in Figure 6011.

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

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

B. Procedure

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

(1) Turn the power 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.

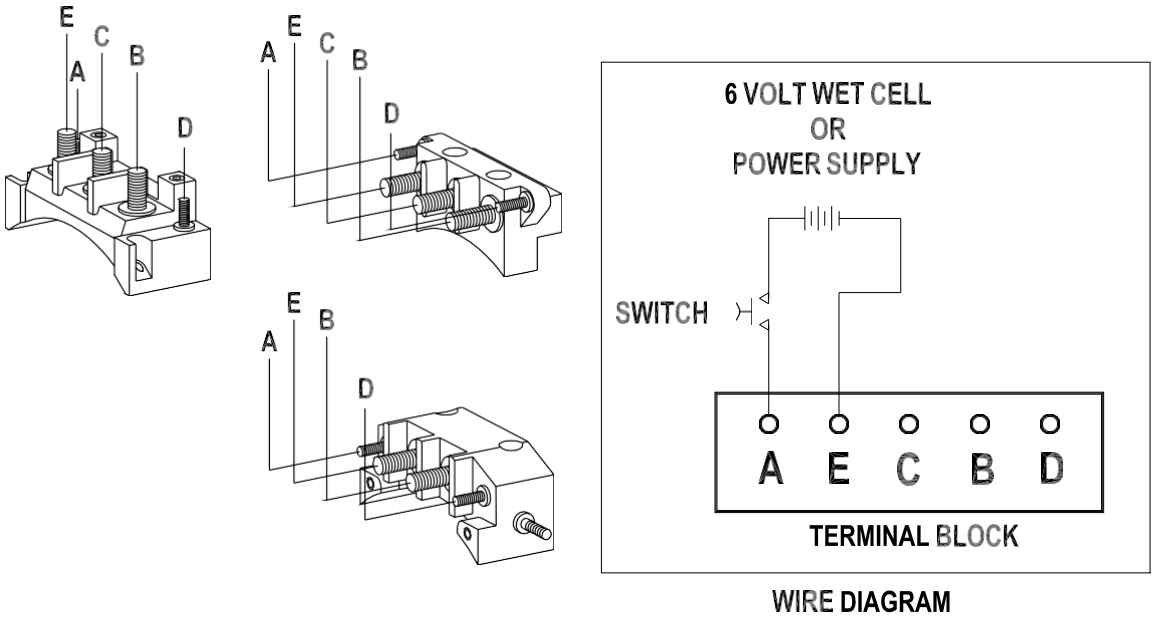


Figure 6011 - Polarizing the Field

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 (25).

A. Tools

A set of pliers, vice grips or suitable tool that lets you grip the guide pin (25) and pull it out.

B. Procedure

(1) Secure the mounting adapter (20) in a vice making sure it is secured enough to handle the force required to pull the guide pin (25).

(2) Using the suitable tool, twist and pull on the guide pin (25) until it releases from the mounting adapter (20).

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 (25) before inserting into the mounting adapter (20).

(4) Insert a new guide pin (25) into the hole in the mounting adapter (20).

(5) Using an arbor press or light hammer, lightly tap the guide pin (20) into the hole.

NOTE: Refer to FITS AND CLEARANCES section for the finished height of the guide pin (25).

ASSEMBLY

1. Introduction

This section gives assembly instructions for 23077 Series DC Starter-Generators. Assemble the unit in a clean work area away from machining or other metal removing operations. Clean all parts as given in the CLEANING section before final assembly.

In addition to specific procedures authorized by Safran Corporation in this manual, standard assembly procedures for starter-generators are described in the following Safran Corporation 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, the tools listed in Table 7001 are needed for unit assembly.

NOTE: Equivalent substitutes can be used for the tools listed in Table 7001.

Tool Description	Reference
Arbor Press	Not Illustrated
Armature Support, Anti-Drive End	Figure 9003
Armature Support, Drive End	Figure 9002
Anti-Drive End Hub Support	Figure 9015
Compressed Air	Commercially Available
Drive End Hub Support	Figure 9014
Inner Race Bearing Driver	Figure 9006
Outer Race Bearing Driver	Figure 9007
Leather or Plastic Mallet	Not Illustrated
Retaining Ring Pliers	Not Illustrated
Spline Wrench	Figure 9016
Horizontal Stator and Housing Assembly Support Fixture	Figure 9012
Vertical Stator and Housing Assembly Support Fixture	Figure 9013
Wire Hook Tool	Not Illustrated
Dampener Hub Driver	Figure 9004

Table 7001 - Assembly Tools

3. Assembly Materials

Table 7002 lists materials required to assemble the generator. Equivalent materials can be used.

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	MIL-I-46058/HumiSeal 1B31	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 Fax: (718) 932-4345 www.humiseal.com (V0SR97)
Electrical Tape	Fiberglass, MIL-I-15126, Type GFT	Commercially available
Grease	Lubricating, MIL-PRF-81322	Commercially available
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
Lubricating and Assembly Paste	Altemp QNB 50	Klueber Lubrication Londonderry, NH Ph: (603) 647-4104 www.klueber.com (03053)
Protective Paper	MIL-B-121A, Grade A, Type II, Class I	National Paper Cleveland, OH www.nationalpaper.com (V0LAX1)
Sandpaper	180 Grit, non-aluminum oxide	Commercially available

Table 7002 - Assembly Materials

Item	Description/Specification	Source (CAGE Code)
Sealant, Silicone Rubber, One Part	Silastic RTV 732, Black	Dow Corning Corporation PO Box 994 Midland, MI 48686-0994 Ph: (989) 496 4400 FAX: (989) 496 6731 www.dowcorning.com (V71984)
Thread Sealing Compound	Gasoila, Soft Set, Lead Free	GSA Supply on-line www.gsasupplyco.com or Federal Process Co. 4620 Richmond Rd. Beachwood, OH 44128
Thread Locking Adhesive	Loctite Grade D MIL-C-22473, Grade D	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com (V7V827)

Table 7002 - Assembly Materials (Continued)

4. Assemble Stator and Housing Assembly

The following procedure details the assembly of the stator and housing assembly.

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

A. Attach the terminal block (25) to the stator housing. See Figure 7001.

NOTE: Before acceptance testing, attach an unserviceable terminal block to the stator and housing assembly (10001-235) or disconnect the terminal block ground lead. Acceptance testing can damage the internal capacitors of a terminal block.

(1) Set the stator housing onto a horizontal stator support.

(2) On models 23077-002, 23077-002-1, 23077-003, and 23077-004:

CAUTION: DO NOT BEND THE LARGE STATOR LEADS MORE THAN NECESSARY TO INSTALL THE TERMINAL BLOCK.

(a) Carefully bend back the large stator leads enough to insert terminal studs B, C, and E up into the large stator leads.

(b) Set the terminal block (25) onto the stator housing and slide it into position under the large stator leads.

(c) Carefully lower the large stator leads onto the terminal block (25).

(3) On all other models, set the terminal block (25) onto the stator housing and slide it into position into the large stator leads.

(4) Put a spring lock washer (35) and a flat washer (40) on each of the two screws or bolts (30).

(5) Put the two screws or bolts (30) in the through holes of the terminal block. Torque the screws as follows:

(a) (30) and (30B): tighten bolts to a torque of 22.7 to 35.0 in-lbs (2,6 to 4,0 N·m).

(b) (30A): tighten screws to a torque of 7.7 to 10.3 in-lbs (0,9 to 1,2 N·m).

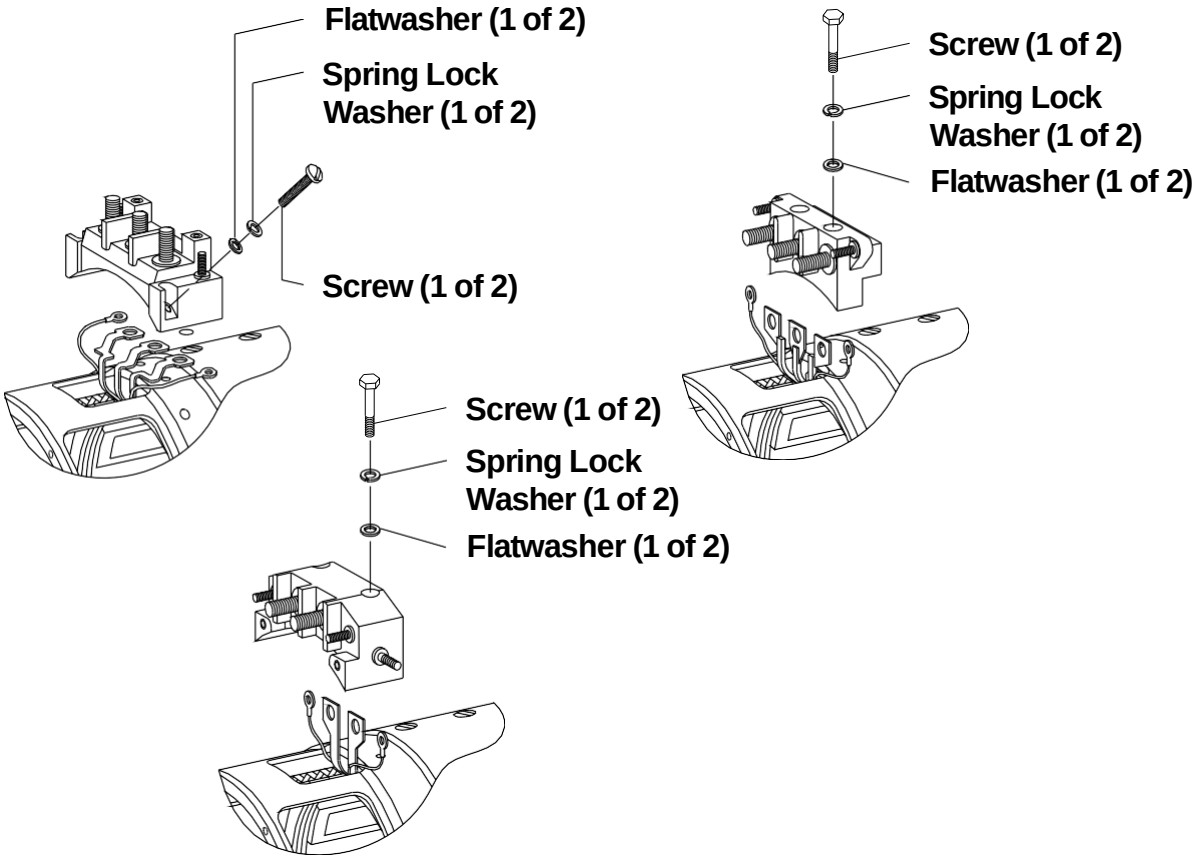


Figure 7001 - Terminal Block Attachment

B. Install attaching hardware on terminal block (25). See Figure 7002.

(1) Set the stator housing onto a horizontal stator support.

(2) Position one terminal lug (45) on each of terminal block (25) terminals A and D. Secure each terminal lug with one flat washer (20) and nut (15).

NOTE: Do not tighten the nuts (15) on terminal block (25) terminals 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.

(3) Install one flat washer (10) and nut (5) on each of three terminals C, B and E.

NOTE: Do not tighten the nuts (5) on terminals C, B and E. They will be tightened at the time of installation into the aircraft.

NOTE: No “C” terminal on (25B).

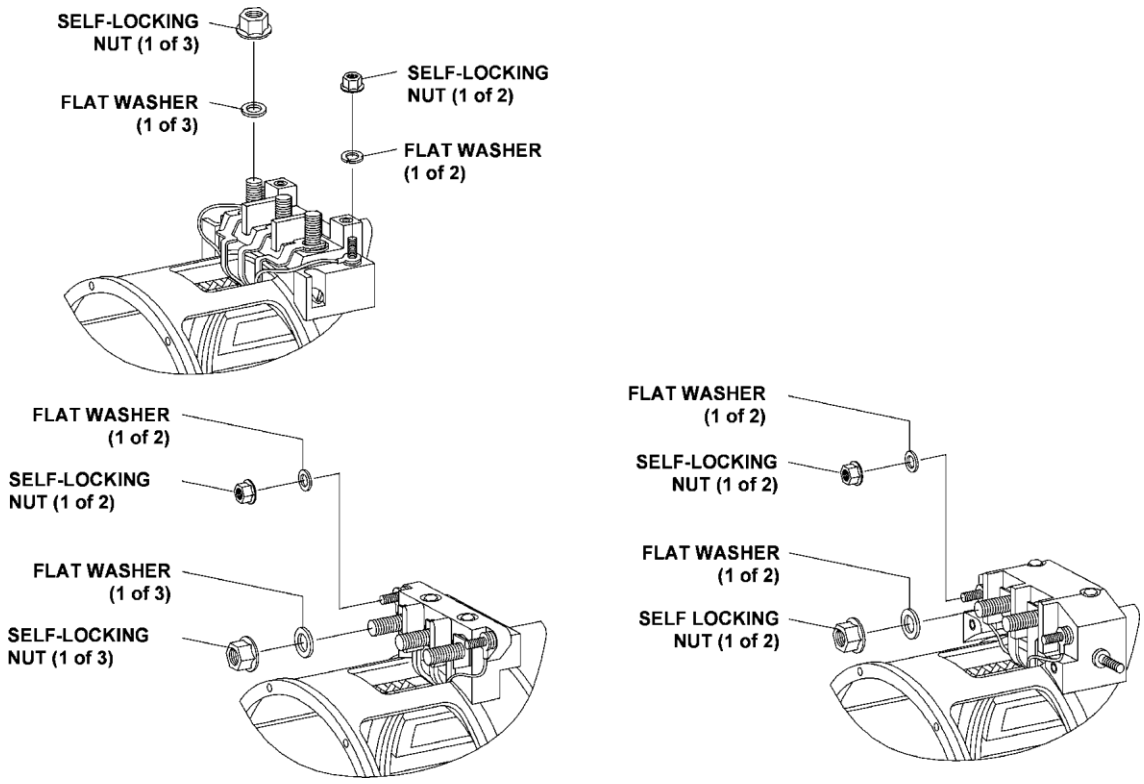


Figure 7002 - Install Attaching Hardware

C. Install thermal switch (10001-170). See Figure 7003.

NOTE: Refer to the CHECK section for testing the thermal switch for proper operation before installing into unit.

(1) Put lock washer (10001-180) on thermal switch assembly.

(2) Thread the thermal switch assembly into stator and housing assembly (10001-235) to a torque of 25.0 to 30.0 in-lbs (2,8 to 3,4 N·m).

(3) Put the switch lead wire lug on the terminal block (25) post and secure with self-locking nut (10001-175).

(4) Use silicone rubber sealant to bond switch lead wire to the stator and housing assembly and to coat the thermal switch assembly body and lock washer (10001-180).

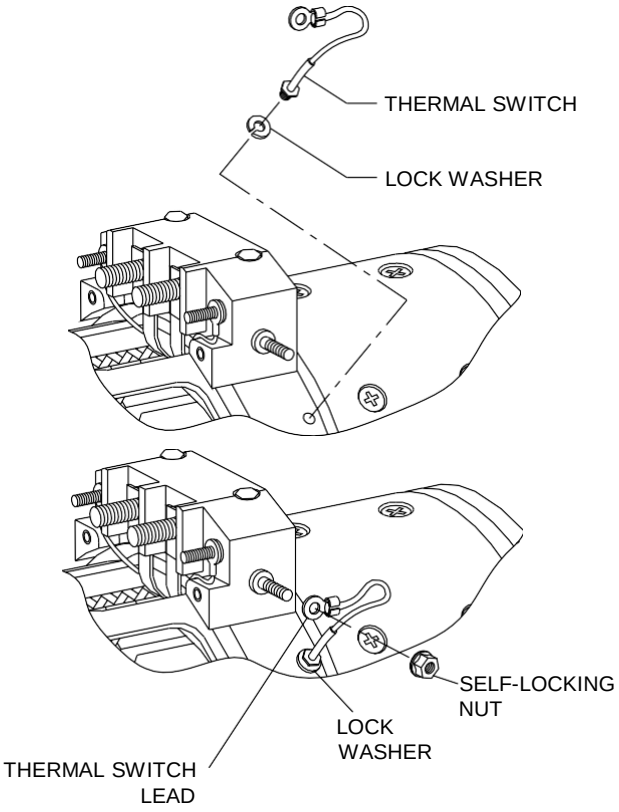


Figure 7003 - Thermal Switch Assembly

5. Assemble of the Drive End Bearing Support Assembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10003 of the ILLUSTRATED PARTS LIST. Where applicable, refer to torque specifications provided in the FITS AND CLEARANCES section.

A. Attach the screen (10) to the drive end end bell (5). See Figure 7004.

(1) Put the screen (10) on the drive end bearing support (5) and secure with six flat washers (20) and drive screws (15).

NOTE: Installation of drive screws (15) will require a plastic mallet to pound the drive screws in place.

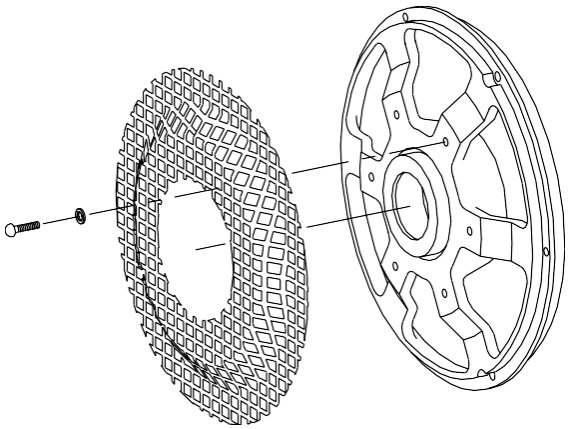


Figure 7004 - Screen Installation

6. Assemble of the Bearing and Brush Support Assembly

NOTE: Refer to IPL Figure 10002 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

A. Install the brush springs (75) on the brush holder assemblies (15). See Figure 7005.

CAUTION: DO NOT WIND THE BRUSH SPRINGS TOO TIGHTLY OR THIS CAN RESULT IN REDUCED BRUSH SPRING PRESSURE.

(1) Wind the brush spring (75) about 3/4 turn and put brush spring onto brush holder assembly (15). Repeat for remaining brush springs.

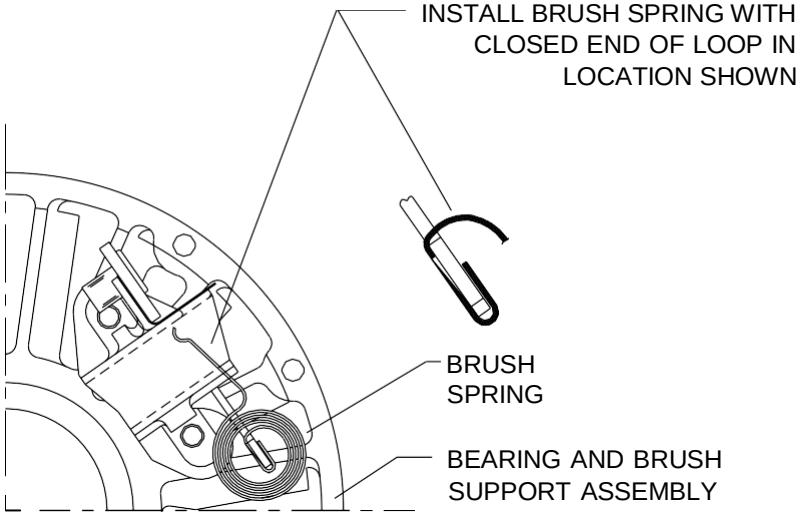


Figure 7005 - Brush Spring Installation

B. Attach each brush holder assembly (15) to the anti-drive end end bell (5). See Figure 7006 and refer to SPD 1004.

CAUTION: CORRECT INSTALLATION OF THE INSULATING SLEEVES IS CRITICAL. USE GREAT CARE WHEN INSERTING THE INSULATING SLEEVES INTO THE ANTI-DRIVE END END BELL. IF AN INSULATING SLEEVE IS PINCHED BETWEEN THE ANTI-DRIVE END END BELL AND A COMPLETE BRUSH HOLDER, CARBON DUST WILL COLLECT IN THE AREA WHERE THE INSULATING 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 insulating sleeves (50) into two adjacent through holes in the anti-drive end end bell (5). Make sure the insulating sleeves extend out of the through holes on both sides of the anti-drive end end bell (5).

(2) Put an insulating board (55) onto the ends of the exposed insulating sleeves on the inboard side of the anti-drive end end bell (5).

(3) Put an insulating washer (40) onto the ends of each exposed insulating sleeves (50) on the outboard side of the anti-drive end end bell (5). Make sure the insulating sleeves (50) do not slide and that the insulating board does not fall off.

(4) Put flat washers (45) on two attaching bolts (35).

WARNING: THREAD LOCKING ADHESIVE IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES.

(5) Apply thread-locking adhesive grade D to the threads of the two attaching bolts (35).

(6) Insert one bolt (35) into each of two insulating sleeves (50) on the outboard side of the anti-drive end end bell (5). Make sure that the insulating sleeves (50) do not slide and that the insulating board (55) does not fall off.

(7) Put the brush holder assembly (15) against the two bolts (35) on the inboard side of the anti-drive end end bell (5).

(8) Attach the brush holder assembly (15) to the anti-drive end end bell (5) with the two attaching bolts (35). ATTACH LOOSELY. DO NOT TIGHTEN THE BOLTS (35) AT THIS TIME.

(9) Repeat steps 6.B.(1) through 6.B.(8) to attach the remaining brush holder assemblies.

(10) Lower the bearing and brush support assembly (10001-160) onto the brush holder alignment fixture as shown in Figure 7007.

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 (15) until they are properly aligned. Refer to SPD 1004.

(12) Tighten bolts (35) to a torque of 25.0 to 30.0 in-lbs. (2,8 to 3,4 N·m).

(13) Remove the bearing and brush support assembly (10001-160) 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 procedure in SPD 1002.

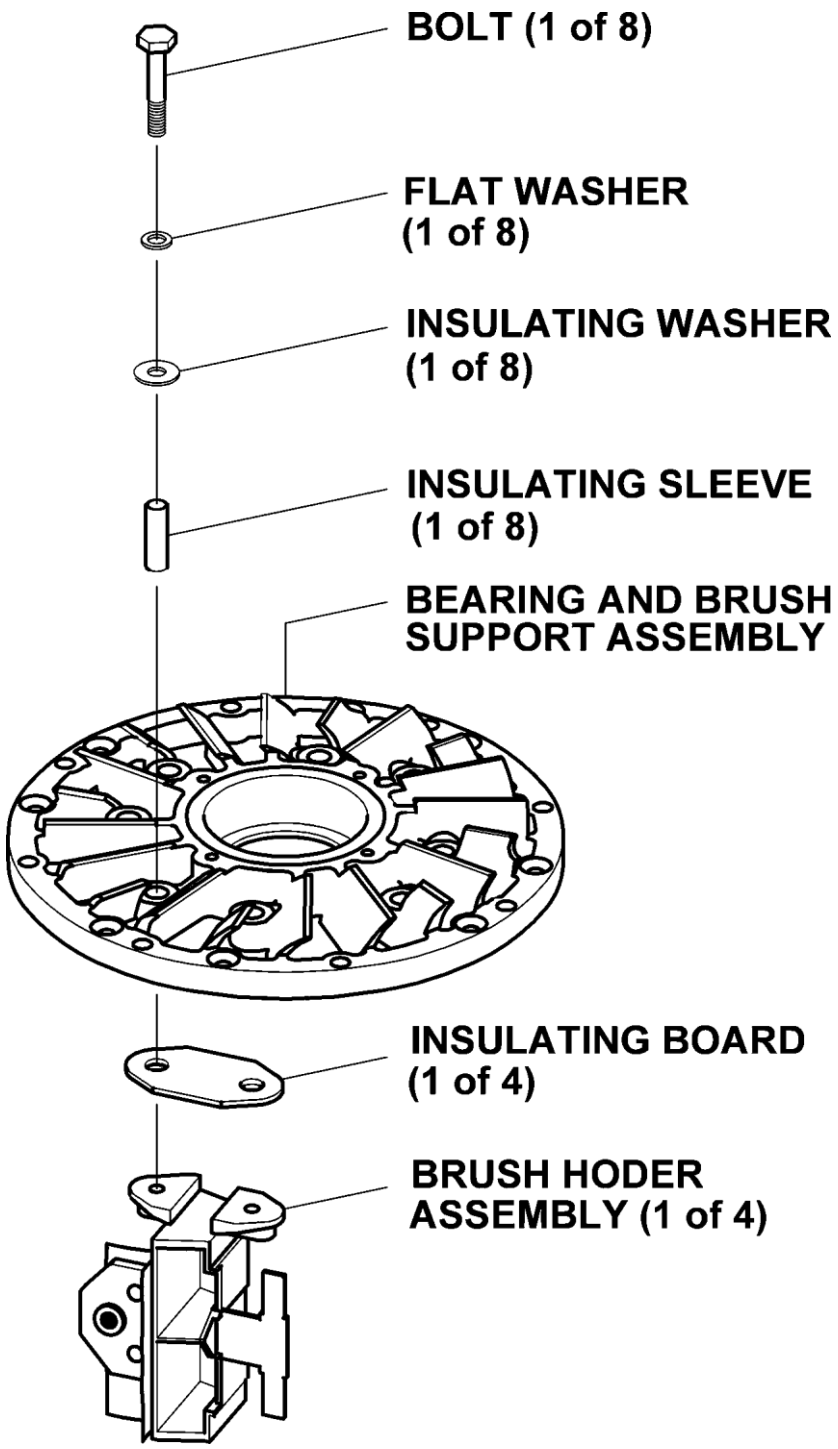


Figure 7006 - Brush Holder Attachment to the Anti-drive End End Bell

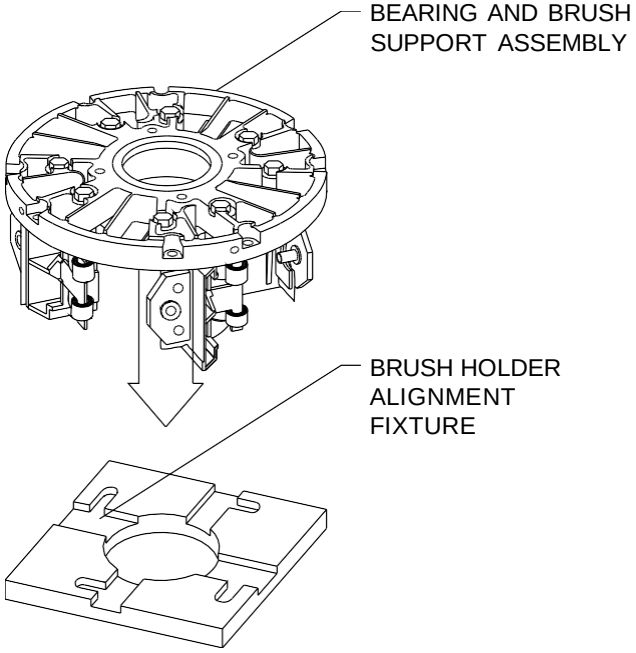


Figure 7007 - Brush Holder Alignment Fixture to the Anti-drive End End Bell

C. Perform a dielectric test.

(1) Perform a dielectric test of the bearing and brush support assembly. Refer to the CHECK section.

7. Final Assembly of the DC starter-generator

NOTE: Refer to IPL Figure 10001 for an illustration. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

A. Install an inboard baffle disc (225) and drive end bearing (221) onto the drive end of the armature (205) shaft. See Figure 7008.

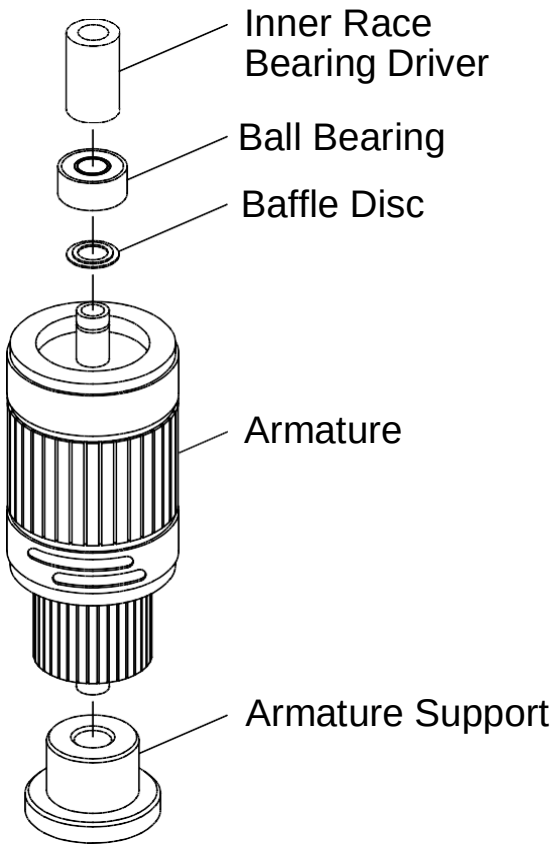


Figure 7008 - Baffle Disc and Ball Bearing Installation on Drive End of Armature Shaft

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

(1) Set armature support on arbor press table.

(2) Put the armature (205), commutator end down on the armature support.

(3) Put an inboard baffle disc (225) on the drive end of the armature shaft with the concave side facing toward the armature.

(4) Set a ball bearing (221) onto the armature shaft (205).

NOTE: The Safran Corporation part marking on the drive end ball bearing (221) must be facing towards the inside of the starter-generator.

(5) Set an inner race bearing driver on the ball bearing (221).

(6) Press the ball bearing (221) down onto the armature shaft (205).

(7) Make sure the ball bearing (221) is fully seated against the baffle disc (225).

B. Install a spacer (230) or an outboard baffle disc (225) and a retaining ring (155) onto the drive end of the armature shaft (205). See Figure 7009.

(1) On spring loaded units using P/N 23065-1663 drive end bearing support assembly, put a spacer (230) onto the drive end of the armature shaft (205).

(2) On non-spring loaded units using a P/N 23065-1660 or P/N 23065-1662 drive end bearing support assembly, put a second outboard baffle disc (225) on the drive end of the armature shaft (205) with the concave side facing away from the armature shaft (205).

(3) Put a retaining ring (155) in the groove on the drive end of the armature shaft using snap ring pliers. Make sure it is fully engaged in the groove of the armature shaft (205).

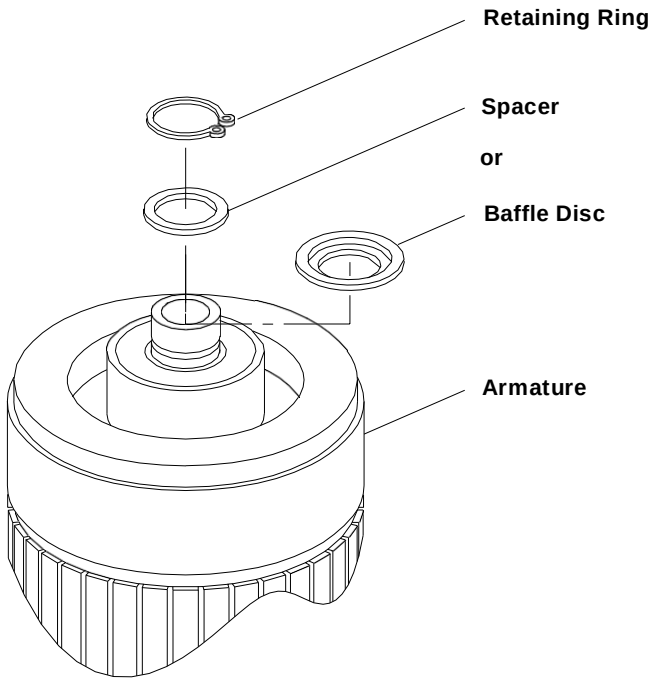


Figure 7009 - Spacer/Baffle Disc and Retaining Ring Installation on Armature Shaft

C. Press anti-drive end ball bearing (220) into the bearing and brush support assembly (160). See Figure 7010.

CAUTION: FAILURE TO USE ANTI-DRIVE END HUB SUPPORT DURING ASSEMBLY OPERATIONS CAN CAUSE PERMANENT DAMAGE TO BEARING AND BRUSH SUPPORT ASSEMBLY.

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

(2) Put the bearing and brush support assembly (160), brush holders down, on the 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 liner of the bearing and brush support assembly (160).

(4) Put the anti-drive end ball bearing (220) on bearing liner of bearing and brush support assembly (160).

NOTE: The Safran Corporation part marking on the anti-drive end ball bearing (400) must be facing towards the inside of the starter-generator.

(5) Set an outer race bearing drive onto the ball bearing (220).

(6) Press the anti-drive end ball bearing (220) into the bearing liner of the anti-drive end bearing and brush support assembly (160).

(7) Make sure that the ball bearing is fully seated against the inner lip of the bearing liner.

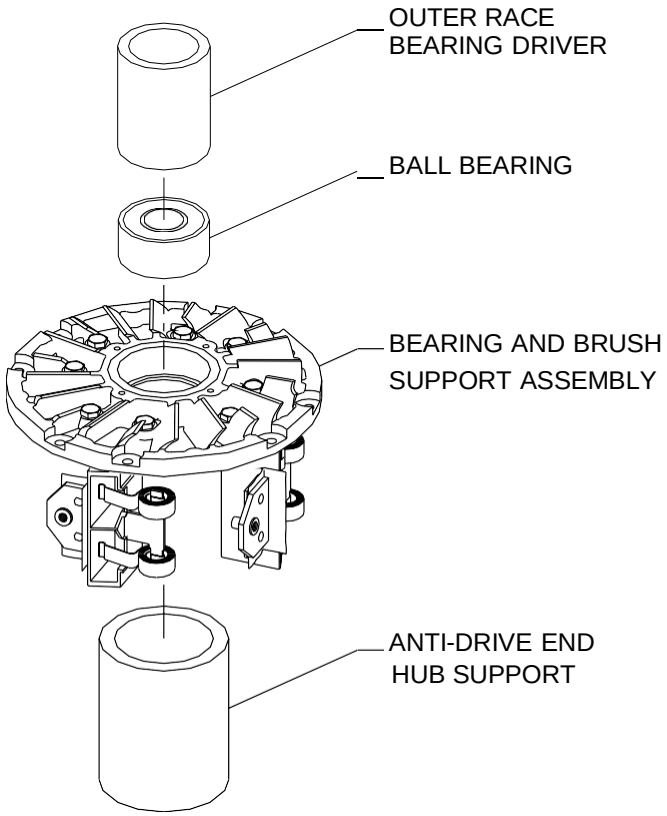


Figure 7010 - Ball Bearing Installation into Bearing and Brush Support Assembly

D. Attach the bearing retainer (210) to the bearing and brush support assembly (160). See Figure 7011.

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 sealing compound to the threads of the four attaching screws (215).

(2) Attach the bearing retainer (210) to the bearing and brush support assembly (160) using the attaching screws (215). Torque screws (215) 13.5 to 18.0 in-lbs (1,5 to 2,0 N·m).

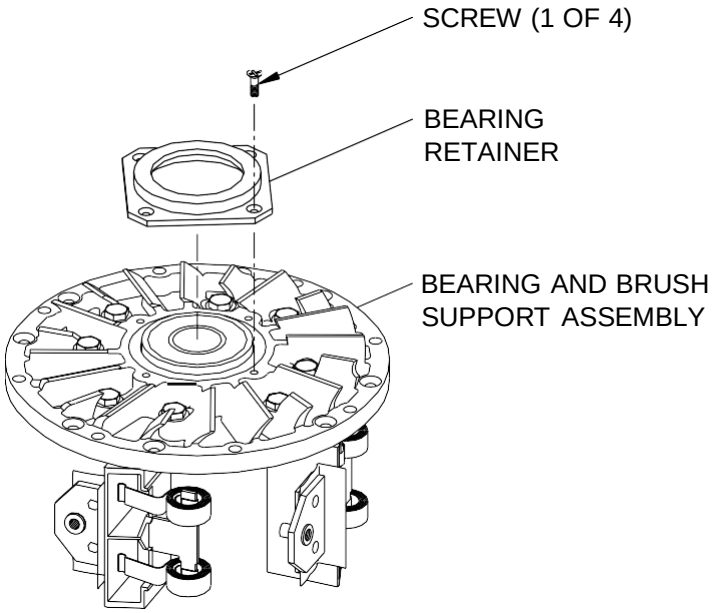


Figure 7011 - Attaching the Bearing Retainer

E. Prepare armature (205) for coarse brush seating.

(1) Prepare the armature (205) 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. See Figure 7012.

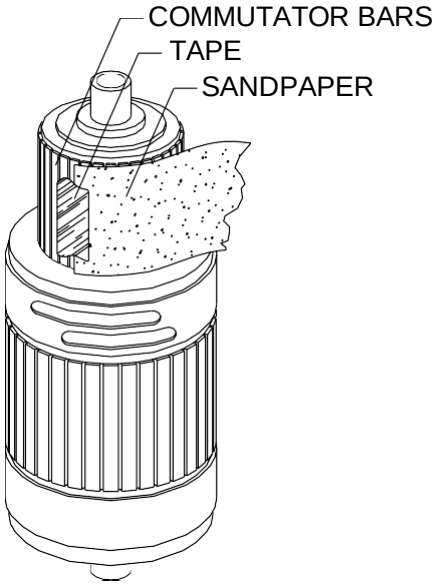


Figure 7012 - Preparing Armature for Rough Seating

F. Press bearing and brush support assembly (160) onto armature (205) shaft. See Figure 7013.

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

(1) Put the armature (205) on a stand. Put the stand on an arbor press table so that the commutator points up.

(2) Set bearing and brush support assembly (160), brush holders down, on commutator end of armature (205) shaft.

(3) Use an inner race bearing driver to push the bearing and brush support assembly (160) onto the anti-drive end of the armature (205).

(4) Make sure that anti-drive end ball bearing (220) is fully seated against shoulder of armature (205) shaft.

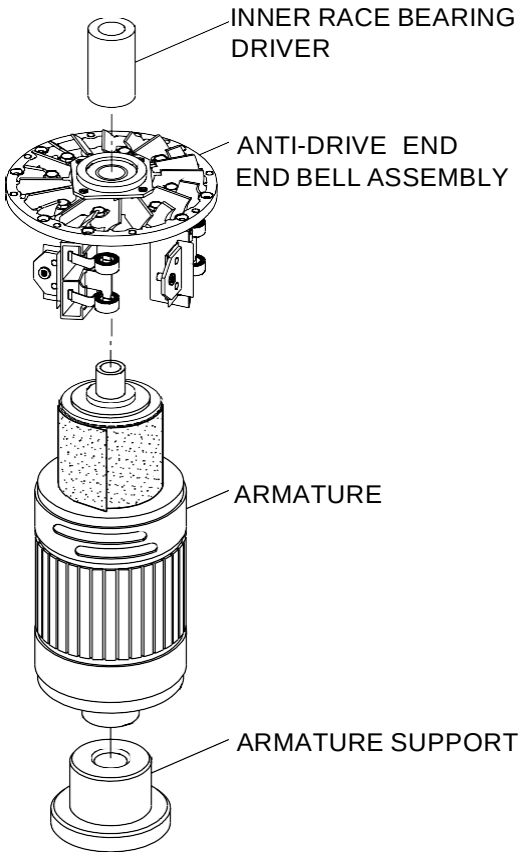


Figure 7013 - Attaching Bearing and Brush Support Assembly and Armature

G. Attach drive end bearing support assembly (185) to stator and housing assembly (235). See Figure 7014.

(1) Place the stator and housing assembly (235) on a vertical stator support with the drive end up.

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.

(2) Apply thread sealing compound to the threads of the three attaching screws (190).

(3) Attach drive end bearing support assembly (185) to stator and housing assembly (235) with three screws (190). Torque the screws (190) 7.7 to 10.3 in-lbs. (0,87 to 1,16 N·m).

NOTE: Heads of attaching screws (190) must be flush or below mounting surface of drive end bearing support assembly (185).

(4) Make sure the mounting surfaces of the drive end bearing support assembly and the stator and housing assembly are fully seated against each other.

(5) For non-preload models, skip to Paragraph 7.I. to continue assembly.

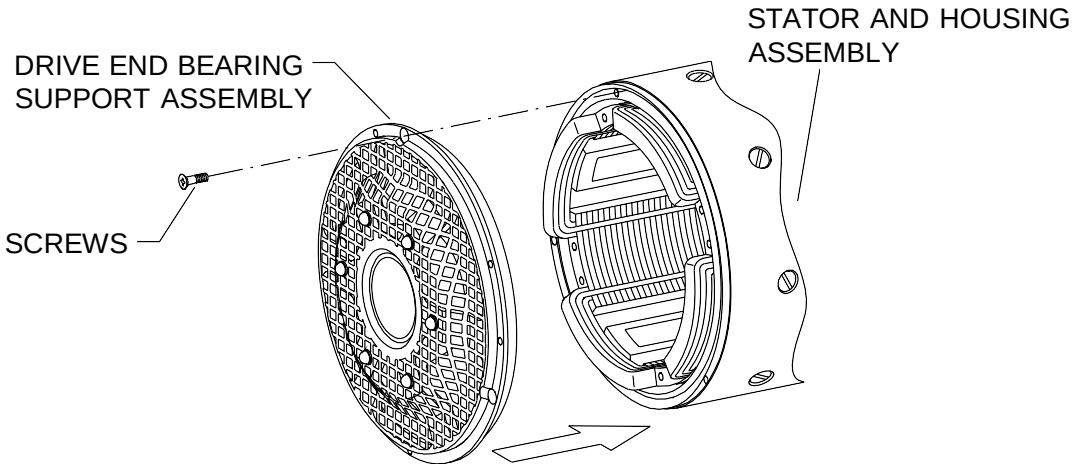


Figure 7014 - Attaching Drive End End Bell to Stator and Housing Assembly

H. For preload models, determine the shim (200) requirements for the spring wave washer (195). See Figure 7015.

NOTE: This paragraph is applicable only for spring loaded units using a P/N 23065-1663 drive end bearing support assembly.

(1) Using a dial indicator, or equivalent, mounted on appropriate stand, measure distance from mounting surface of the bearing and brush support assembly (160) to inner race of drive end ball bearing (221) on drive end of armature (205) shaft. Record as dimension “A”.

(2) Measure distance from mounting surface of stator and housing assembly (235) to bottom of bearing liner in drive end bearing support assembly (185). Record as dimension “B.”

(3) Subtract dimension “A” from dimension “B” and record the difference.

NOTE: The calculated difference between dimensions “A” and “B” is the gap for the spring wave washer. The desired gap of the compressed spring wave washer is 0.041 ±.005 inch (1,04 ±0,13 mm). Make up a shim pack with enough shims (200) to reduce the gap to within the specified tolerance range.

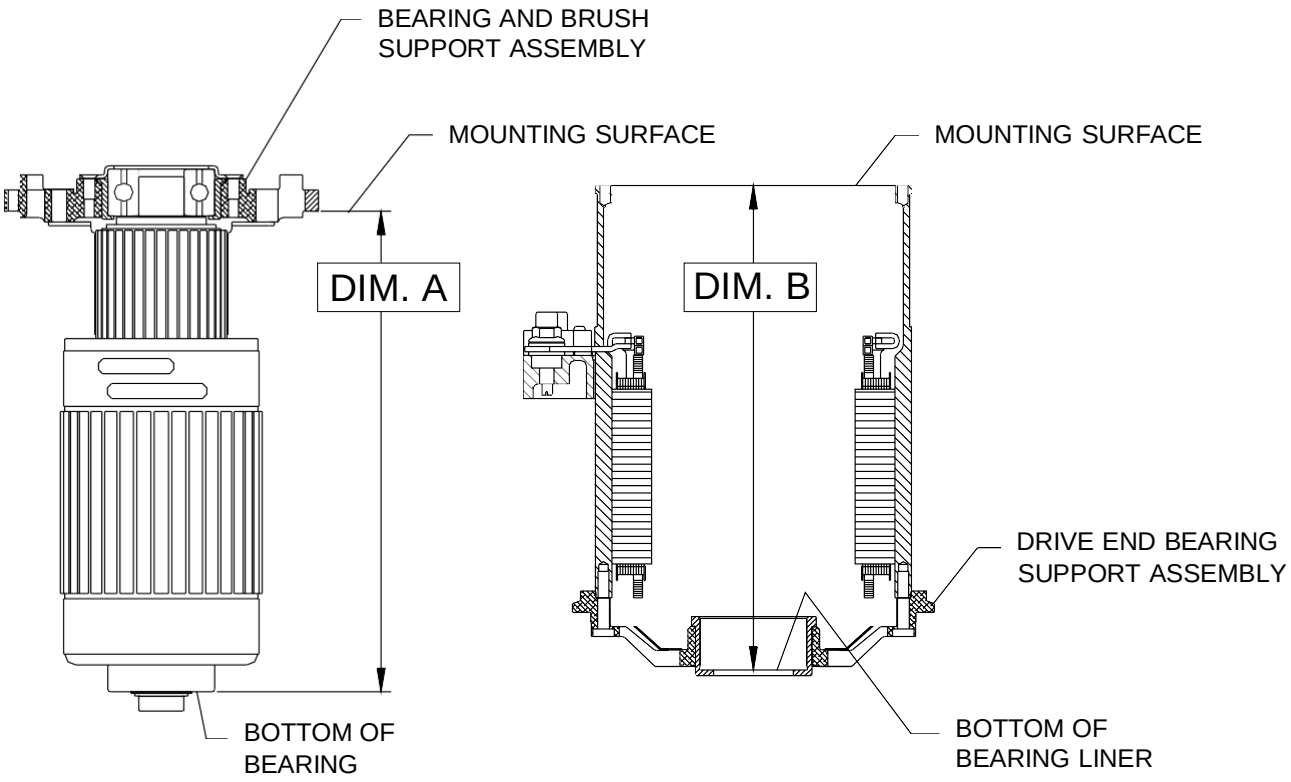


Figure 7015 - Determining Shim Requirements

I. For preload models, install the shim (200) pack and the spring wave washer (195) into the drive end bearing support assembly. See Figure 7016.

NOTE: This paragraph is applicable only for spring loaded units using a P/N 23065-1663 drive end bearing support assembly.

(1) Put the shim pack (200) into the bottom of the bearing liner of the drive end bearing support assembly (185).

(2) Put the spring wave washer (195) into the bearing liner on top of the shim pack (200).

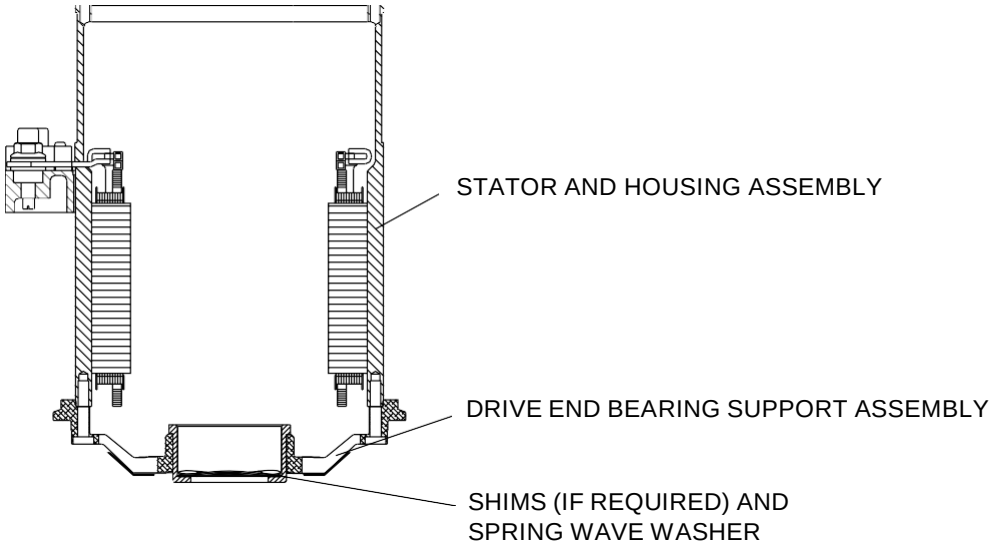


Figure 7016 - Installing Shim(s)

J. Attach the bearing and brush support assembly (160), with the attached armature (205), to the stator and housing assembly (235). See Figure 7017.

(1) Set the drive end hub support onto the arbor press table.

(2) Carefully set the stator and housing assembly, with the attached drive end bearing support assembly (185), drive end down, on the 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) On models 23077-006, -007 and -009 apply lubricating and assembly paste to the inside diameter of the bearing liner of the drive end bearing support assembly (185).

NOTE: For (pre-load) models, make sure that shim(s) and the spring wave washer are correctly located in the drive end bearing liner.

(4) Insert the armature (205), with the attached bearing and brush support assembly (160), into the stator and housing assembly (235). Make sure the drive end bearing (220) on the armature shaft (205) is correctly centered over the bearing liner of the drive end bearing support assembly (185).

(5) Make sure the brush stator leads are aligned with each brush holder assembly (10002-25). If necessary, use a probe to move the brush stator leads to their correct position.

(6) Set an inner race bearing driver on anti-drive end bearing (220).

(7) Press drive end ball bearing (221) into bearing liner of drive end bearing support assembly (185) making sure screw holes (of bearing and brush support assembly) are aligned with holes in stator and housing assembly (235) and that the machined faces are fully flush.

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 the eight attaching screws (165).

(9) Attach bearing and brush support assembly (160) to stator and housing assembly (235) with eight screws (165). Torque the eight screws (165) 13.5 to 18.0 in-lbs. (1,5 to 2,0 N·m).

(10) Make sure that the mounting surfaces of the bearing and brush support assembly and the stator and housing assembly are fully seated against each other.

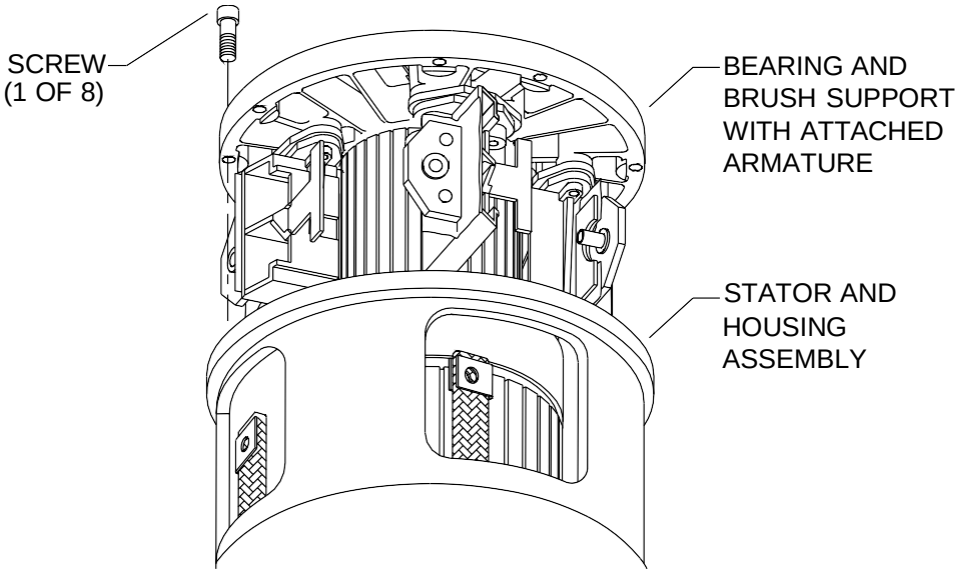


Figure 7017 - Attaching Bearing and Brush Support Assembly with Attached Armature to Stator

K. Install the dampener backplate (150) and friction ring (145) onto the armature (205) shaft. See Figure 7018.

CAUTION: DO NOT FORCE THE DAMPENER HUB.

(1) Set the stator and housing assembly (235) on a horizontal stator support.

(2) Twist the dampener backplate (150) onto the drive end of the armature shaft (205) until it is fully seated.

(3) Put friction ring (145) into recess of the dampener back plate (150).

NOTE: Friction ring (145) cannot stay in place until drive shaft with dampener plate is installed.

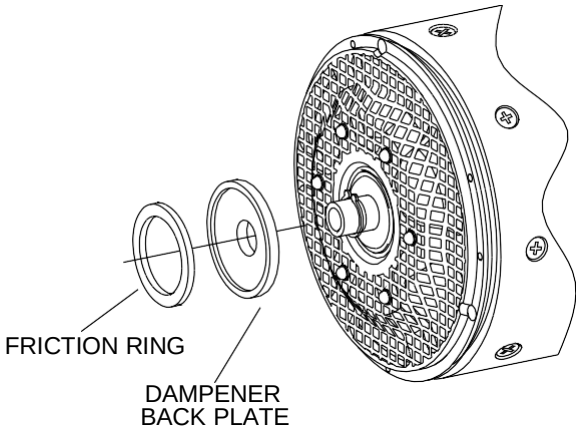


Figure 7018 - Attach Dampener Back Plate and Friction Ring

L. Install the dampener hub (135) and dampener plate (140) onto the drive shaft (125). See Figure 7019.

CAUTION: DO NOT FORCE THE DAMPENER HUB ONTO THE DRIVE SHAFT MATING TAPER OR THE HUB CAN FRACTURE.

(1) If the dampener hub (135) was removed from the drive shaft, press the dampener hub by hand onto the drive shaft taper and make sure it is fully seated.

(2) Insert the drive shaft (125) through the dampener plate while aligning the plate and hub splines.

(3) Lightly tap the drive end of drive shaft (125) using a leather or plastic mallet to seat the dampener plate onto the hub.

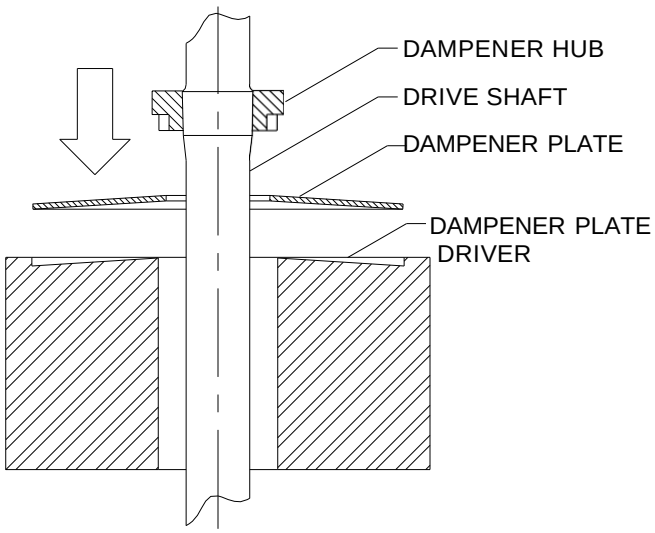


Figure 7019 - Dampener Plate and Driver

M. Insert the drive shaft (125) into the armature (205) shaft. See Figure 7020.

CAUTION: DO NOT USE FORCE TO ENGAGE THE DRIVE SHAFT AND ARMATURE SHAFT MATING SPLINES. FAILURE TO ENGAGE THE DRIVE SHAFT SPLINES CORRECTLY CAN DAMAGE THE DRIVE AND ARMATURE SHAFT.

(1) Put the friction ring (145) in the recess in the dampener backplate (150).

(2) Insert the drive shaft (125) into the drive end of the armature shaft (205).

(3) Push the drive shaft (125) through the armature shaft (205) until the dampener plate (140) is fully engaged against the friction ring (145).

(4) Turn the drive shaft (125) in the direction of rotation to make sure that the armature shaft (205) and drive shaft splines are correctly engaged.

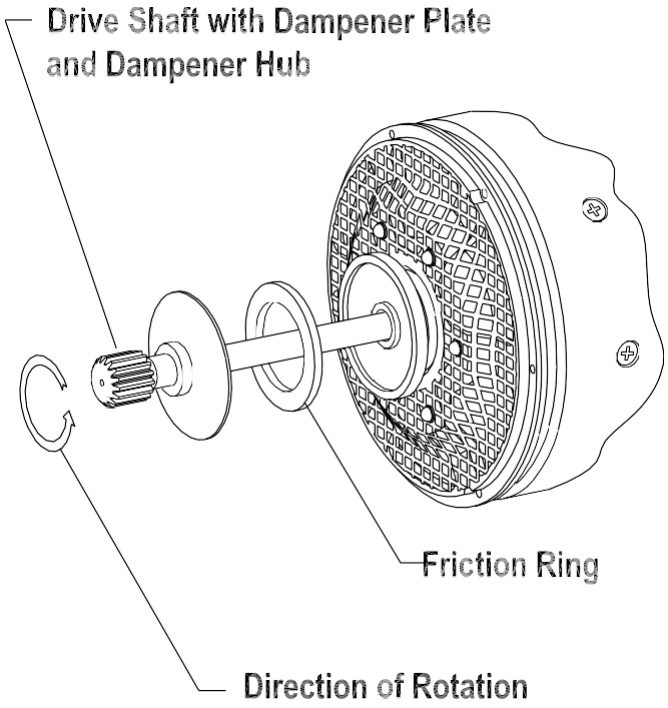


Figure 7020 - Installing Drive Shaft into Armature Shaft

N. Attach the fan (110) to the drive shaft (125). See Figure 7021.

NOTE: To keep the drive shaft from turning, use a spline wrench on the drive spline when tightening the self-locking nut onto the drive shaft.

(1) Turn the fan (110) by hand until the two keys align with the slots in the drive shaft (125), then push the fan till seated.

(2) Attach the fan (110) to the drive shaft (125) with a flat washer (120) and a self-locking nut (115).

(3) Use a spline wrench to hold the drive shaft (125). Tighten the self-locking nut (115) to a torque of 100 to 120 in.-lbs (11,3 to 13,6 N·m).

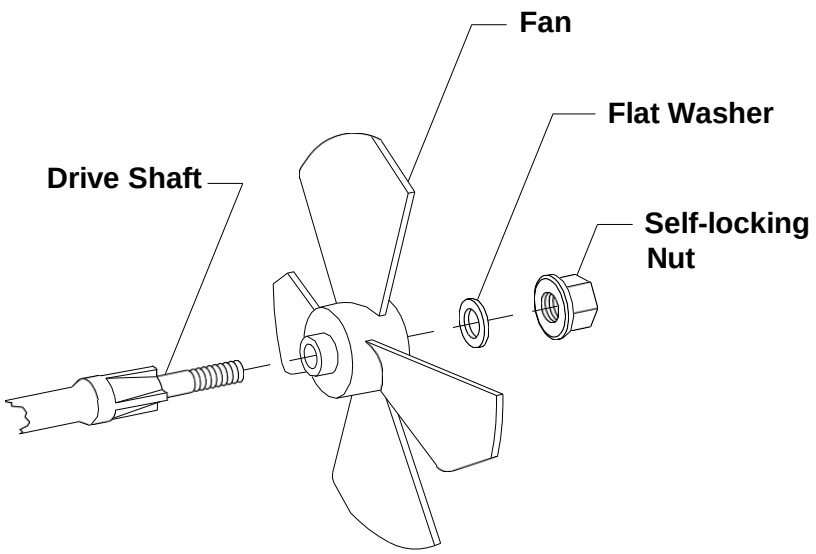


Figure 7021 - Installing the Fan

O. Install electrical brushes (100). See Figure 7022.

NOTE: If new brushes (100) are to be used, identify the brushes (100) 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) Install four brushes (100) into the corresponding complete brush holders (10002-15).

(a) Set starter-generator, anti-drive end up, onto a vertical stator support.

(b) 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.

(c) Slowly lower springs on top of brushes. Make sure that brush leads are not caught under brush springs.

(2) Secure the four brush (100) leads and four braided stator leads to complete brush holders (10002-15) with four screws (105) to a torque of 22.7 to 35.0 in-lbs (2,6 to 4,0 N·m).

NOTE: Make sure the leads are arranged over brush springs (10002-10) to prevent brushes (100) from hanging up.

NOTE: Refer to Safran Corporation SPD 1006 for brush lead dressing.

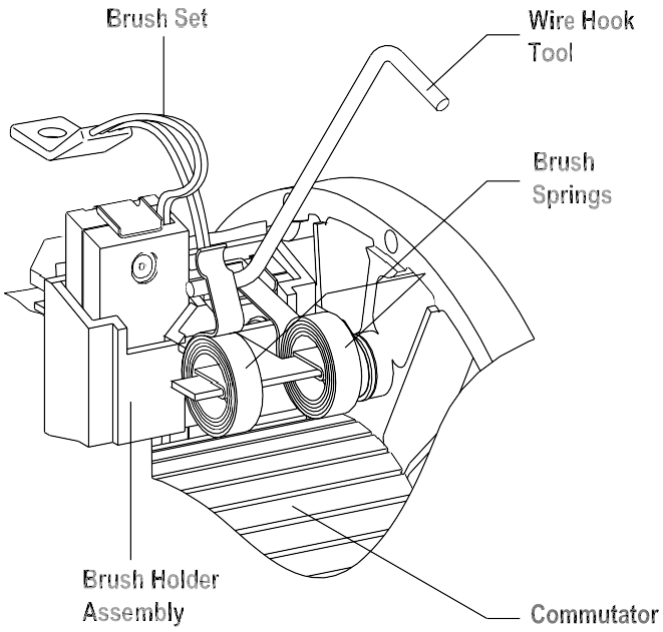


Figure 7022 - Installing Brush Sets

P. Coarse seat the new brushes (100).

CAUTION: FAILURE TO FULLY SEAT THE BRUSHES CAN DECREASE BRUSH LIFE, LOWER STARTER- GENERATOR PERFORMANCE, OR CAUSE STARTER-GENERATOR FAILURE.

(1) Coarse seat the brushes (100) as given in Safran Corporation SPD 1006.

NOTE: The sandpaper should first touch the leading edge (short side) of the brush (100) when the armature (205) is rotated in its normal direction.

(2) Remove sandpaper when done with seating.

Q. Attach the commutator viewing adapter to the starter-generator.

(1) Put the commutation viewing adapter over the openings in the stator and housing assembly (235).

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

(2) Center the brackets of the commutation viewing adapter between two brush access openings in the stator and housing assembly (235).

(3) Tighten the screw into the rivet nut that is attached to the commutation viewing adapter.

R. Attach the air inlet adapter (70) with the air inlet (55), if present, to the starter-generator. See Figure 7023.

NOTE: For models 23077-006 and 23077-007 only. The air inlet adapter can be installed separately if the air inlet is not already attached.

(1) Put a flat washer (80) onto each of the eight attaching screws (75) of the air inlet adapter.

WARNING: SEALING COMPOUND IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES.

(2) Apply sealing compound to the screws.

(3) Install the air inlet adapter (70), and air inlet (55) with the attaching screws (75) and flat washers (80) to a torque of 9.0 to 12.0 in.lbs. (1,0 to 1,4 N·m).

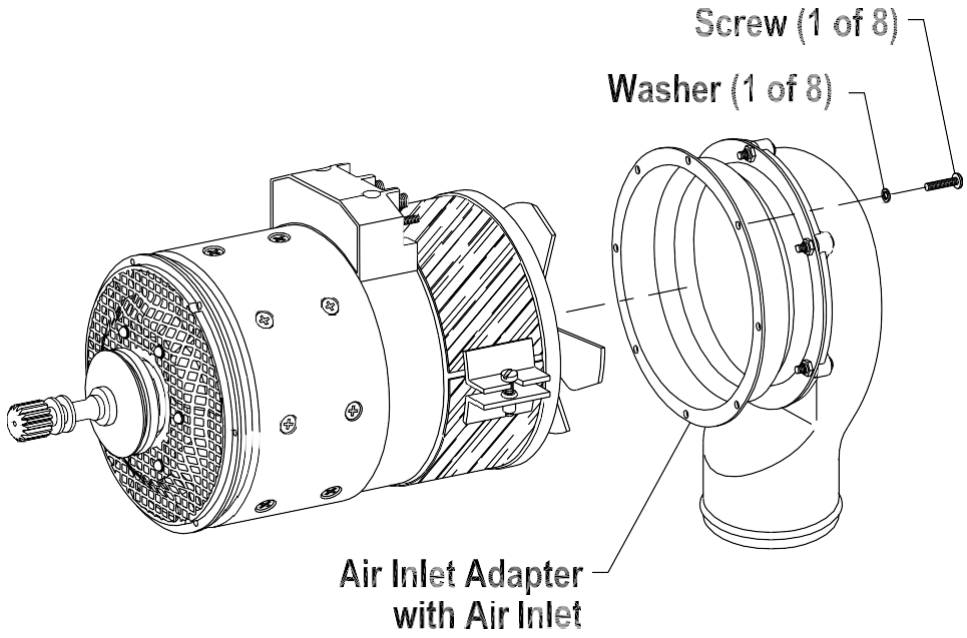


Figure 7023 - Attaching the Air Inlet Adapter with Air Inlet Attached

S. Attach the air inlet or fan cover (55) to the starter-generator. See Figure 7024.

(1) Put a flat washer (65) onto each attaching screw (60) of the air inlet.

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.**

(2) Apply thread sealing compound to threads of the attaching screws (60).

(3) Install the air inlet (55) with the attaching screws (60) and flat washers (65).

(4) Tighten the screws (60) as follows:

(a) For P/N MS35265-43, tighten to a torque of 9.0 to 12.0 in-lbs (1,0 to 1,3 N·m).

(b) For P/N MS35265-65, tighten to a torque of 22.7 to 35.0 in-lbs (2,6 to 4,0 N·m).

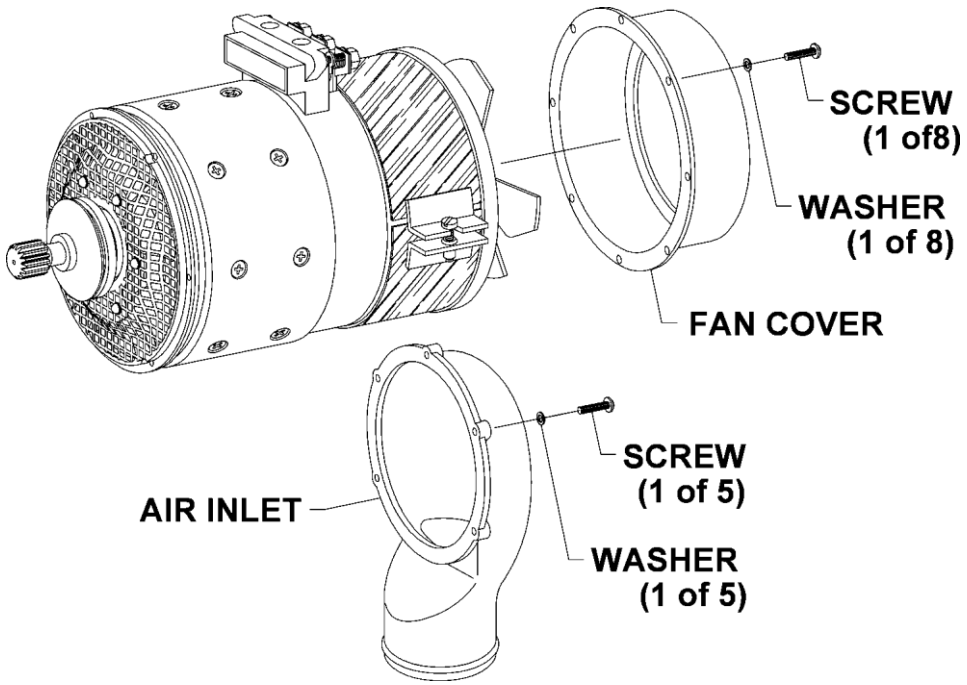


Figure 7024 - Attaching the Air Inlet

T. Perform brush (100) run-in.

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 as given in Safran Corporation SPD 1006.

NOTE: A correctly seated brush (100) has a smooth and semi-gloss contact surface.

U. Attach the brush access cover (85) to the starter-generator.

(1) Put the brush access cover (85) over the openings in the stator and housing assembly (235).

CAUTION: ORIENT AIR BLEED HOLES IN THE BRUSH BAND TOWARD THE TERMINAL BLOCK.

CAUTION: DO NOT CENTER THE BRACKETS DIRECTLY OVER AN OPENING IN THE STATOR AND HOUSING ASSEMBLY. POSITION THE SPLIT LINE OVER A HOUSING RIB.

(2) Center the brush access cover (85) between the four brush access openings in the stator and housing assembly (235).

(3) Tighten the screw (95) into the rivet nut (90) that is attached to the brush access cover (85). Torque screw 22.7 to 35.0 in-lbs (2,6 to 4,0 N·m).

V. Attach the terminal block cover (45) to the starter-generator if present.

NOTE: For models 23077-002, 23077-002-1, 23077-003, 23077-004, 23077-006, and 23077-007.

(1) Put the terminal block cover onto the terminal block (10004-25).

(2) Secure the terminal block cover with two attaching screws (50). Tighten screws (50) to a torque of 7.7 to 10.3 in.-lbs (0,9 to 1,2 N·m).

8. Identification and Other Plates

A. Install nameplate (10), information plate (20), modification status label (30) (if present), patent notification label (40), caution label (35) and FAA-PMA label (41) (if applicable) from stator and housing assembly (235).

NOTE: See the ILLUSTRATED PARTS LIST for the applicable model and modification status when re-identifying a starter-generator.

CAUTION: DO NOT STAMP INFORMATION DIRECTLY ONTO ANY PART OF THE STATOR AND HOUSING ASSEMBLY.

(1) Install nameplate (10) as follows:

(a) If starter-generator was modified and the original nameplate is not damaged:

1 Put a blank modification status label on a wooden work surface.

2 Stamp the letter “X” under the applicable letter on the modification status label (30).

3 Install the modification status label (30) to the stator and housing assembly (235) next to the nameplate (10) and orientated to read in the same direction as the nameplate (Refer Step Paragraph 8.A.).

(b) If the starter-generator was modified and the original nameplate was damaged:

1 If the starter-generator has a modification status label, note the existing modification status, then remove and discard the modification status label (30).

2 Remove and retain the old nameplate.

3 Put a new replacement nameplate (10) on a wooden work surface.

4 Transfer all the information from the old nameplate by stamping the information with a 1/8” letter punch set and a light hammer on the replacement nameplate.

5 Discard the old nameplate.

6 Stamp the letter “X” under the applicable letters on the replacement nameplate.

7 Attach the replacement nameplate (10) to the stator and housing assembly (235) using four drive screws (15).

8 Apply acrylic coating to the replacement nameplate (10).

9 Allow the coating to air dry.

(c) If the starter-generator was not modified but the nameplate was damaged:

1 Put a new replacement nameplate (10) on a wooden work surface.

2 Transfer all the information from the old nameplate by stamping the information with a 1/8” letter punch set and a light hammer on the replacement nameplate.

3 Discard the old nameplate.

4 Attach the replacement nameplate (10) to the stator and housing assembly (235) using four drive screws (15).

5 Apply acrylic coating to the replacement nameplate (10).

6 Allow the coating to air dry.

(2) Install new caution label (35) if existing caution label is damaged or unreadable:

(a) Remove the old caution label from the stator and housing assembly.

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.

(b) Clean the surface of the stator and housing assembly (235) using a cloth moistened with isopropyl alcohol.

(c) Apply a new caution label (35) to the stator and housing assembly (235) next to the terminal block (30).

(3) Install new patent (40) if existing patent is damaged or unreadable:

(a) Remove the old patent label from the stator and housing assembly (235).

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.

(b) Clean the surface of the stator and housing assembly (235) using a cloth moistened with isopropyl alcohol.

(c) Apply a new patent label (40) to the stator and housing assembly (235) next to the nameplate (10) and orientated to read in the same direction as the nameplate.

NOTE: For models 23077-006 and 23077-007 only.

(4) Install new information plate (20) if existing information plate is damaged or unreadable:

(a) Remove and retain the old information plate.

(b) Put a new replacement information plate (20) on a wooden work surface.

(c) Transfer all the information from the old information plate by stamping the information with a 1/8” letter punch set and a light hammer on the replacement information plate.

(d) Discard the old information plate.

(e) Attach the replacement information plate (20) to the stator and housing assembly using four drive screws (25).

(f) Apply acrylic coating to the replacement information plate (20).

(g) Allow the coating to air dry.

(5) Install modification status label (30), if applicable:

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.

(a) Clean stator and housing assembly (235) surface where decal is to be applied using isopropyl alcohol and a clean, lint-free cloth.

(b) Allow the alcohol to dry.

(c) Remove the protective backing on the modification status label (30) and install modification status label (30) on stator and housing assembly (235).

(6) Install new FAA-PMA label (41), if existing FAA-PMA label damaged:

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.

(a) Clean stator and housing assembly (235) surface where decal is to be applied using isopropyl alcohol and a clean, lint-free cloth.

(b) Allow the alcohol to dry.

(c) Remove the protective backing on the FAA-PMA label (41) and install FAA-PMA label (41) on stator and housing assembly (235).

9. Perform acceptance test on starter-generator

Perform acceptance test procedure on the assembled generator as detailed in the TESTING AND FAULT ISOLATION section.

10. Install QAD mounting kit

A. If present, attach the QAD mounting kit (10001-5) to the starter-generator.

NOTE: When a starter-generator has been removed from service, the QAD mounting kit usually stays on the aircraft.

(1) Engage the guide pins of the mounting adapter (10005-25) to the pin holes in the drive end bearing support assembly (10001-185).

(2) Be sure the guide pins are located correctly and that the pilot diameters of the mounting adapter and the drive end bearing support assembly are fully engaged.

(3) While holding the mounting adapter firmly in place, put the V-band clamp (10005-5) over the flanges of the mounting adapter and the drive end bearing support assembly (10001-185).

(4) Tighten the self-locking nut (10005-10) onto the T-bolt (10005-15). Torque to 70 in-lbs. (7.9 Nm) to lock the QAD mounting kit to the starter-generator.

11. Package the 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 the starter-generator unit in a suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

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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 required torque values to be used during repair and assembly of starter-generator components and attaching parts are listed in Paragraph 2.

E. The acceptance limits for starter-generator components and subassemblies are listed in Paragraph 3.

2. Torque Limits

NOTE: Refer to the ILLUSTRATED PARTS LIST for illustrations. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

Table 8001 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 8001 are to be tightened in accordance with Safran Corporation methods and techniques or practices acceptable to your administration as specified in FAR PART 43.

Hardware Description	Torque Limits
Screw, Machine (10001-50)	7.7 to 10.3 in-lbs (0,9 to 1,2 N·m)
Screw (10001-60, effect codes A, B, C, D, E, F, G, H, L and M)	9.0 to 12.0 in-lbs (1,0 to 1,4 N·m)
Screw (10001-60, effect codes J and K)	22.7 to 35.0 in-lbs (2,6 to 4,0 N·m)
Screw (10001-75)	9.0 to 12.0 in-lbs (1,0 to 1,4 N·m)
Rivnut® (10001-90)	60 in-lbs (6,8 N·m) Min. torque out
Screw (10001-95)	22.7 to 35.0 in-lbs (2,6 to 4,0 N·m)
Nut, Self-Locking (10001-115)	100 to 120 in-lbs (11,3 to 13,5 N·m)
Screw, Machine (10001-165)	13.5 to 18.0 in-lbs (1,5 to 2,0 N·m)
Thermostatic Switch (10001-170)	4.0 in-lbs (0,45 N·m)
Bolt, Machine (10002-35)	25 to 30 in-lbs (2,8 to 3,4 N·m)
Bolt, Machine (10004-30 and 10004-30B)	22.7 to 35.0 in-lbs (2,6 to 4,0 N·m)
Screw, Machine (10004-30A)	7.7 to 10.3 in-lbs (0,9 to 1,2 N·m)

Table 8001 - Torque Limits

Hardware Description	Torque Limits
Coupling, V-Retainer (10005-5)	70 in-lbs (7,9 N·m)

Table 8001 - Torque Limits

3. Component Acceptance Limits

Refer to Table 8002 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: Refer to the ILLUSTRATED PARTS LIST for illustrations. Numbers in parentheses ( ) refer to item numbers on the illustration, unless otherwise specified.

CHECK	Nomenclature	Inspection	Acceptance Limits
8.W.	Thermal Switch (10001-170)	Actuation	Opens at 300 ± 8° F (144,4 to 153,3° C), closes at 330 ± 8° F (161,1 to 170° C), and reopens at 300 ± 8° F (144,4 to 153,3° C).
8.J.	Drive Shaft (10001-125)	External Spline Diameter 16 Tooth Splines (0.800 P.D.)	Gauge Pin Dia: 0.096 inch (2,44 mm). Distance Over Two Pins: 0.921 inch (23,39 mm) Min.
	This allows wear of approximately 0.0105 inch (0,267 mm) or 50% of the case depth.		
8.K.	Friction Ring (10001-145)	Thickness	0.060 inch (1,52 mm) min.
8.L.	Dampener Plate (10001-140)	Thickness	P/N: 30054-1480 0.044 inch (1,11 mm) Min.
		Internal Spline Diameter	Gauge Pin Dia: 0.090 inch (2,29 mm) Distance between two pins: 0.6550 inch (16,637 mm) Max.
8.N.	Bearing And Brush Support Assembly (10001-160)	Bearing Liner Diameter See Figure 8002.	1.8501 to 1.8504 inch (46,993 to 47,000 mm)
		Bearing Liner Finish	32 µin (0,813 µm)
8.O.	Drive End Bearing Support Assembly (10001-185)	Bearing Liner Diameter	1.8501 to 1.8504 inch (46,993 to 47,000 mm)

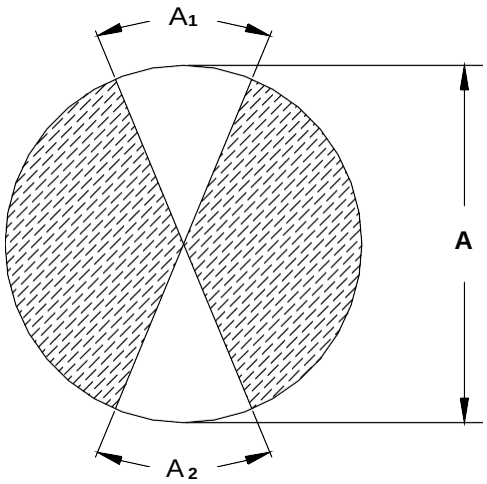
Table 8002 - Acceptance Limits

CHECK	Nomenclature	Inspection	Acceptance Limits
8.Q.	Armature (10001-205)	Bearing Journal Diameter (A, C) See Figure 8001.	0.7872 to 0.7875 inch (19.995 to 20.003 mm)
		Commutator Diameter (B)	2.50 inch (63.50 mm) Min.
		Commutator Bar to Bar Acceptance Test Values	Bar to Bar: 0.0002 inch (0,005 mm) Max. T.I.R.: 0.0007 inch (0,018 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.
		Mica Undercut (Before Re-cut)	Depth: 0.045 inch (1,14 mm) Min. to 0.070 inch (1,78 mm) Max. Width: 0.035 to 0.045 inch (0,89 to 1,14 mm) Max.
		Mica Undercut (After Re-cut)	Depth: 0.050 inch (1,27 mm) Min. to 0.070 inch (1,78 mm) Max. Width: 0.035 to 0.045 inch (0,89 to 1,14 mm) Max.
		Balance	5 grain inch (8,23 gram-mm) max. at each end
8.V.	Terminal Block (10004-25)	Capacitance Values	See Figure 8003.
	Capacitance measured at 77° F (25° C). Frequency at which capacitance is measured is 120 Hz ± 10 Hz.		
8.B.	Mounting Adapter (10005-20)	Guide Pin Height	0.055 to 0.075 inch (1,40 to 1,91 mm)
		Pilot Flange Dia.	4.120 to 4.122 inch (104,65 to 104,70 mm)
		Pilot Bore Dia.	5.870 to 5.872 inch (149,1 to 149,15 mm)

Table 8002 - Acceptance Limits

CHECK	Nomenclature	Inspection	Acceptance Limits
8.N.	Brush Spring (10002-75)	Force	P/N: 23033-1120 Position “A”: 2.70 lb (1,2 kg) @ 20° Position “B”: 3.95 lb (1,8 kg) @ 12° P/N: 23033-1200 Position “A”: 2.70 lb (1,2 kg) @ 20° Position “B”: 3.50 lb (1,6 kg) @ 12° P/N: 23064-1350 Position “A”: 2.70 lb (1,2 kg) @ 20° Position “B”: 3.60 lb (1,6 kg) @ 12°

Table 8002 - Acceptance Limits

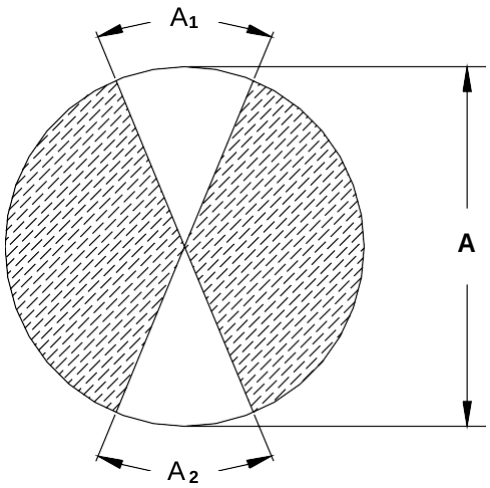


A1 + A2 < 25% of Diameter A Minimum

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 (0,003 mm) below maximum diameter limit.

NOTE: Acceptance criteria for used journals, not new or repaired journals.



A1 + A2 < 25% of Diameter A Maximum

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 (0,003 mm) above maximum diameter limit.

NOTE: Acceptance criteria for used liners, not new or repaired liners.

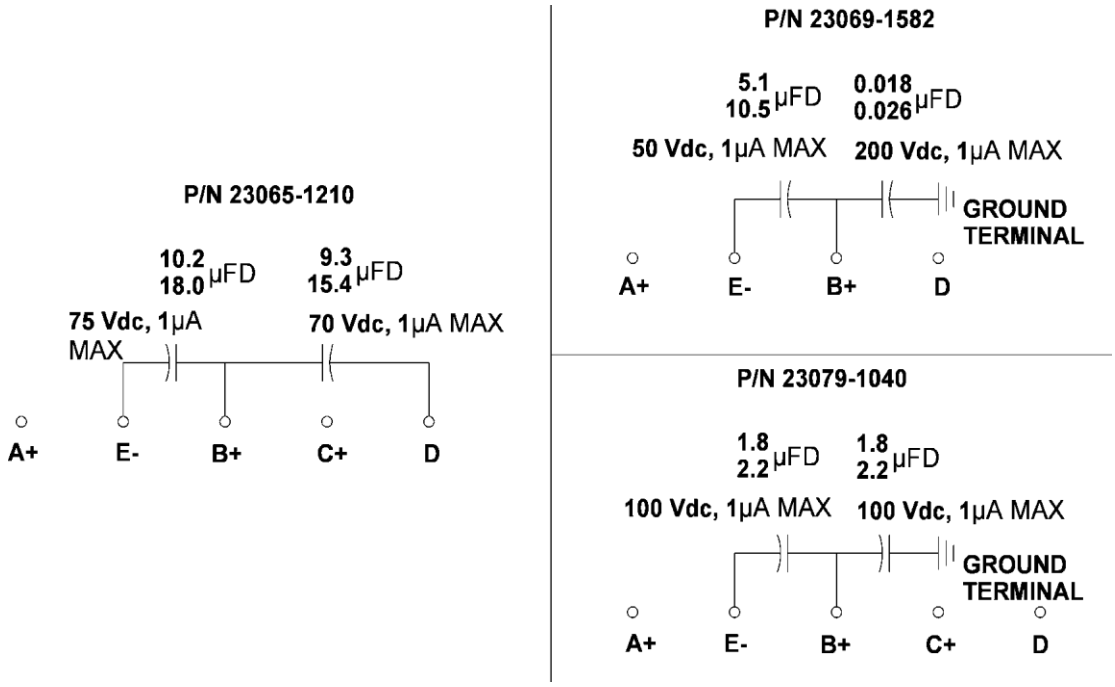


Figure 8003 - Terminal Block Schematics

NOTE: Terminal block capacitance values are measured at a frequency of 120 Hz ±10 Hz and at an ambient temperature between 50° to 104°F (10° to 40°C). All capacitance values shown are in micro farads.

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SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Introduction

Table 9001 lists the approved special tools, fixtures, and equipment necessary for generator service.

Nomenclature	Figure No.
Adapter, commutation, Viewing	Figure 9001
Adapter, Armature Shaft (drive end)	Figure 9002
Adapter, Armature Shaft (anti-drive end)	Figure 9003
Driver, Dampener Hub	Figure 9004
Driver, PlusNut® Fastener Header	Figure 9005
Driver, Bearing, Inner-race	Figure 9006
Driver, Bearing, Outer-race	Figure 9007
Fixture, Commutator Turning	Figure 9008
Fixtures, Rivet Alignment and Rivet Press	Figure 9009
Support, Armature	Figure 9010
Support, Bearing and Brush Support Assembly	Figure 9011
Support, Stator, Horizontal	Figure 9012
Support, Stator, Vertical	Figure 9013
Support, Hub (drive end)	Figure 9014
Support, Hub (anti-drive end)	Figure 9015
Wrench, Spline	Figure 9016

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 Corporation. Equivalent tooling and fixture requirements meeting with Safran Corporation specifications can be used.

A. Commutation Viewing Adapters (See Figure 9001).

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 0.63 inch (16,0 mm) thick. Design two uses one piece of acrylic, 19.00 inch (482,6 mm) long by 2.30 inch (58,4 mm) by 0.63 inch (16,0 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.

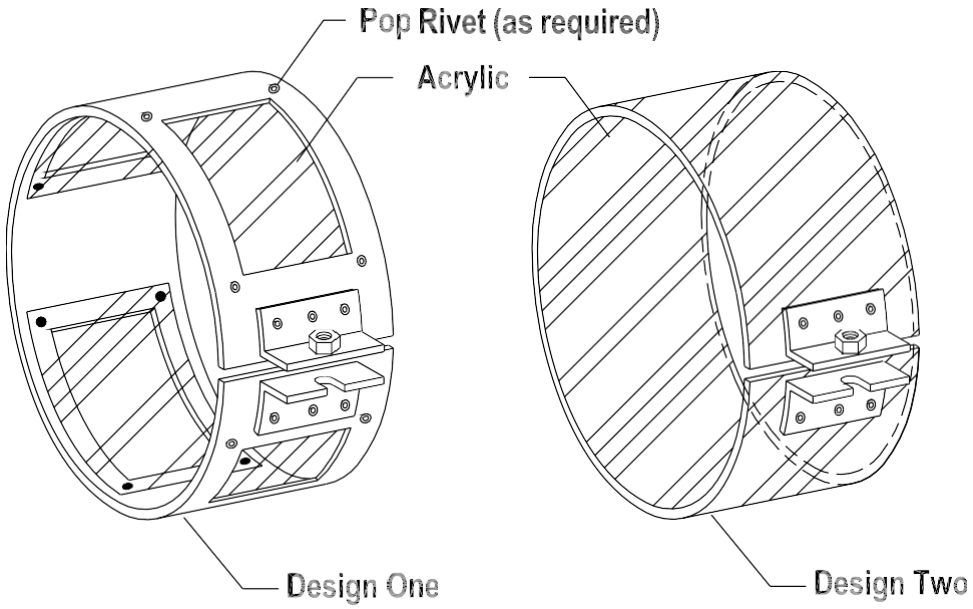


Figure 9001 - Commutation Viewing Adapter

B. Drive End Armature Shaft Adapter (See Figure 9002).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. Material is CD-260 Brass or equivalent (Stock size: 1.00” diameter).

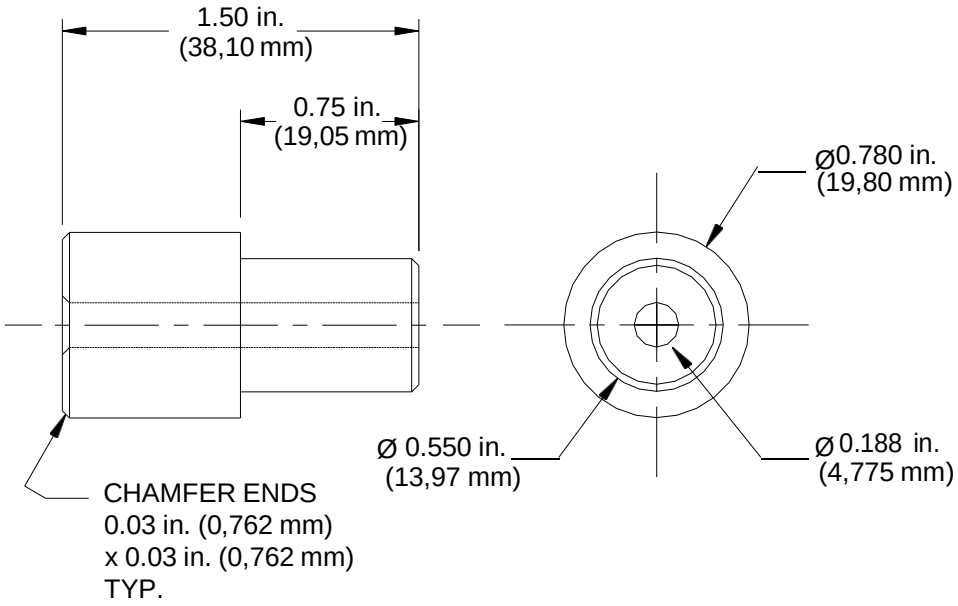


Figure 9002 - Drive End Armature Shaft Adapter

C. Anti-Drive End Armature Shaft Adapter (See Figure 9003).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. Material is CD-260 Brass or equivalent (Stock size: 1.00” diameter).

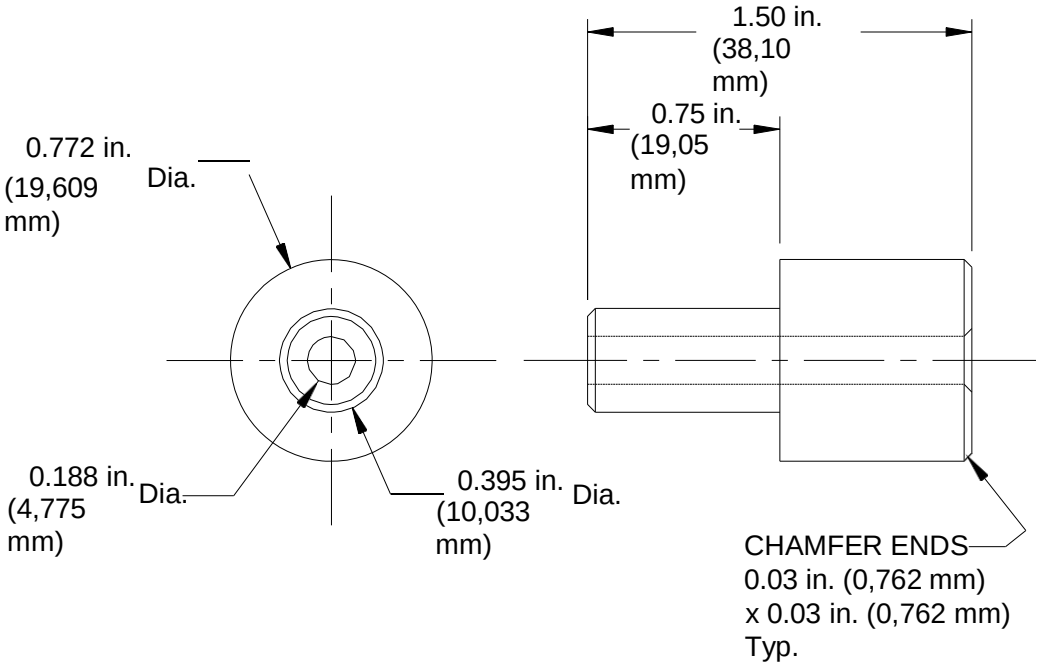


Figure 9003 - Anti-Drive End Armature Shaft Adapter

D. Dampener Hub Driver (See Figure 9004).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is 01 tool or equivalent hardened to Rc 55-60. Stock size is 3.00 diameter.

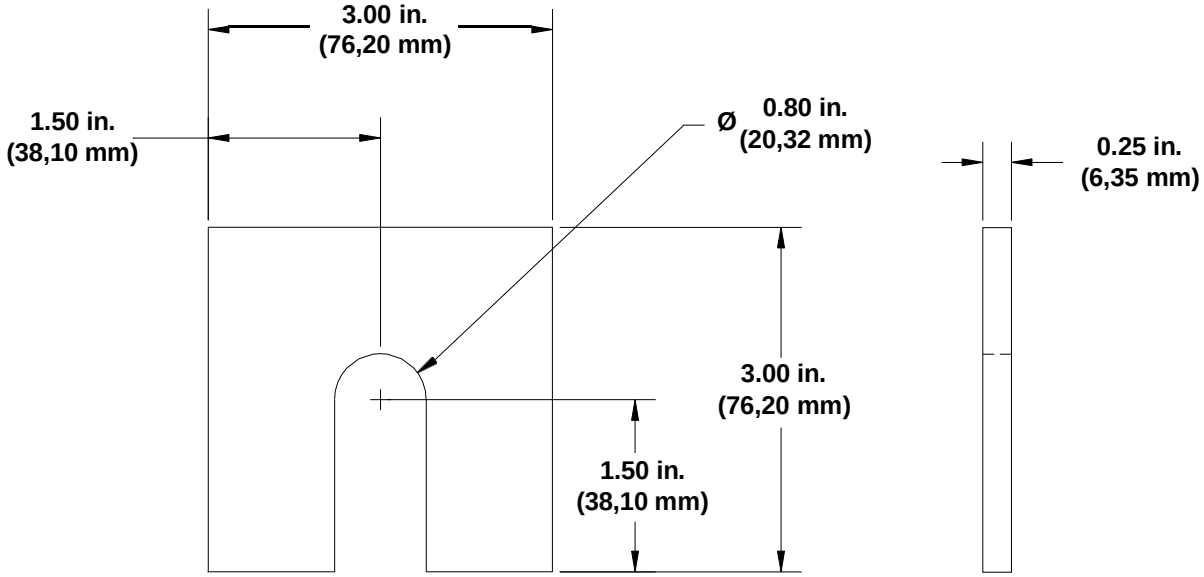


Figure 9004 - Dampener Hub Driver

E. PlusNut® Fastener Header (See Figure 9005).

NOTE: For rivnut® replacement - Reference REPAIR. Unless otherwise specified, dimensions are in inches. Tolerances on decimals are: .XX±0.01, XXX±0.005. Angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. Material is 01 tool steel or equivalent hardened to Rc 35-40. Use 2.00” diameter stock.

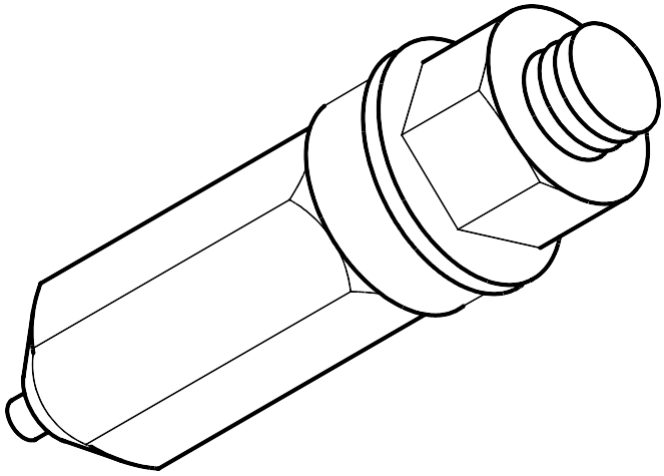


Figure 9005 - PlusNut® Fastener Header

F. Inner Race Bearing Driver (See Figure 9006).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. Material is 01 tool steel or equivalent hardened to Rc 55-60. Stock size: 2.00” diameter.

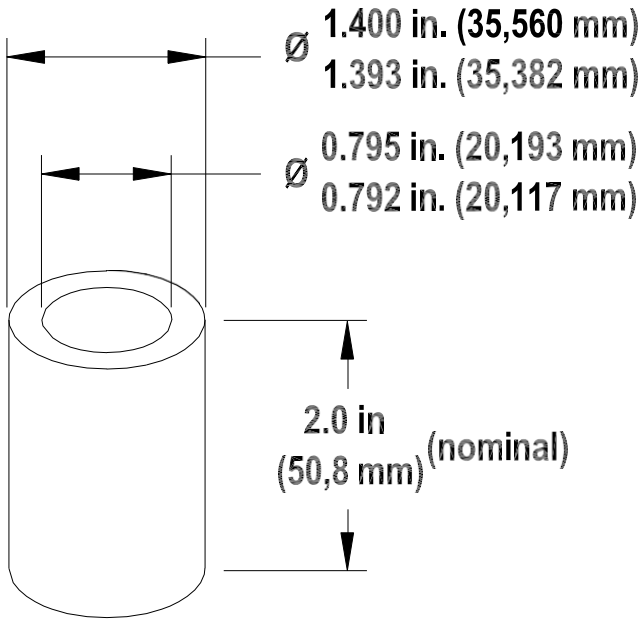


Figure 9006 - Inner Race Bearing Driver

G. Outer Race Bearing Driver (See Figure 9007).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. Material is 01 tool steel or equivalent hardened to Rc 55-60. Stock size: 2.00” diameter.

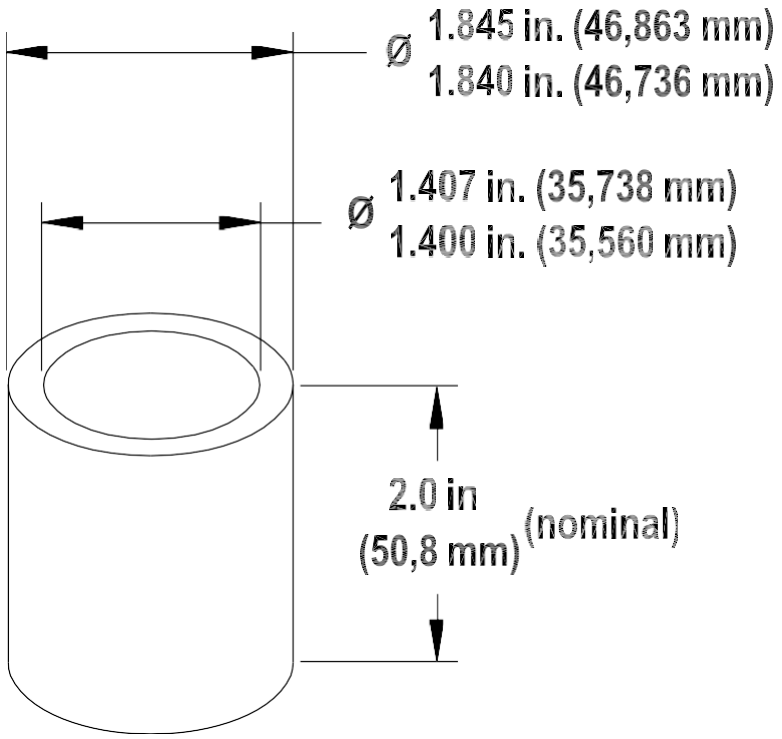


Figure 9007 - Outer Race Bearing Driver

H. Commutator Turning Fixture (See Figure 9008).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Materials are 0.250” 01 tool steel or equivalent hardened to Rc 35-40 and one ball bearing, IPL Item 10001-220.

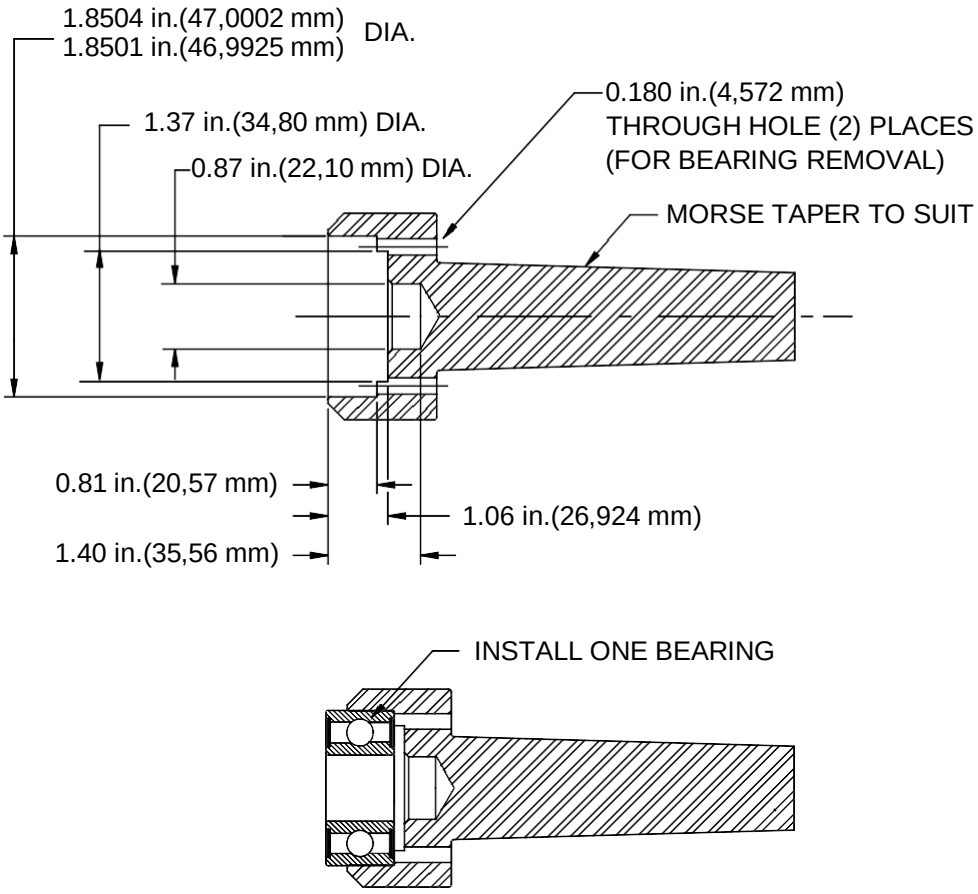


Figure 9008 - Commutator Turning Fixture

I. Rivet Alignment and Rivet Press Fixtures (See Figure 9009).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is a indicated on the chart found on the figure.

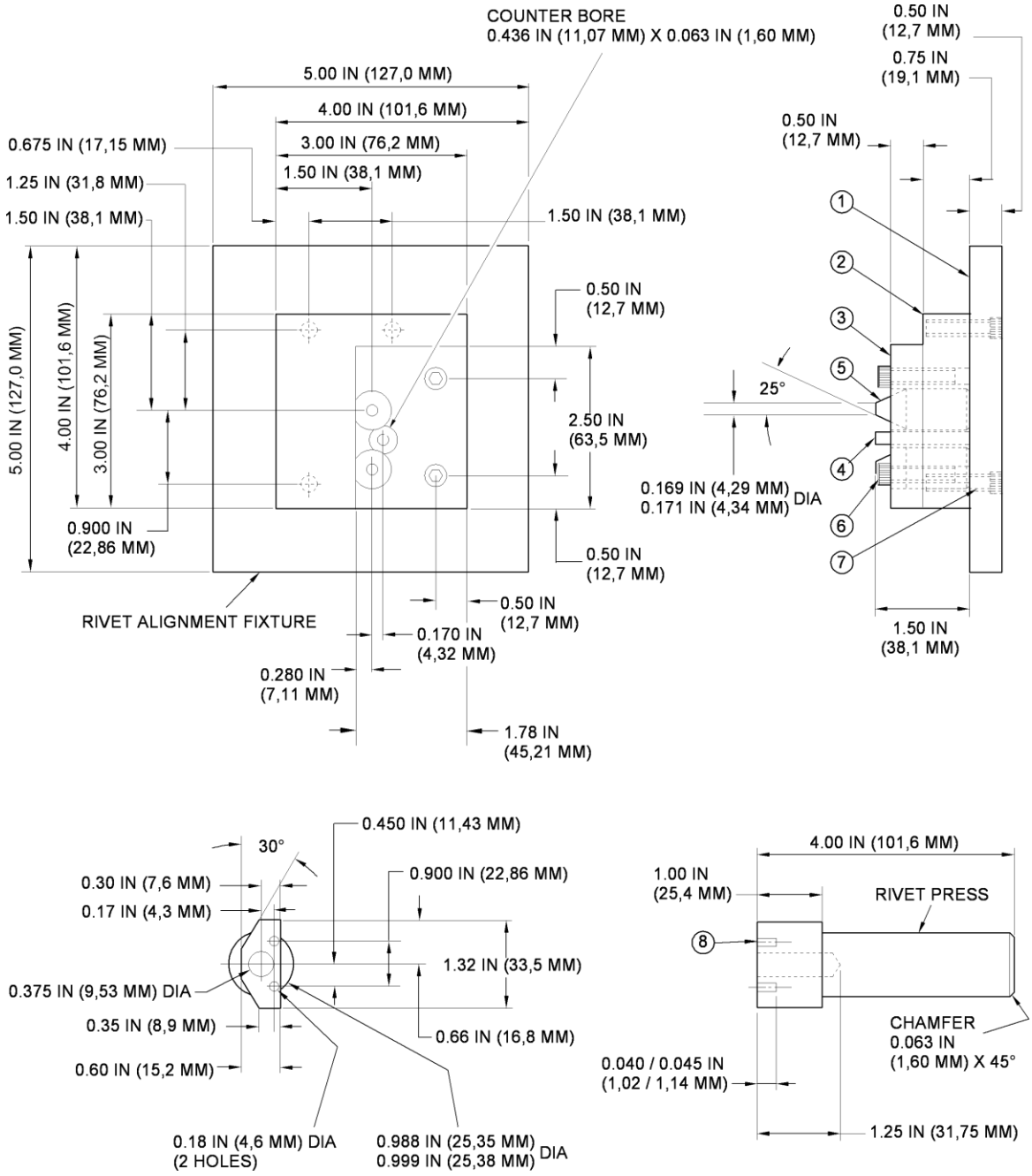


Figure 9009 - Rivet Alignment and Rivet Press Fixtures

J. Armature Support (See Figure 9010).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. Material is 3.50 inch (88,9 mm) diameter 01 tool steel or equivalent hardened to Rc 35-40.

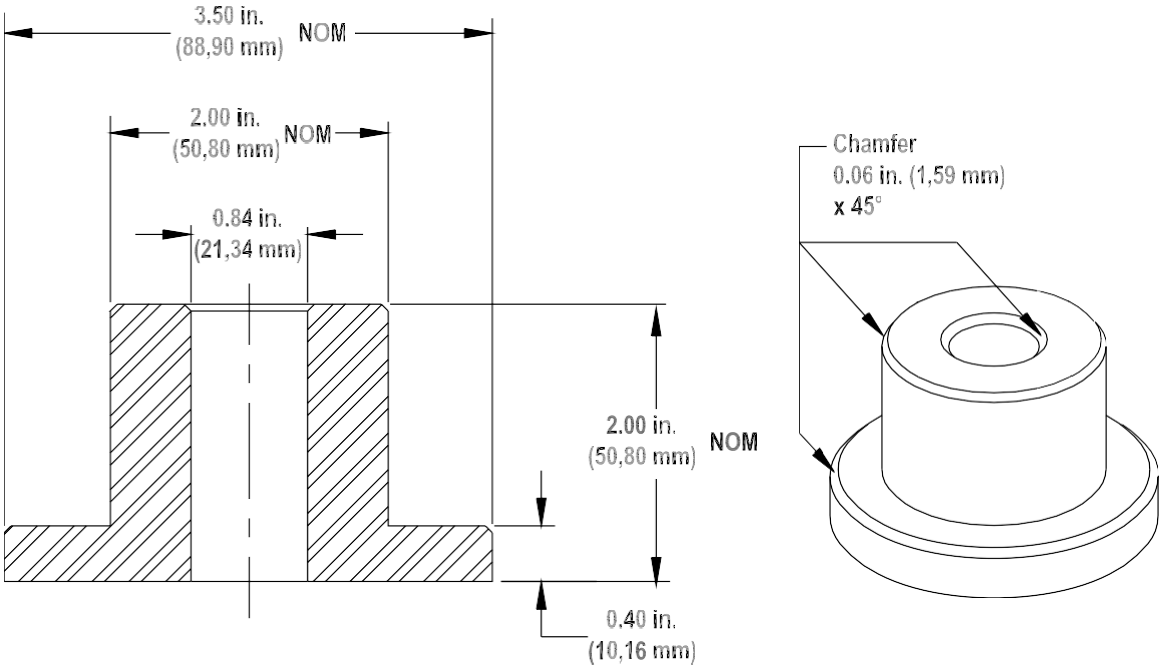


Figure 9010 - Armature Support

K. Bearing and Brush Support Assembly Support (See Figure 9011).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is 6.00” diameter 01 tool steel or equivalent.

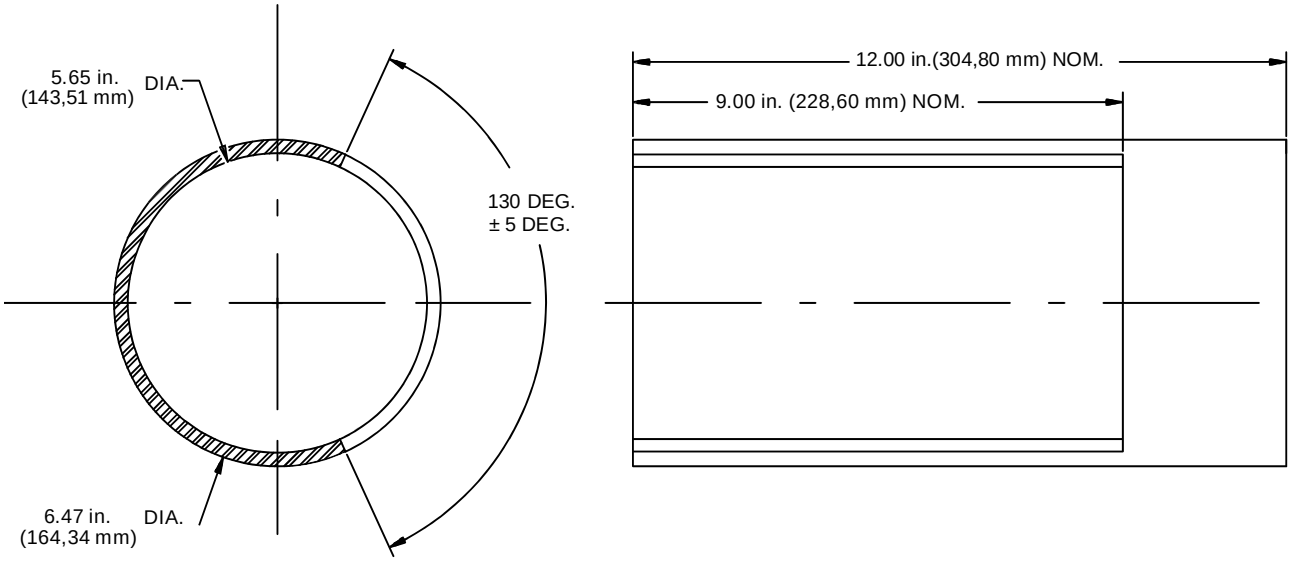


Figure 9011 - Bearing and Brush Support Assembly Support

L. Horizontal Stator Support (See Figure 9012).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is any suitable hardwood. (Stock size 7.5" X 6" X4".)

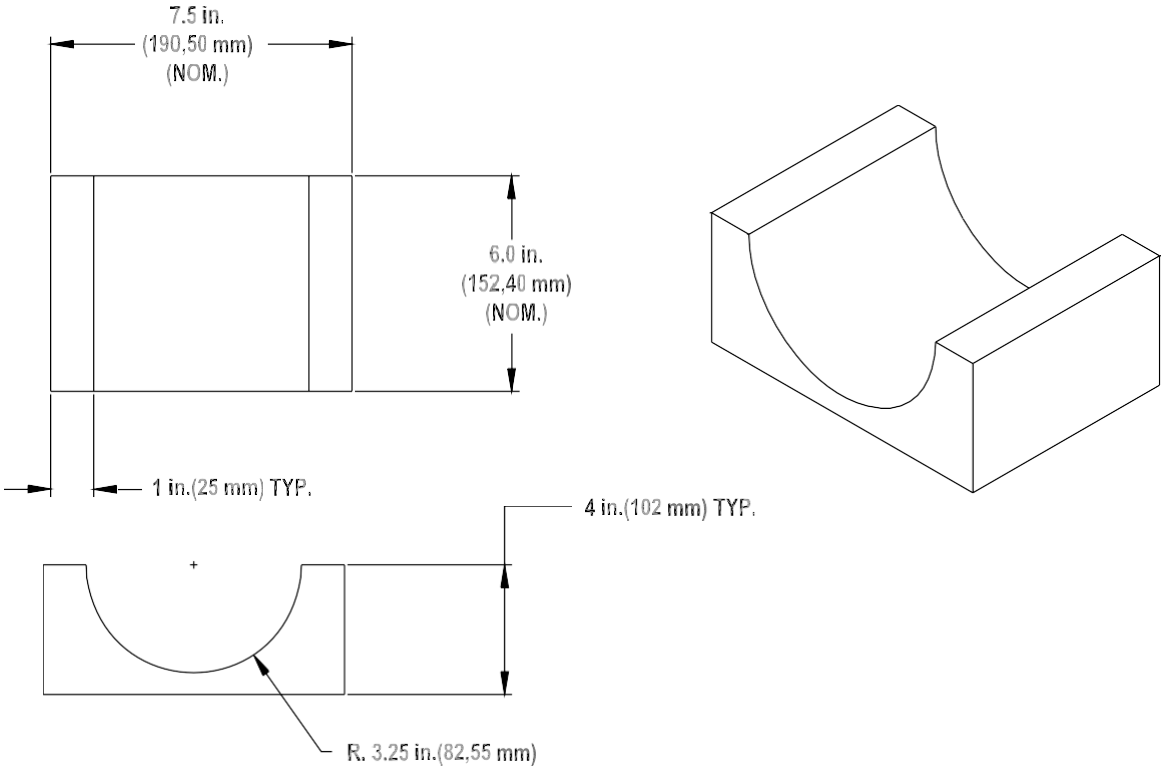


Figure 9012 - Horizontal Stator Support Fixture

M. Vertical Stator Support (See Figure 9013).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is any suitable hardwood. (Stock size 9" X 9" X3".)

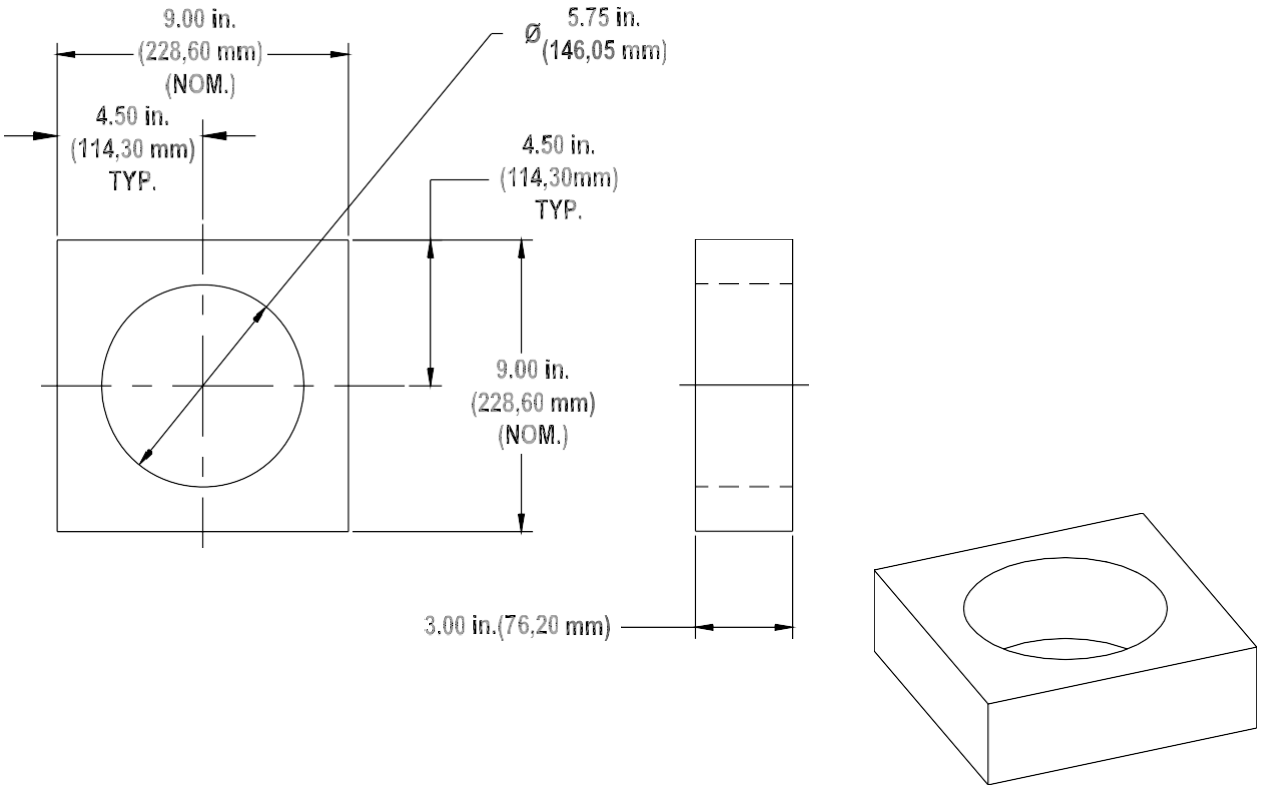


Figure 9013 - Vertical Stator Support Fixture

N. Drive End Hub Support Fixture (See Figure 9014).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is 2.50” diameter 01 tool steel or equivalent, hardened to Rc 35-40.

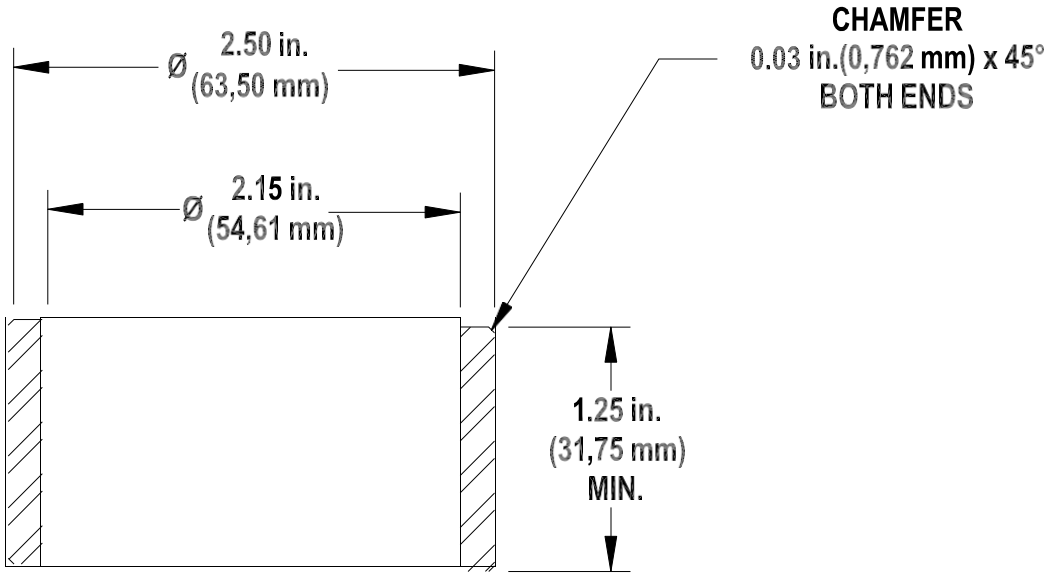


Figure 9014 - Drive End Hub Support

O. Anti-drive End Hub Support (See Figure 9015).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±5°0'. Material is 2.50” diameter 01 tool steel or equivalent, hardened to Rc 35-40.

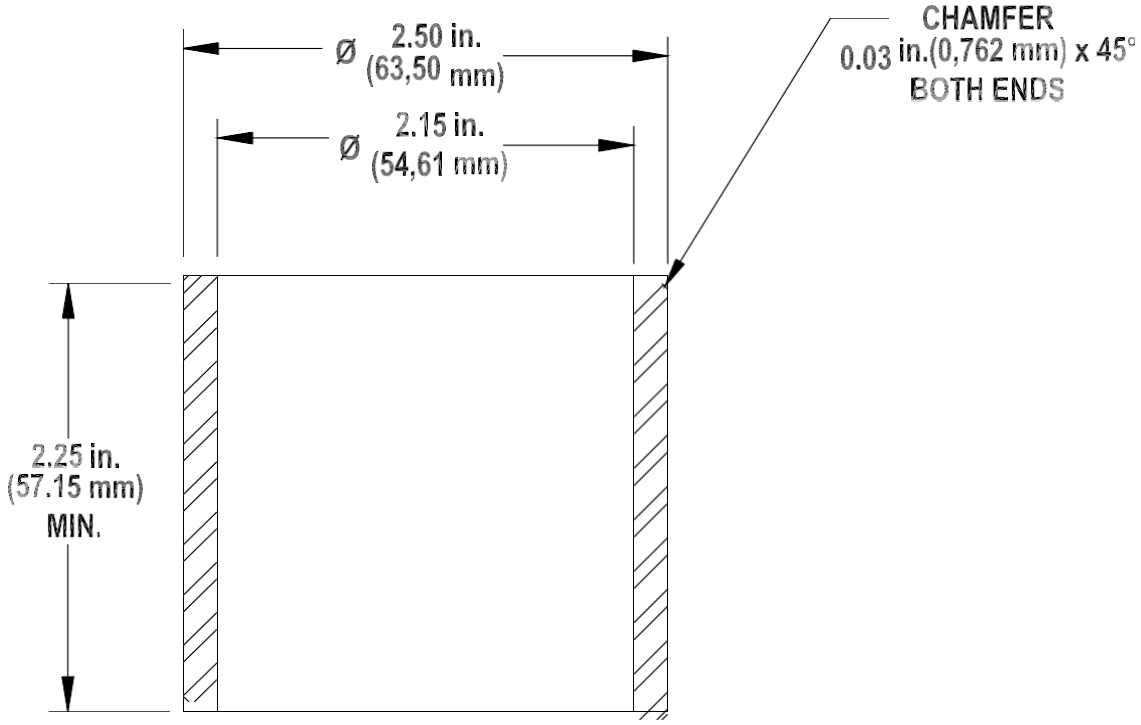
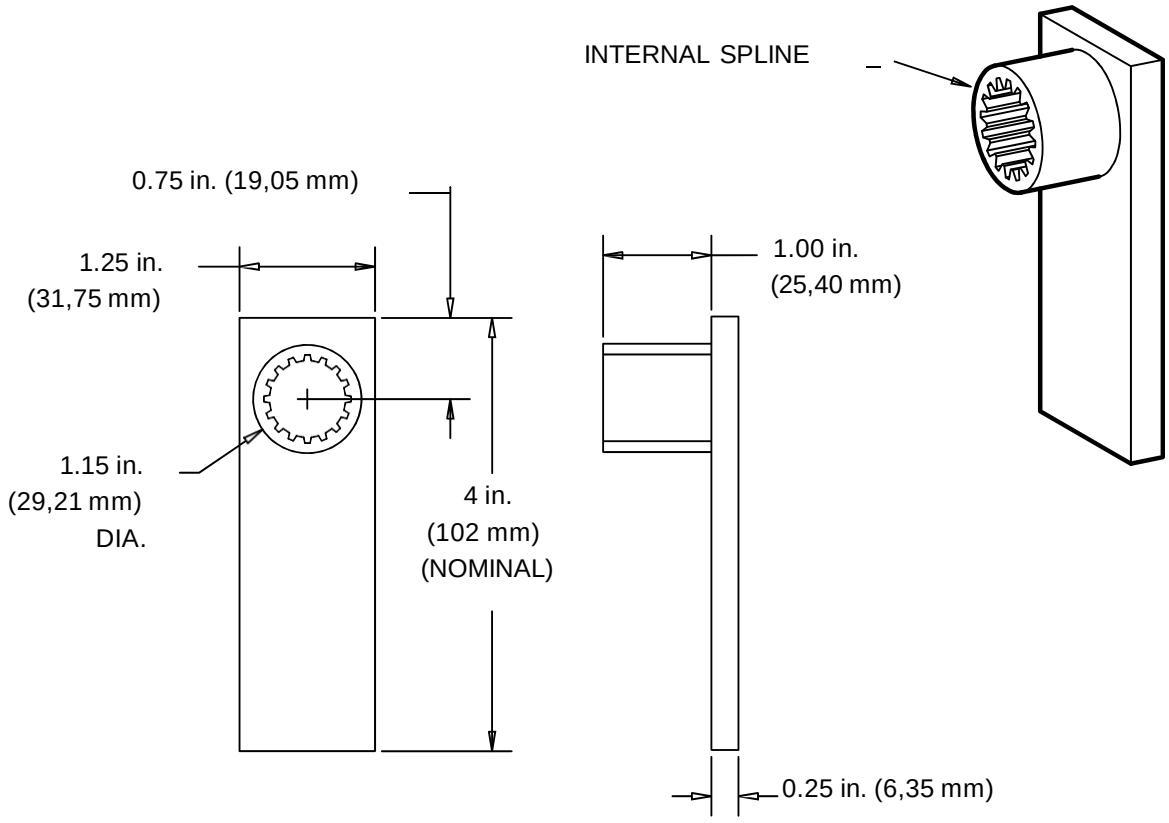


Figure 9015 - Anti-drive End Hub Support

P. Spline Wrench (See Figure 9016).

Unless otherwise specified, dimensions are in inches. Tolerances on decimals are:.XX±0.01, XXX±0.005. Angles are ±2°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees.
Material: 01 Tool Steel hardened to Rc 55-60



16 TOOTH SPLINE

Internal Involute Spline Data Fillet Root Side Fit	inch	mm
Number of Teeth	16	
Diametral Pitch	20 / 40	
Pressure Angle	30 DEG.	
Pitch Diameter	0.8000	20,320
Minor Diameter (min.)	0.7270	18,590
Major Diameter (min.)	0.8640	21,946
Chord Space (min.)	0.0728	1,849
Pin Diameter	0.0720	1,829
Between three .072 Pins (min.)	0.7096	18,024

Figure 9016 - Spline Wrench

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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 recommended for packaging rotating machines containing grease-lubricated bearings for storage or shipment are listed below 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, double, 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, sized to completely enclose domestic class packaging - for overseas shipment only	PPP-B-636 or suitable equivalent	1 ea.
Cardboard Tubing	Commercially available	AR
Chemically neutral protective paper	Commercially available	AR
Desiccant	MIL-D-3464 Type I and II	AR
Grease	MIL-PRF-81322	AR
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam. (Safran Corporation's recommended method: 3 inch (76,2 mm) thick minimum expanded foam surrounding machine on all sides.)	Commercially available	AR
Polyethylene (plastic) wrap	Commercially available	AR

Table 15001 - Packaging Material

Description	Specification	Quantity
Tag	Commercially available	1 (Domestic) 2 (International)
Tape - waterproof, pressure sensitive	Commercially available	AR
O-ring (for drive shaft on applicable models)	Check Illustrated Parts List for current p/n	1 ea.

Table 15001 - Packaging Material

A. GENERAL INFORMATION

CAUTION: IF MACHINE STORAGE TIME HAS EXCEEDED 24 MONTHS WITH NO USE, IT IS RECOMMENDED THAT THE BALL BEARINGS BE REPLACED. IT MUST THEN BE RE-TESTED ACCORDING TO THE TESTING AND FAULT ISOLATION SECTION BEFORE BEING PUT INTO SERVICE.

(1) Unit is to have successfully completed tests specified in TESTING AND FAULT ISOLATION section of this manual before preparing unit for shipment or storage.

(2) Verify that lockwire (if required) is in place.

(3) Record following information on tag(s):

- Model Number
- Serial Number
- Modification (MOD) Status
- Test Date (PASSED)
- Packing date

(4) Select packaging materials as described 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

Recommended packaging procedure for generators and starter-generators is:

(1) If machine includes drive shaft with O-ring/oil sealing provision, place O-ring into small plastic bag, include instructions to lubricate and install the O-ring on drive end of shaft prior to installation on aircraft, seal bag, and attach it to the machine.

(2) 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.

(3) Put 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.

(4) Insert vacuum tube into bag to draw remaining air out of bag.

(5) Withdraw vacuum tube quickly and complete heat-sealing of bag.

(6) Use machine's original shipping container if possible. Put bagged machine into box surrounded with a minimum of three (3) inch (76,2 mm) thick shock absorbing, cushioning material on all six sides.

(7) Securely and completely seal all flapped openings of box with tape.

(8) Tape tag to exterior of box. Make sure all information is visible.

D. OVERSEAS SHIPMENT ON SURFACE VESSELS

(1) Package the machine as given in the DOMESTIC PACKAGING paragraph in this section.

(2) Put domestically packaged generator or starter-generator into WC5 shipping container.

(3) Securely and completely seal all flapped-openings of shipping container with tape.

(4) Tape tag to exterior of shipping container. Make sure all information is visible.

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REWORK

1. Introduction

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ILLUSTRATED PARTS LIST

1. Introduction

This section contains lists of assemblies and detail parts for the 23077 Series of Starter-Generators. All parts are listed, except for parts which lose their identities by being permanently fastened to other parts or are parts 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 Corporation,with the exception of those listed in Paragraph 2.B.

WARNING: ANY USE OF PARTS, MATERIALS OR PROCEDURES NOT AUTHORIZED BY SAFRAN CORPORATION FOR MAINTENANCE OR OVERHAUL OF UNIT(S) CAN AFFECT CONTINUED AIRWORTHINESS OR INVALIDATE CERTIFICATION.

To order authorized Safran Corporation parts, contact your regional SafranCorporation 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 Corporation 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. A list of the terms used to show interchangeability and their definition is as follows:

Term	Parts List Abbreviation	Definition
Alternate	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 alternate. The information is for reference only or as a way to help identify the part.
Modification	Mod	Modification (Mod) status details information about effectivity of parts in regard to upgrades and modifications. Alpha variants (A through Y) (but I, O, Q, S, X, and Z) are assigned to existing model numbers when necessary.
Order separately		Part is not furnished as part of the GCU.
Superseded	SUPSD BY	Part number listed is obsolete and must be replaced by the new part listed at the next repair. A superseded part is not to be installed or reinstalled.
Supersedes	SUPSDS	Part number listed must replace the obsolete part number at the next repair.
Replaced by	REPLD BY	Part number listed is discontinued and should be replaced by the new part number. Original part may be for use until current stock is depleted and then must be replaced by the new part listed.
Replaces	REPLS	Part listed replaces and is interchangeable with the item number shown in the notation.

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 can not be ordered. The abbreviation RF indicates that the item is listed for reference only.

F. MODEL NOTES

NOTE 1: Models 23077-000, 23077-000-1, 23077-000-2, 23077-002, 23077-002-1, 23077-003, 23077-004, and 23077-007 are not supplied with a QAD kit. The P/N 23065-504 QAD kit is required for installation and may be ordered separately.

NOTE 2: Model 23077-005 is not supplied with a QAD kit. QAD kit P/Ns 23065-504, 23065-512, and 23065-513 are application specific. The QAD kit is required for installation and may be ordered separately.

NOTE 3: Model 23077-006 is supplied with a P/N 23065-504 QAD kit. The QAD kit is required for installation and may be called out in aircraft documentation for this model.

NOTE 4: Models 23077-009 and 23077-010 are not supplied with a QAD kit. QAD kit P/N 23065-513 is required for installation and may be ordered separately.

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 Corporation 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.

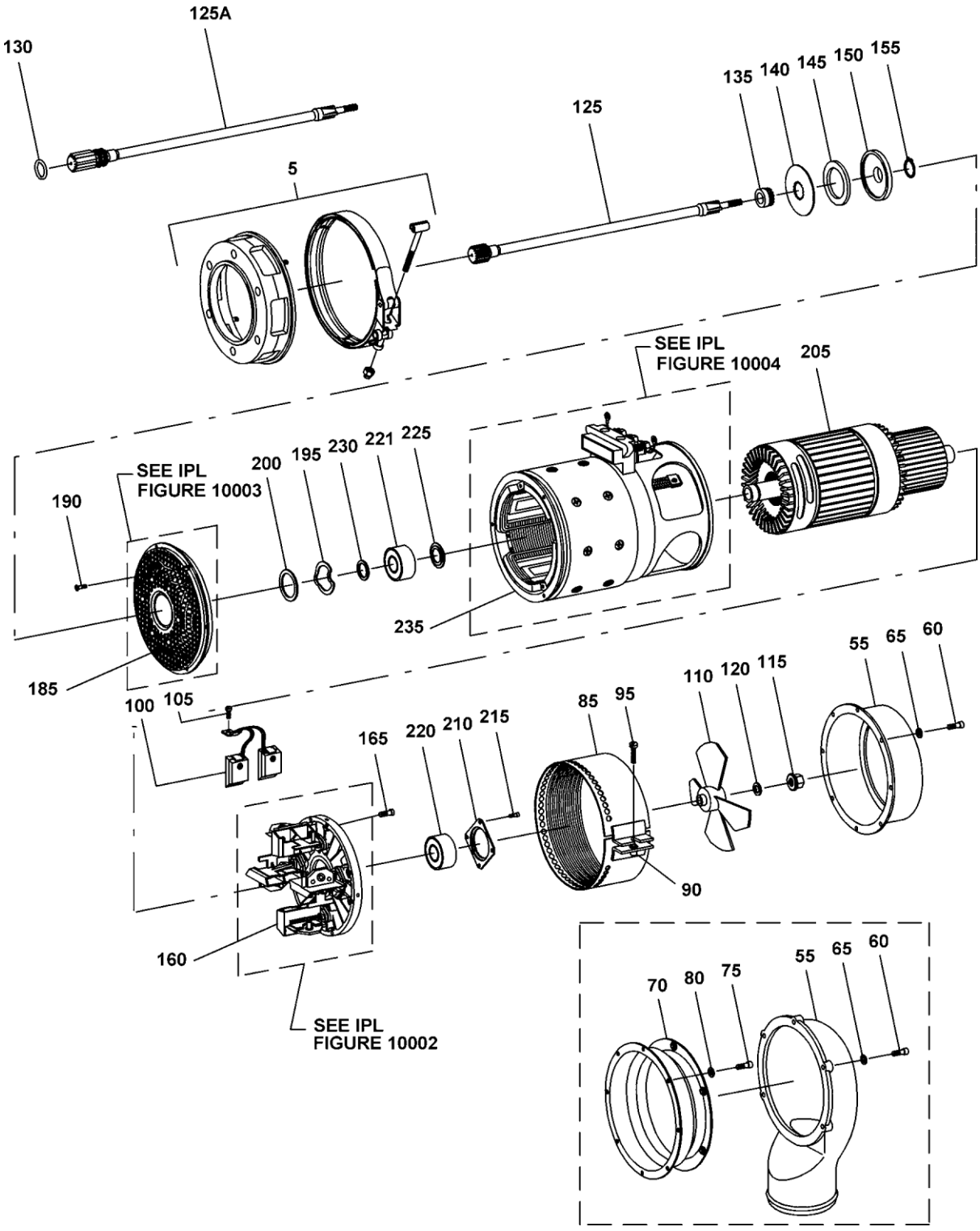

Figure 10001 - DC Starter-Generator Assembly, 23077 Series

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
	23077-000	DC STARTER-GENERATOR . . . . . See Note (1)	A	RF
	23077-000-1	DC STARTER-GENERATOR . . . . . See Note (1)	B	RF
	23077-000-2	DC STARTER-GENERATOR . . . . . See Note (1)	C	RF
	23077-002	DC STARTER-GENERATOR . . . . . See Note (1)	D	RF
	23077-002-1	DC STARTER-GENERATOR . . . . . See Note (1)	E	RF
	23077-003	DC STARTER-GENERATOR . . . . . See Note (1)	F	RF
	23077-004	DC STARTER-GENERATOR . . . . . See Note (1)	G	RF
	23077-005	DC STARTER-GENERATOR . . . . . See Note (2)	H	RF
	23077-006	DC STARTER-GENERATOR . . . . . See Note (3)	J	RF
	23077-007	DC STARTER-GENERATOR . . . . . See Note (1)	K	RF
	23077-009	DC STARTER-GENERATOR . . . . . See Note (4)	L	RF
	23077-010	DC STARTER-GENERATOR . . . . . See Note (4)	M	RF
5	23065-504	• KIT, Q.A.D., Mounting . . . . . See IPL Figure 10005	ABCDE FGHJK	1
	23065-504	• KIT, Q.A.D., Mounting . . . . . See IPL Figure 10005 SUPSD BY 23065-513	M	RF
	23065-512	• KIT, Q.A.D., Mounting . . . . . See IPL Figure 10005	H	1
	23065-513	• KIT, Q.A.D., Mounting . . . . . See IPL Figure 10005	HL	1
	23065-513	• KIT, Q.A.D., Mounting . . . . . See IPL Figure 10005 SUPSDS 23065-504 SB 23077-010-24-01	M	1
-10	06-209285	• IDENTIFICATION PLATE, Replacement (ATTACHING PARTS)		1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-15	MS21318-14	• SCREW, Drive. . . . . REPLD BY MS21318-13	ABCDE FGHJKL	RF
	MS21318-13	• SCREW, Drive. . . . . REPLS MS21318-14	ABCDE FGHJKL	4
	MS21318-13	• SCREW, Drive.	M	4
		*		
-20	06-0017-01	• INFORMATION PLATE, Replacement .	JK	1
		(ATTACHING PARTS)		
-25	MS21318-14	• SCREW, Drive. . . . . REPLD BY MS21318-13	JK	RF
	MS21318-13	• SCREW, Drive. . . . . REPLS MS21318-14	JK	2
		*		
-30	06-201100	• LABEL, Modification Status. . . . . SB 23077-0XX-24-03/-04/-05/-06 SB 23077-009-24-05/-06/-07 SB 23077-00X-24-02 SB 23077-010-24-02		AR
-35	06-201020	• LABEL, Caution.		1
-40	06-200001	• LABEL, Patent.	BCEGH JKLM	1
-41	06-123301	• LABEL, FAA-PMA	BDGHL	1
-45	23077-1060	• COVER, Terminal Block	DEFG	1
	23069-1241	• COVER, Terminal Block	JK	1
		(ATTACHING PARTS)		
-50	NAS1189-06P12L	• SCREW, Machine, Flat Head	DEFG	2
	NAS1189-06P14L	• SCREW, Machine, Flat Head . . . . . ALT: 05-350108	JK	2
		*		
55	23065-1470	• COVER, Fan	ABCDE HLM	1
	23065-1340	• INLET, Air	FG	1
	G29-383	• INLET, Air	JK	1
		(ATTACHING PARTS)		
60	MS35265-43	• SCREW, Machine Drilled, Fillister Hd. .	ABCDE FGHLM	8
	MS35266-65	• SCREW, Machine Drilled, Fillister Hd. .	JK	5

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
65	MS35333-38	• WASHER, Lock.	ABCDE FGH	8
	05-700105	• WASHER, Lock. . . . . ALT: to MS35333-38	LM	8
	AN960-10L	• WASHER, Flat	JK	5
		*		
70	23065-1370	• ADAPTER, Air Inlet	JK	1
		(ATTACHING PARTS)		
75	MS35265-43	• SCREW, Machine Drilled, Fillister Hd. .	JK	8
80	MS35333-38	• WASHER, Lock. . . . . ALT: 05-700105	JK	8
	05-700105	• WASHER, Lock. . . . . ALT: MS35333-38	JK	8
		*		
85	23065-1055	• COVER, Brush Access	ABCDE FG	1
	23048-1123	• COVER, Brush Access	HJKLM	1
90	05-321002	• • RIVNUT® . . . . . REPLD BY NAS1329H3K80L		RF
	NAS1329H3K80L	• • RIVNUT® . . . . . REPLS 05-321002 REPLD BY NAS1329H3K130L		RF
	NAS1329H3K130L	• • RIVNUT® . . . . . REPLS NAS1329H3K80L		1
		(ATTACHING PARTS)		
95	AN502-10-14	• • SCREW, Machine Drilled, Fillister Hd.	ABCDE FG	1
	AN502-10-18	• • SCREW, Machine Drilled, Fillister Hd.	HJKLM	1
		*		
100	30300-1284	• BRUSH, Electrical Contact	ABDEF GHJKM	4
	30300-1415	• BRUSH, Electrical Contact . . . . . SUPSD BY 23077-1281	L	RF
	23077-1281	• BRUSH, Electrical Contact ..... MOD G SUPSDS 30300-1415 SB 23077-009-24-07	L	4
	23077-1281	• BRUSH, Electrical Contact	C	4
		(ATTACHING PARTS)		
105	05-340201	• SCREW, Machine, Binding Head	ADF	4

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
105 (Con	05-340209	• SCREW, Machine, Binding Head	BCEGH JKLM	4
		---------- * ----------		
110	23065-1403	• FAN . . . . . REPLD BY 23065-1743	ABDE	RF
	23065-1743	• FAN . . . . . REPLS 23065-1403	ABDE	1
	23065-1743	• FAN	CHLM	1
	23065-1740	• FAN	FGJK	1
		(ATTACHING PARTS)		
115	02-4107-01	• NUT, Self-Locking . . . . . REPLD BY MS21042-4	ABCDE FGHJKL	RF
	MS21042-4	• NUT, Self-Locking . . . . . REPLS 02-4107-01 SIL 23703	ABCDE FGHJKL	1
	MS21042-4	• NUT, Self-Locking	M	1
120	AN960-416L	• WASHER, Flat . . . . . REPLD BY AN960-416	ABCDE FGHJKL	RF
	AN960-416	• WASHER, Flat . . . . . REPLS AN960-416L	ABCDE FGHJKL	1
	AN960-416	• WASHER, Flat	M	1
		---------- * ----------		
125	23065-1520	• SHAFT, Drive	ABCDE FGHLM	1
125A	02-6102-03	• SHAFT, Drive	JK	1
130	M83248-1-210	• O-RING	JK	1
135	23032-1900	• HUB, Dampener		1
140	30059-1480	• PLATE, Dampener		1
145	02-5600-06	• RING, Friction . . . . . **WARNING: CAN CONTAIN ASBESTOS** SUPSD BY 02-5600-14		RF
	02-5600-14	• RING, Friction . . . . . SUPSDS 02-5600-06 SIL 02-5600-01	ABCDE FGHJKL	1
	02-5600-14	• RING, Friction	M	1
150	30059-1471	• BACKPLATE, Dampener		1
155	MS16628-1078	• RING, Retaining		1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
160	23046-306	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160A/D/E (See Figure 10002) REPLD BY 160J	AD	1
	23046-306	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160D REPLD BY 160J	F	1
-160A	23046-373	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160, 160D/E REPLD BY 160J	AD	1
-160B	23075-331	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160C/F/G REPLD BY 160H	BEGHJ KLM	RF
-160C	23075-335	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160B/F/G REPLD BY 160H	BEGHJ KLM	RF
-160D	23065-360	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160, 160A/E REPLD BY 160J	AD	1
	23065-360	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160 REPLD BY 160J	F	1
-160E	23065-361	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160,160A/D REPLD BY 160J	AD	1
-160F	23065-362	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160B/C/G REPLD BY 160H	BEGHJ KLM	RF
-160G	23065-363	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY ALT: 160B/C/F REPLD BY 160H	BEGHJ KLM	RF
-160H	23065-380	• BEARING AND BRUSH SUPPORT ASSEMBLY .....MOD D REPLS 160B/C/F/G SB 23077-0XX-24-03	BEGHJ K	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-160H (Cont.)	23065-380	• BEARING AND BRUSH SUPPORT ASSEMBLY .....MOD E REPLS 160B/C/F/G SB 23077-009-24-05	L	1
	23065-380	• BEARING AND BRUSH SUPPORT ASSEMBLY .....MOD B REPLS 160B/C/F/G SB 23077-0XX-24-03	M	1
	23065-380	• BEARING AND BRUSH SUPPORT ASSEMBLY	C	1
-160J	23065-381	• BEARING AND BRUSH SUPPORT ASSEMBLY .....MOD D REPLS 160, 160A/D/E SB 23077-0XX-24-03	AD	1
	23065-381	• BEARING AND BRUSH SUPPORT ASSEMBLY .....MOD D REPLS 160, 160D SB 23077-0XX-24-03	F	1
		(ATTACHING PARTS)		
165	NAS1189-08P12L	• SCREW Machine, Flat Head.		8
		*		
-170	23065-1620	• SWITCH ASSEMBLY, Thermal	JK	1
		(ATTACHING PARTS)		
-175	MS21043-08	• NUT, Self Locking	JK	1
-180	MS35333-74	• WASHER, Lock.	JK	1
		*		
185	23065-1660	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY REPLD BY 23065-1662	ABHLM	RF
	23065-1660	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY REPLD BY 23065-1663	DEFGJK	RF
-185A	23065-1662	• DRIVE END BEARING SUPPORT ASSEMBLY .....MOD C REPLS 23065-1660 REPLD BY 23065-1663	ABH	RF
	23065-1662	• DRIVE END BEARING SUPPORT ASSEMBLY .....MOD A REPLS 23065-1660 REPLD BY 23065-1663	M	RF

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-185A (Cont.)	23065-1662	• DRIVE END BEARING SUPPORT ASSEMBLY .....MOD D REPLS 23065-1660 REPLD BY 23065-1663	L	RF
-185B	23065-1663	• DRIVE END BEARING SUPPORT ASSEMBLY (Pre-Load)..... MOD G REPLS 23065-1662 SB 23077-0XX-24-04	ABM	1
	23065-1663	• DRIVE END BEARING SUPPORT ASSEMBLY(Pre-Load) .....MOD C REPLS 23065-1660 SB 23077-0XX-24-04	DEFGJ K	1
	23065-1663	• DRIVE END BEARING SUPPORT ASSEMBLY(Pre-Load) .....MOD F REPLS 23065-1662 SB 23077-0XX-24-04	H	1
	23065-1663	• DRIVE END BEARING SUPPORT ASSEMBLY(Pre-Load) .....MOD H REPLS 23065-1662 SB 23077-009-24-06	L	1
	23065-1663	• DRIVE END BEARING SUPPORT ASSEMBLY(Pre-Load)	C	1
		(ATTACHING PARTS)		
190	MS24693-S23	• SCREW, Machine, Flat, Countersunk Head		3
		*		
195	02-4231-02	• WASHER, Spring Wave ..... MOD G . . . . . MOD C . . . . . MOD C . . . . . .MOD F Post SB 23077-0XX-24-04	ABM DEFG JK H	1
	02-4231-02	• WASHER, Spring Wave . . . . . . Post SB 23077-009-24-06	L	1
	02-4231-02	• WASHER, Spring Wave	C	1
200	23080-1940	• SHIM, Steel, 0.003 inch (0,08 mm) thick Post SB 23077-0XX-24-04 Post SB 23077-009-24-06		AR
	23080-1941	• SHIM, Steel, 0.020 inch (0,51 mm) thick Post SB 23077-0XX-24-04 Post SB 23077-009-24-06		AR
	23080-1942	• SHIM, Steel, 0.030 inch (0,76 mm) thick Post SB 23077-0XX-24-04 Post SB 23077-009-24-06		AR

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
205	23077-1020	• ARMATURE . . . . . (REPLD BY 23077-330)	ABDEF GHJKL M	RF
	23077-330	• ARMATURE .....MOD E (REPLS 23077-1020) SB 23077-0XX-24-05	ABDEF GHJK	1
		. . . . . .MOD F	L	1
		. . . . . MOD C	M	1
	23077-330	• ARMATURE . . . . . ALT: 23077-1020	C	1
210	23046-1111	• RETAINER, Bearing . . . . . (ATTACHING PARTS)		1
215	MS24694-S3	• SCREW, Machine, Fillister Head . . . . . *		4
220	03-6010-08	• BEARING, Ball, Anti-Drive End . . . . . SUPSD BY 03-6010-15	ABDEF GHJK	RF
	03-6010-10	• BEARING, Ball, Anti-Drive End . . . . . SUPSD BY 03-6010-14	L	RF
	03-6010-10	• BEARING, Ball, Anti-Drive End . MOD D SUPSDS 03-6010-14 SB 23077-010-24-02	M	1
	03-6010-14	• BEARING, Ball, Anti-Drive End . .MOD A SUPSDS 03-6010-10 SB 23077-009-24-01 SUPSD BY 03-6010-17	L	RF
	03-6010-14	• BEARING, Ball, Anti-Drive End . . . . . SUPSD BY 03-6010-10	M	RF
	03-6010-15	• BEARING, Ball, Anti-Drive End . .MOD A SUPSDS 03-6010-08 SB 23077-00X-24-01 SUPSD BY 03-6010-18	ABDEF GHJK	RF
	03-6010-17	• BEARING, Ball, Anti-Drive End . .MOD B SUPSDS 03-6010-14 SB 23077-009-24-03 SUPSD BY 03-6010-18	L	RF
	03-6010-18	• BEARING, Ball, Anti-Drive End . .MOD B SUPSDS 03-6010-15 SB 23077-00X-24-02	ABDEF GHJK	1
	03-6010-18	• BEARING, Ball, Anti-Drive End . MOD C SUPSDS 03-6010-17 SB 23077-00X-24-02	L	1

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
220 (Cont'd)	03-6010-18	• BEARING, Ball, Anti-Drive End	C	1
221	03-6010-08	• BEARING, Ball, Drive End. . . . . SUPSD BY 03-6010-15	ABDEF GHJK	RF
	03-6010-10	• BEARING, Ball, Drive End. . . . . SUPSD BY 03-6010-14	L	RF
	03-6010-10	• BEARING, Ball, Drive End.....MOD D SUPSDS 03-6010-14 SB 23077-010-24-02	M	1
	03-6010-14	• BEARING, Ball, Drive End.....MOD A SUPSDS 03-6010-10 SB 23077-009-24-01 SUPSD BY 03-6010-17	L	RF
	03-6010-14	• BEARING, Ball, Drive End. . . . . SUPSD BY 03-6010-10	M	RF
	03-6010-15	• BEARING, Ball, Drive End.....MOD A SUPSDS 03-6010-08 SB 23077-00X-24-01 SUPSD BY 03-6010-18	ABDEF GHJK	RF
	03-6010-17	• BEARING, Ball, Drive End.....MOD B SUPSDS 03-6010-14 SB 23077-009-24-03 SUPSD BY 03-6010-18	L	RF
	03-6010-18	• BEARING, Ball, Drive End.....MOD B SUPSDS 03-6010-15 SB 23077-00X-24-02	ABDEF GHJK	1
	03-6010-18	• BEARING, Ball, Drive End.....MOD C SUPSDS 03-6010-17 SB 23077-00X-24-02	L	1
	03-6010-18	• BEARING, Ball, Drive End.	C	2
225	G128-178	• BAFFLE DISC, (Inboard) . . . . . SUPSD BY 23080-3110		RF
	23080-3110	• BAFFLE DISC, (Inboard) . . . . . SUPSDS G128-178 (225) SIL 23080-3110-01		1
-225A	G128-178	• BAFFLE DISC, (Outboard) . . . . . REPLD BY 23032-1145 (230)		1
230	23032-1145	• SPACER . . . . . REPLS G128-178 (-225A) SB23077-0XX-24-04 SB23077-009-24-06		1
235	23077-310	• STATOR & HOUSING ASSEMBLY. . . . (See Figure 10004)	ABCHL M	1

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
235 (Cont'd)	23077-320	• STATOR & HOUSING ASSEMBLY. . . . (See Figure 10004)	DEFG	1
	23065-325	• STATOR & HOUSING ASSEMBLY. . . . (See Figure 10004)	JK	1

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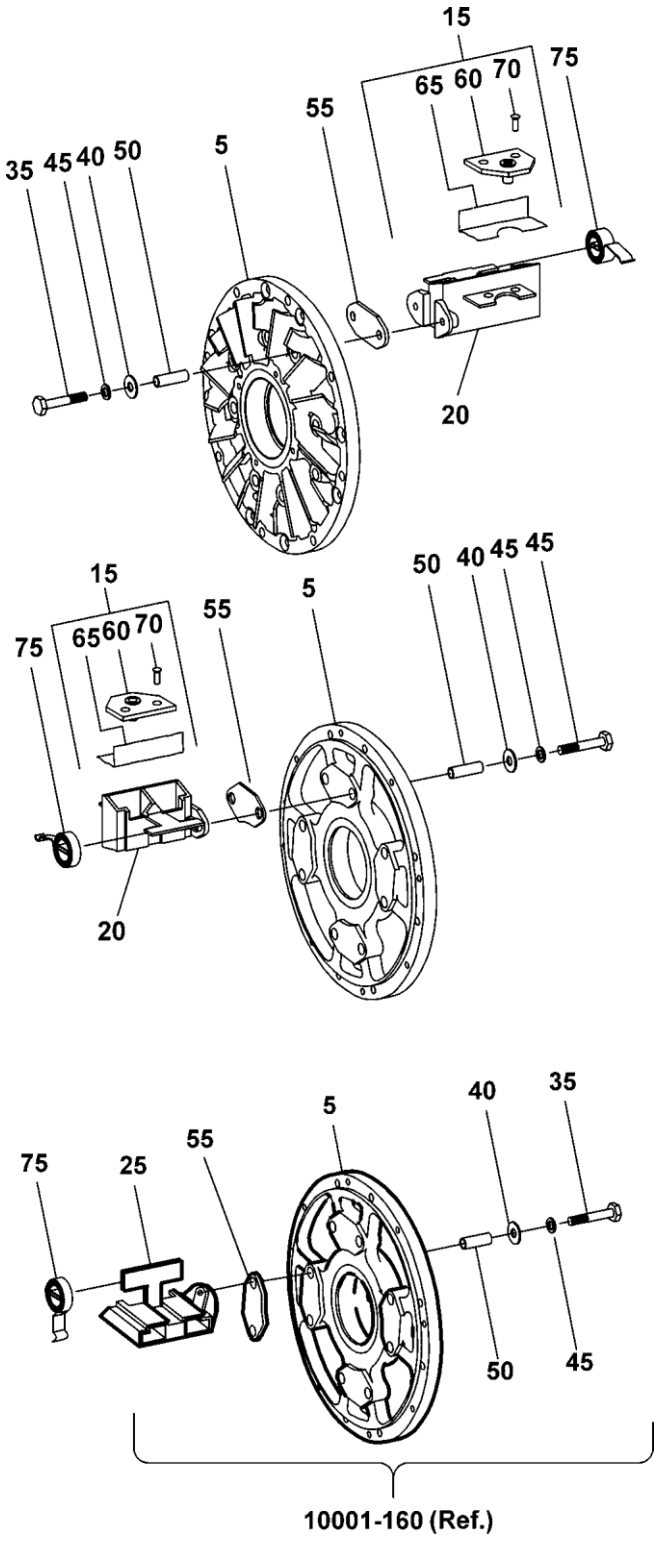

Figure 10002 - Bearing and Brush Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASS'Y
10002-				
	23046-306	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	A	RF
	23046-373	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	B	RF
	23075-331	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	C	RF
	23075-335	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	D	RF
	23065-360	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	E	RF
	23065-361	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	F	RF
	23065-362	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	G	RF
	23065-363	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	H	RF
	23065-380	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	J	RF
	23065-381	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY	K	RF
5	23065-1100	• END BELL, Anti-Drive End	ABCD	1
	23065-1950	• END BELL, Anti-Drive End	EFGH	1
	23065-1952	• END BELL, Anti-Drive End	JK	1
-10	NASM21209C0815	• • INSERT, Helicoil TM . . . . . (REPLD BY MS21209C0815)	ABCD	4
	MS21209C0815	• • INSERT, Helicoil TM . . . . . (REPLS NASM21209C0815)	ABCD	4
	NASM21209C0815	• • INSERT, Helicoil TM . . . . . (REPLD BY MS21209C0815)	EFGHJK	12
	MS21209C0815	• • INSERT, Helicoil TM . . . . . (REPLS NASM21209C0815)	EFGHJK	12
15	23048-1421	• BRUSH HOLDER, Complete (Isolated)	BF	4
	23064-1180	• BRUSH HOLDER, Complete (Isolated)	K	
	23064-1282	• BRUSH HOLDER, Complete (Isolated)	AE	4
	23075-1203	• BRUSH HOLDER, Complete (Isolated)	CGJ	4
	23075-1207	• BRUSH HOLDER, Complete (Isolated)	HD	4
20	23075-1193	• • BRUSH HOLDER, Machining . . . . . (Isolated brush holders)	CGJ	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASS'Y
10002-				
20 (Cont.)	23075-1253	• • BRUSH HOLDER, Machining . . . . . (Isolated brush holders)	DH	1
25	23048-1380	• • BRUSH HOLDER ASSEMBLY . . . . . (Non-isolated brush holders)	BF	1
	23064-1180	• • BRUSH HOLDER, Machining . . . . . (Non-isolated brush holders) Note: All four brush holders must be the same.	AEK	1
-30	NASM21209-F1-15	• THREAD INSERT, Locking . . . . . REPLD BY MS21209-F1-15	AEK	RF
	MS21209-F1-15	• THREAD INSERT, Locking . . . . . REPLS NASM21209-F1-15	AEK	4
		(ATTACHING PARTS)		
35	AN3-7A	• BOLT, Machine, Hex Head	ACEGK	8
	AN3-10A	• BOLT, Machine, Hex Head	BDFHJ	8
40	05-374094	• WASHER, Insulating (Outboard).	ABCDE FGH	8
	05-374095	• WASHER, Insulating (Outboard).	JK	8
-40A	05-374094	• WASHER, Insulating (Inboard) . . . . . REPLD BY 23014-1039	ABCDE FGH	8
	05-374095	• WASHER, Insulating (Inboard) . . . . . REPLD BY 23085-1471	JK	8
45	AN960-10L	• WASHER, Flat	ABCDE FGH	8
	NAS1149F0332P	• WASHER, Flat	JK	8
50	05-631145	• SLEEVE, Insulating.		8
55	23014-1039	• BOARD, Insulating . . . . . REPLS 05-374094 (-40A)	ABCDE FGH	4
	23085-1471	• BOARD, Insulating . . . . . REPLS 05-374095 (-40A)	JK	4
60	23075-1400	• • TERMINAL BOARD, Brush Lead . . .	CDGHJ	1
65	23075-1230	• • SHEET, Insulating	CDGHJ	1
		(ATTACHING PARTS)		
70	MS20426AD3-5	• • RIVET, Solid, Precision head, Countersunk	CDGHJ	2
		---------- * ----------		
75	23033-1200	• SPRING, Brush	CDGHJ	8
	23033-1120	• SPRING, Brush . . . . . ALT: 23064-1350	ABEF	8

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASS'Y
10002-				
75 (Cont.)	23033-1120	• SPRING, Brush	K	8
	23064-1350	• SPRING, Brush . . . . . ALT: 23033-1120	ABEF	8

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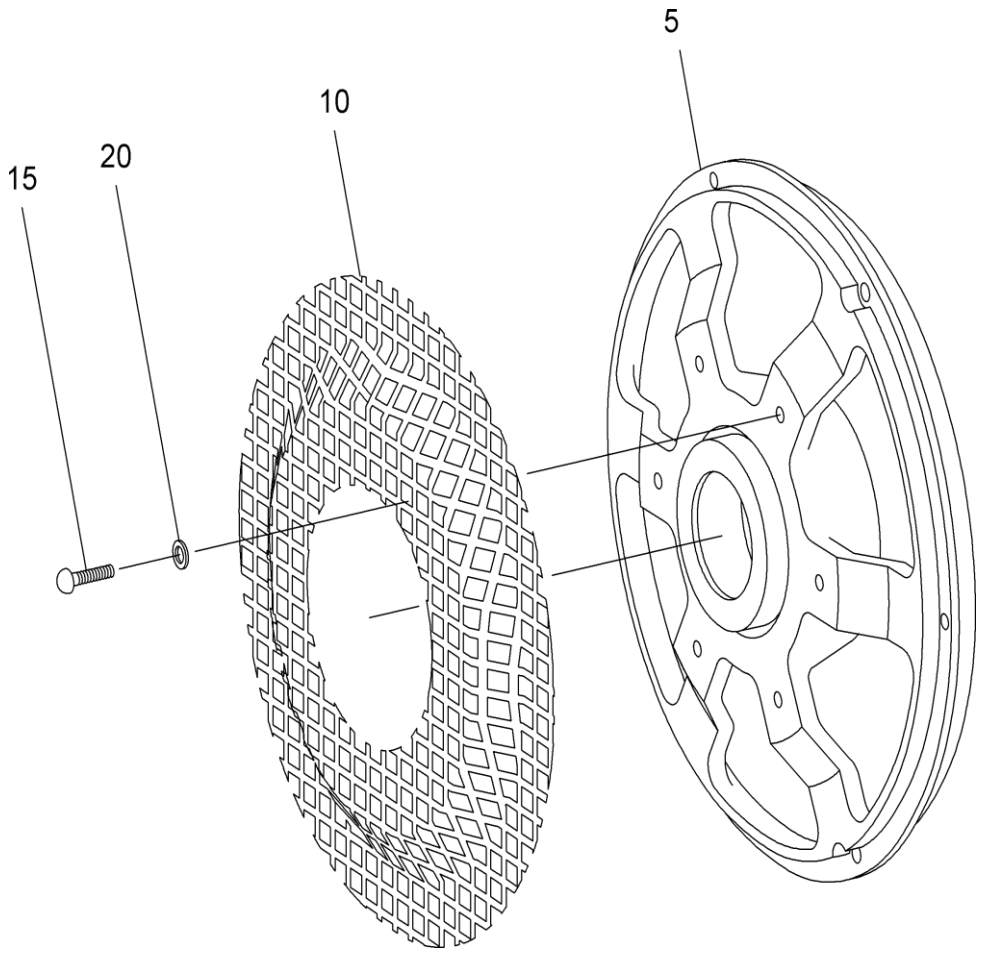

Figure 10003 - Drive End Bearing Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASS'Y
10003-				
	23065-1660	DRIVE END BEARING SUPPORT. . . . . ASSEMBLY	A	RF
	23065-1662	DRIVE END BEARING SUPPORT. . . . . ASSEMBLY	B	RF
	23065-1663	DRIVE END BEARING SUPPORT. . . . . ASSEMBLY (Pre-Load).	C	RF
5	23065-1640	• END BELL, Drive End.	A	1
	23065-1643	• END BELL, Drive End.	B	1
	23065-1645	• END BELL, Drive End.	C	1
10	23065-1650	• SCREEN		1
		(ATTACHING PARTS)		
15	MS21318-15	• SCREW, Drive.		6
20	AN960-4L	• WASHER, Flat		6
		---------- * ----------		

- ITEM NOT ILLUSTRATED

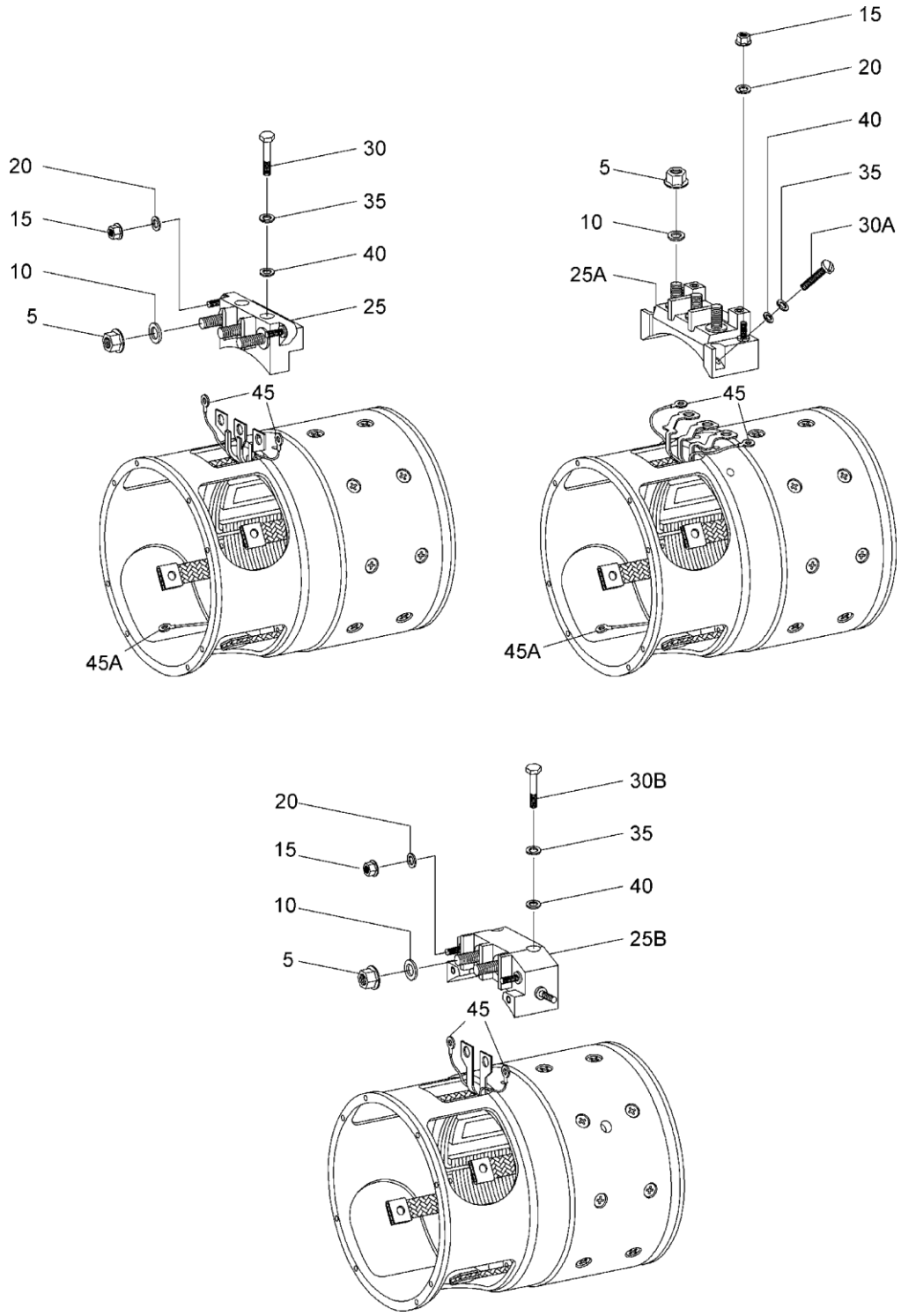

Figure 10004 - Stator and Housing Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASS'Y
10004-				
	23077-310	STATOR AND HOUSING ASSEMBLY (SEE FIGURE 10001 FOR NHA)	A	RF
	23077-320	STATOR AND HOUSING ASSEMBLY (SEE FIGURE 10001 FOR NHA)	B	RF
	23065-325	STATOR AND HOUSING ASSEMBLY (SEE FIGURE 10001 FOR NHA)	C	RF
5	MS21042-6	• NUT, Self Locking	AB	3
	MS21042-6	• NUT, Self Locking	C	2
10	AN960B616	• WASHER, Flat . . . . . SUPSD BY AN960C616	BC	RF
	AN960C616	• WASHER, Flat	A	3
	AN960C616	• WASHER, Flat . . . . . SUPSDS AN960B616	B	3
	AN960C616	• WASHER, Flat . . . . . SUPSDS AN960B616	C	2
15	MS21042-3	• NUT, Self Locking		2
20	AN960B10	• WASHER, Flat . . . . . SUPSD BY AN960C10	B	RF
	AN960C10	• WASHER, Flat	AC	2
	AN960C10	• WASHER, Flat . . . . . SUPSDS AN960B10	B	2
25	23065-1210	• TERMINAL BLOCK.	A	1
25A	23077-1040	• TERMINAL BLOCK.	B	1
25B	23069-1582	• TERMINAL BLOCK.	C	1
		(ATTACHING PARTS)		
30	AN3-13A	• BOLT, Machine	A	2
30A	MS35266-64	• SCREW, Machine	B	2
30B	AN3-14A	• BOLT, Machine	C	2
35	MS35338-43	• WASHER, Spring Lock		2
40	AN960-10	• WASHER, Flat . . . . . SUPSD BY AN960C-10		RF
	AN960C-10	• WASHER, Flat . . . . . SUPSDS AN960-10		2
45	05-652015	• • LUG, Terminal		2
45A	05-652015	• • LUG, Terminal . . . . . Note: To negative brush holder only	AB	1

- ITEM NOT ILLUSTRATED

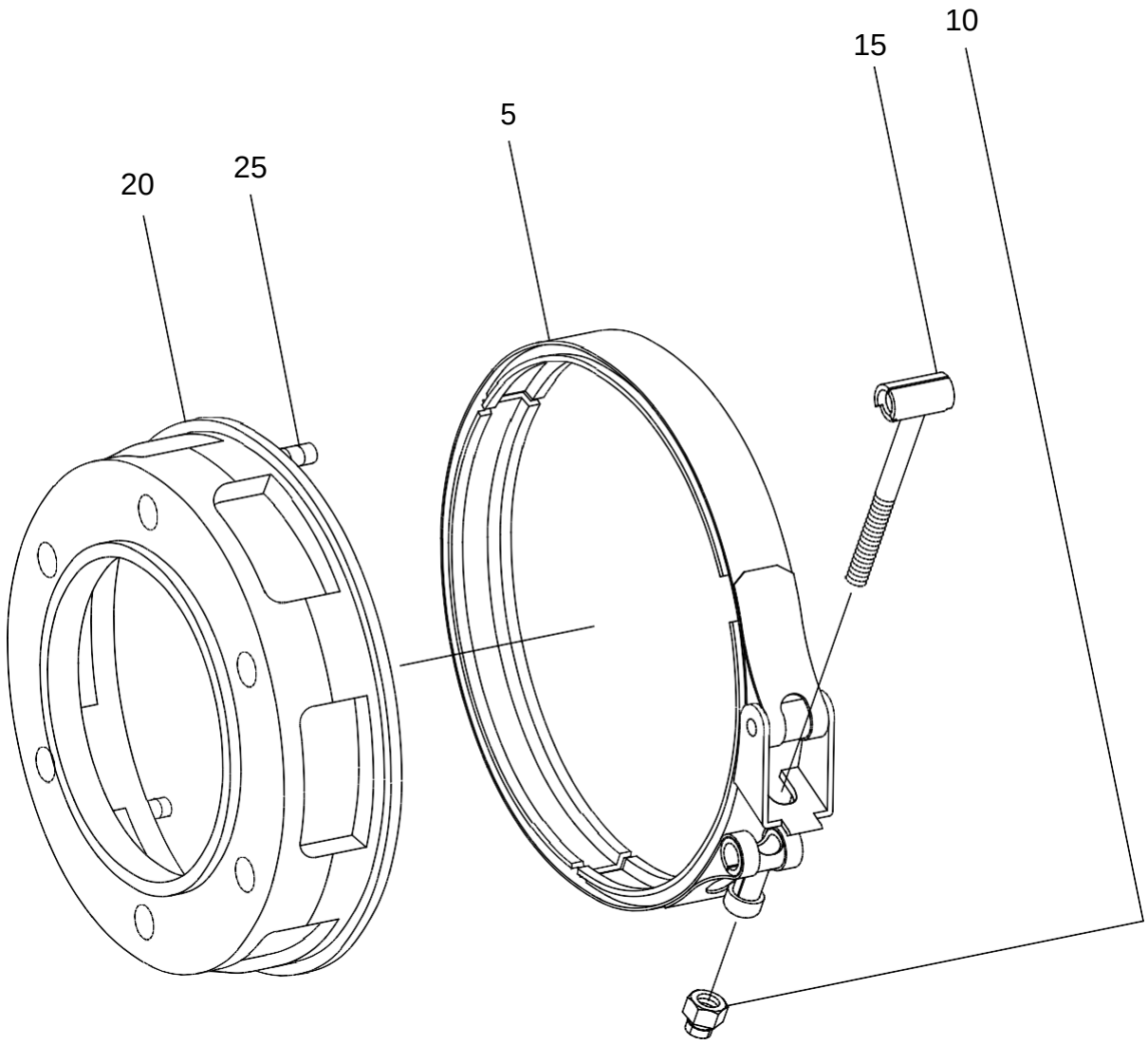

Figure 10005 - Q.A.D. (Quick-Attach-Detach) Mounting Kit

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASS'Y
10005-				
	23065-504	MOUNTING KIT, QAD	A	RF
	23065-512	MOUNTING KIT, QAD	B	RF
	23065-513	MOUNTING KIT, QAD	C	RF
5	23072-1120	• CLAMP, V-Band . . . . . REPLD BY 23072-1327 and 23072-1127	AB	RF
	23072-1327	• CLAMP, V-Band REPLS 23072-1120	AB	1
	23072-1327	• CLAMP, V-Band ALT: 23072-1127	C	1
	23072-1127	• CLAMP, V-Band . . . . . REPLS 23072-1120	AB	1
	23072-1127	• CLAMP, V-Band . . . . . ALT: 23072-1327	C	1
10	MS21045-4	• • NUT, Reduced Hex, Self-Locking . . . Use on 23072-1127		1
	MS21045-L4	• • NUT, Reduced Hex, Self-Locking . . . Use on 23072-1327		1
15	23032-2802	• • T-BOLT . . . . . Use on 23072-1127		1
	23032-2803	• • T-BOLT . . . . . Use on 23072-1327		1
20	23065-1430	• ADAPTER, Mounting . . . . . REPLD BY 23065-1432	A	RF
	23065-1431	• ADAPTER, Mounting . . . . . REPLD BY 23065-1433	B	RF
	23065-1432	• ADAPTER, Mounting . . . . . REPLS 23065-1430	A	1
	23065-1432	• ADAPTER, Mounting	C	1
	23065-1433	• ADAPTER, Mounting . . . . . REPLS 23065-1431	B	1
		(ATTACHING PARTS)		
25	02-4412-09	• • PIN, Grooved, Headless		3
		*		

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