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COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR 23085 SERIES II

List of Part Numbers

23085-029 23085-030
23085-031

TITLE PAGE

EXCLUSIVE DISTRIBUTORS

1. Contact Information

A. Customer Portal

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

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

HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator Models 23085-029, -030, -031.

Attached to this transmittal letter is Revision No. 4 of the Component Maintenance Manual with IPL (basic issue dated September 03, 2008).

REVISION 4, DATED JUNE 06, 2024

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

This Component Maintenance Manual has been fully revised to include the latest engineering information and also to include Temporary Revisions, Service Bulletin(s) and Service Information Letter(s) as listed below.

The contents of this revision has the changes individually identified with revision bars because the new format of the Safran Power, USA manuals were significantly changed to be more consistent with current standards set by the Air Transport Association of America Specifications ATA-100.

Key items included in this revision:

- Copyright information date changed to 2024.
- Changes done in Introduction section:
  - Incorporated the GSIL 2023-02 to update the manual content information to add magnetic particle inspection.
- Changes done in Description and operation section:
  - Incorporated the TR 24-04 to add specification to achieve 28 VDC rated voltage in Table 1.
  - Incorporated the TR 24-05 to updated the weight for the model 23085-031.
- Changes done in Check section:
  - Incorporated the GSIL 2023-02 to update the procedure to do magnetic inspection test on the dampener plate and dampener back plate.

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

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RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	Sep 03/08	Sep 03/08	SP
1	Nov 25/14	Nov 25/14	SP
2	Sep 16/15	Sep 16/15	SP
3	Apr 26/23	Apr 26/23	SP
4	Jun 06/24	Jun 06/24	SP

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	3	Apr 08/09	Apr 08/09	SP	Nov 25/14	SP
24-02	2	Jul 30/09	Jul 30/09	SP	Nov 25/14	SP
24-03	6010	Jun 23/16	Jun 23/16	SP	Apr 26/23	SP
24-04	2	Jun 20/23	Jun 20/23	SP	Jun 06/24	SP
24-05	3	Mar 01/24	Mar 01/24	SP	Jun 06/24	SP

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SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
23085-0XX-24-07	Incorporated	-	Apr 25/13				
23085-029-24-01	Incorporated	2	Apr 08/14				
23088-107X-24-01	Valid	-	Apr 09/09				

Retain Service Bulletin Record in front of CMM. On receipt of service bulletins, record service bulletin number, status, revision number (if applicable), and date issued.

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SERVICE INFORMATION LETTER LIST

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued
GSIL 2004-01	Limited Distribution	-	Jun 26/04				
GSIL 2006-01	Valid	-	Sep 26/06				
GSIL 2006-02	Valid	1	Feb 10/09				
GSIL 2006-03	Valid	-	Sep 15/06				
GSIL 2011-01	Valid	-	Dec 16/11				
GSIL 2020-01	Valid	1	Apr 16/21				
GIL K4358-24-003	Valid	1	Jan 10/17				
23032-1910-24-01	Incorporated	1	Feb 14/22				
GSIL 2023-02	Incorporated	0	Oct 23/23				

Retain this record in the front of CMM. On receipt of service information letters, record letter number, status, revision number (if applicable) and date issued.

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for overhaul and service repair of the 23085 Series II DC Starter-Generator. 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.
- Magnetic particle inspection of drive shaft and dampener hub.

  NOTE: Magnetic particle inspection is not necessary for dampener plate and dampener back plate unless suspect cracks are found in visual inspection.

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

Only an overhaul and an acceptance test authorize assignment of zero operating hours time since overhaul (TSO) to a DC Starter-Generator. Repairs performed that are partial of an overhaul do not affect TSO and equipment is released on a continued 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 an overhaul procedure, become thoroughly familiar with the capabilities and limitations of the equipment. Make sure all necessary safety equipment, test equipment, repair materials, special tools, and fixtures are on hand.

If errors, omissions, or other technical discrepancies exist in CMM, fill out a Technical Publication Comment Form. Send a copy of form to: lps.twn.techpubs@safrangroup.com.

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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. Statement of Verification

The procedures given in this manual were verified by:

SECTION	METHOD	DATE
TESTING AND FAULT ISOLATION	Verification	Aug. 26/08
DISASSEMBLY	Verification	Aug. 26/08
ASSEMBLY	Verification	Aug. 26/08

6. 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 ONE 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
Chemical Film Solution	REPAIR
Corrosion Preventative	CLEANING
Detergent	CLEANING
Epoxy Bonding Cement	ASSEMBLY
Isopropyl Alcohol	ASSEMBLY, CHECK, CLEANING, DISASSEMBLY, REPAIR
Loctite® Grade D	ASSEMBLY
Lubricating and Assembly Paste	ASSEMBLY
Thread Sealing Compound	ASSEMBLY
Zinc Chromate Primer	REPAIR
Zinc Phosphate Coating	REPAIR

Table i - Material Table

7. Non-Safran Power Authorized Components and Processes Policy

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

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

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

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

8. Abbreviations

The following abbreviations are used in this manual:

A	- Ampere
ADE	- anti-drive end
CMM	- Component Maintenance Manual
GCU	- Generator Control Unit
IAW	- in accordance with
kPa	- kilopascal(s)
lbf.in	- pound force inch
µFd	- micro Farad
NDT	- Non-Destructive Test
N·m	- Newton meter
PSIG	- pounds per square inch gage
QAD	- Quick Attach/Detach
RMS	- Root Mean Square
rpm	- Revolutions Per Minute
SP	- Safran Power
SPD	- Standard Practice Document
TIR	- Total Indicator Reading
TSO	- time since overhaul

UUT	- Unit Under Test
Ω	- Ohm
V	- Volts or Voltage
VDC	- Volt Direct Current

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DESCRIPTION AND OPERATION

1. Description

The 23085 Series II DC Starter-Generator operates as a motor providing torque for engine starting and (after engine startup) as a generator to provide DC electrical power.

The starter-generator consists of an armature enclosed by, and rotating within, the stator and housing assembly (see Figure 1). The armature is supported on two bearings, one at the drive end bearing support assembly, and a second at the anti-drive end bearing and brush support assembly. The drive shaft is installed through an isolator into the hollow armature shaft. Both shafts have mating square splines engaging through the isolator at the anti-drive end.

At the drive end, a dampener assembly absorbs torsional vibration generated by changes in engine gearbox speed and electrical load conditions. The dampener assembly consists of a dampener plate, a friction ring, and a dampener back plate.

For on-ground operation, a fan attached to the anti-drive end of the drive shaft supplies forced-air cooling. In flight, the starter-generator, in addition to the fan, is blast-cooled through the air inlet and aircraft's air ducting system.

These models feature a newly designed drive shaft, shaft isolator, bearings and armature that help to electrically insulate the starter-generator drive shaft from the armature and stator housing.

Some models feature a quick attach/detach (QAD) kit easing starter-generator installation and removal on the aircraft. A QAD kit consists of a mounting adapter attaching to the engine gearbox accessory drive pad, and a V-retainer coupling securing the starter-generator to the mounting adapter.

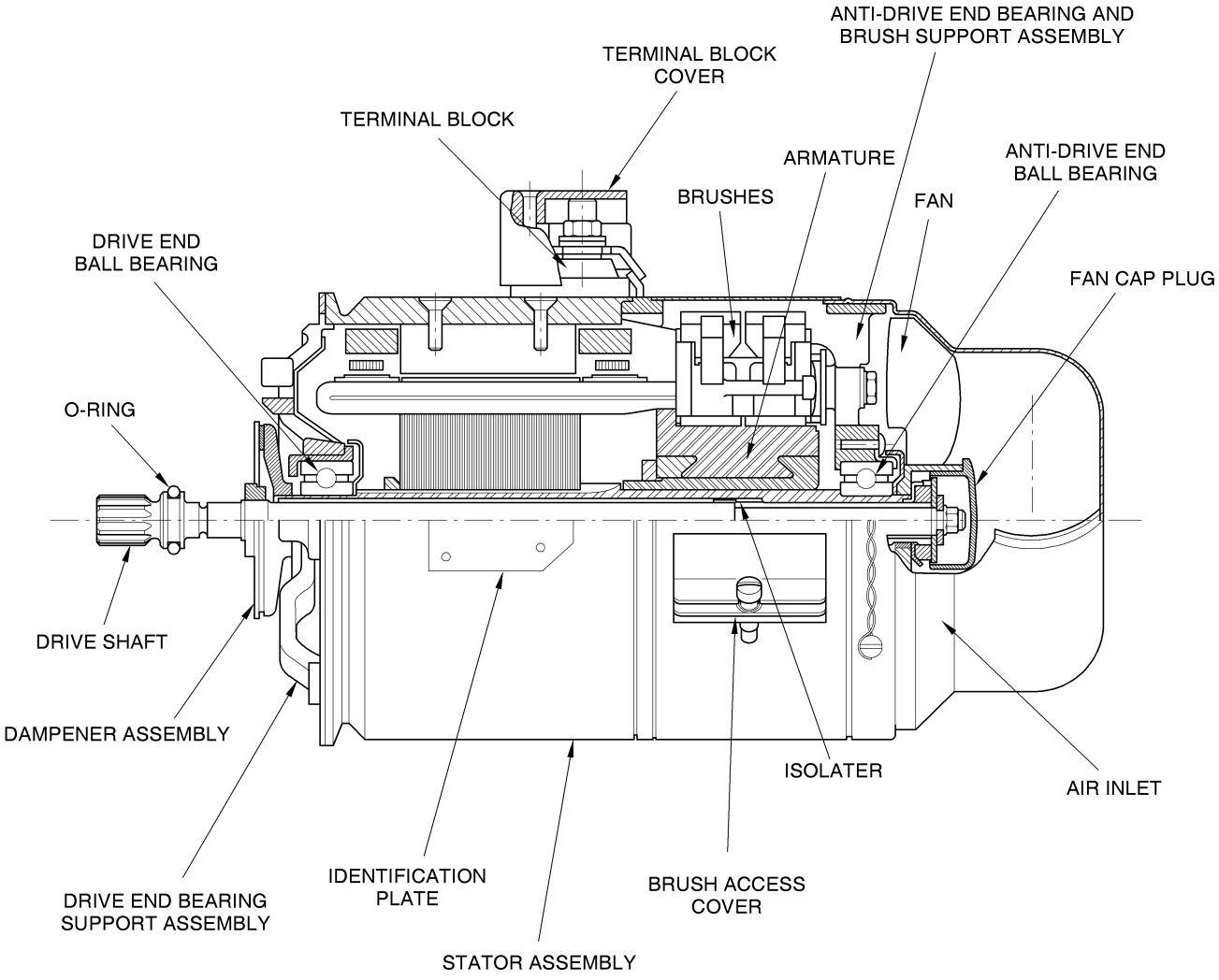

Figure 1 - Typical DC Starter-Generator Features

2. Equipment specifications

Characteristic	Model Number	Specifications
Output rating	All models	9kw
Rating for continuous load within speed range	All models	300A, 30 VDC, 7,200 to 12,000 rpm 300A, 28 VDC min., 6,900 to 12,000 rpm (with 0.4 Ω min. in external field circuit at 122 °F (50 °C))

Table 1 - Electrical Performance and Physical Characteristics

Characteristic	Model Number	Specifications
External starting power supply limitations	All models	Self-limiting current load of 1,700 A max. with 28 VDC max. at start receptacle and 0.004 Ω aircraft circuit resistance.
Direction of rotation (viewed from drive end)	All models	COUNTERCLOCKWISE
Air inlet opening	All models	2.50 inch (63,5mm) diameter
Cooling	All models	Self-cooled during ground operations. Combination self-cooled and blast-cooled in flight.
Cooling air pressure	All models	6 inches H_20
Terminal designations	All models	Series Start: B+ Positive E- Negative C+ Starting A+ Shunt Field D Equalizer

Table 1 - Electrical Performance and Physical Characteristics (Continued)

Characteristic	Model Number	Specifications
Starter-Generator Max Weight	23085-029	29.3 lbs (13,3 kg) max. without QAD kit
	23085-029	29.3 lbs (13,3 kg) max. without QAD kit
	23085-031	28.7 lbs (13,02 kg) max. without QAD kit (23085-524 or -525) and air inlet
		28.4 lbs (12,9 kg) max. without QAD kit (23085-507) and air inlet
QAD Kit Max Weight	23085-029	1.4 lbs (0,63 kg) max. (23085-500)
	23085-030	1.9 lbs (0,86 kg) max. (23085-507)
	23085-031	1.83 lbs (0,83 kg) max. (23085-524 and -525)
		1.9 lbs (0,86 kg) max. (23085-507)
Air Inlet Max. Weight	23085-031	0.87 lbs (0,39 kg) max. (23085-1746 (ALT: 23085-1745))
		0.9 lbs (0,41 kg) max. (23085-1746 (ALT: 23085-1743))
Overhung Moment with QAD Kit	23085-029	139 lbf.in (15,7 N·m) max. (23085-500)

Table 2 - Overhung Moment and Weight

Characteristic	Model Number	Specifications
	23085-030	145 lbf.in (16,4 N·m) max. (23085-507)
	23085-031	145 lbf.in (16,4 N·m) max. with air inlet (23085-524, -525 and -507)

Table 2 - Overhung Moment and Weight

Characteristic	Model Number	Specifications
Mounting Flange Specification	All models	QAD mounting flange conforms to MS3331-1P. Mates with MS3326-2 drive pad.
Drive Shaft Spline	All models	Spline conforms to AS972. Number of teeth: 12 Pitch diameter: 0.600 inch (15,24 mm)
Drive Shaft Shear Torque	All models	1,600 lbf.in. (180,8 N·m) Max.

Table 3 - Mounting Flange and Drive Shaft Specifications

3. Equipment Modifications

Modification of the starter-generator is shown by a letter in the MOD area on the identification plate. Refer to the SERVICE BULLETIN LIST at the front of this CMM for service bulletins which give data on modifications.

23085 Series II			Description
-029	-030	-031	
A	A	A	23093-1301 Brush

Table 4 - MOD Status

4. DC Starter-Generator operation

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

A. Starter Operation

The 23085 Series II DC starter-generators operate as a series start motor.

During engine start cycle, the aircraft power bus applies DC voltage across terminals C+ and E- supplying current to armature and stator windings. Starting power can be supplied by aircraft batteries or a ground power source. See Figure 2.

In a series-wound generator, output voltage varies directly with load current.

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, system voltage is maintained at a nominal 28 VDC.

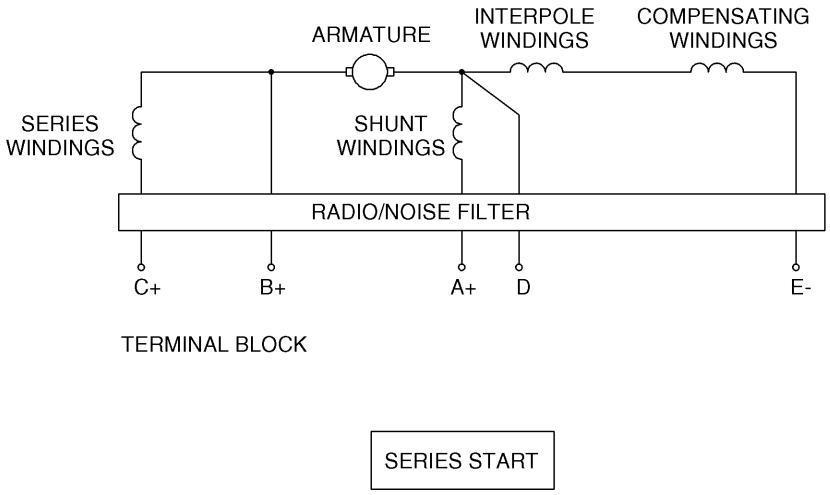

Figure 2 - DC Starter-Generator Schematic

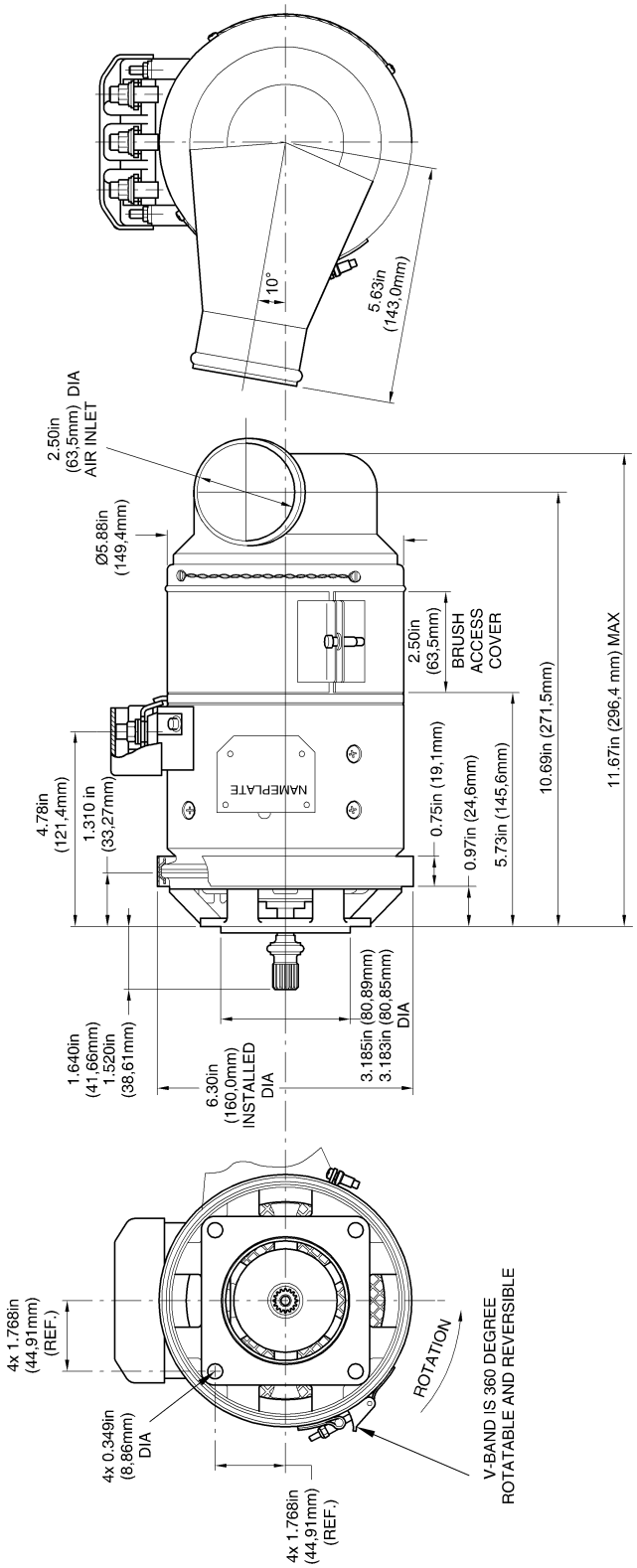

Figure 3 - Model 23085-029 DC Starter-Generator with QAD Kit 23085-500 - Outline Diagram

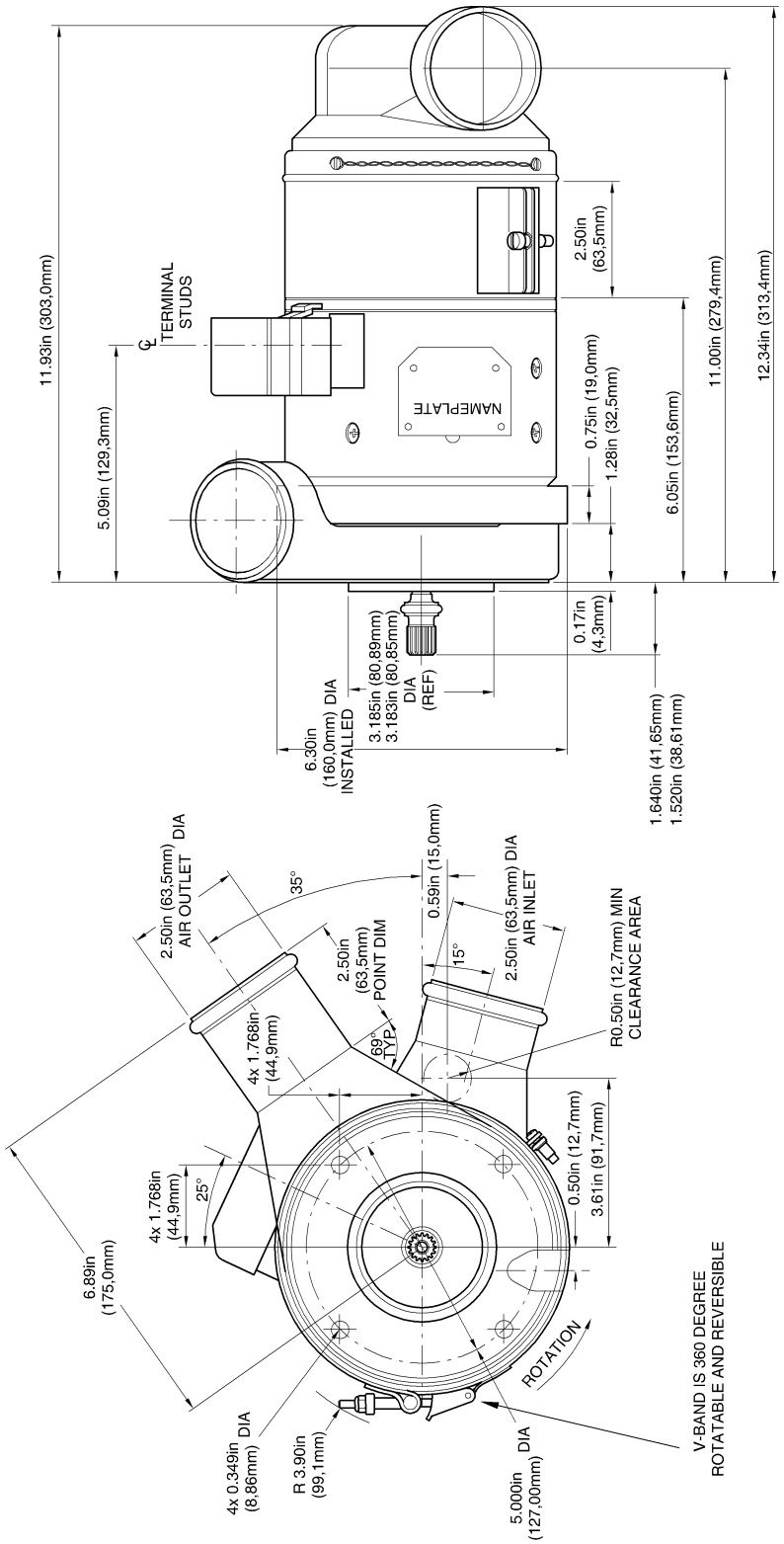

Figure 4 - Model 23085-030 DC Starter-Generator with QAD Kit 23085-507 - Outline Diagram

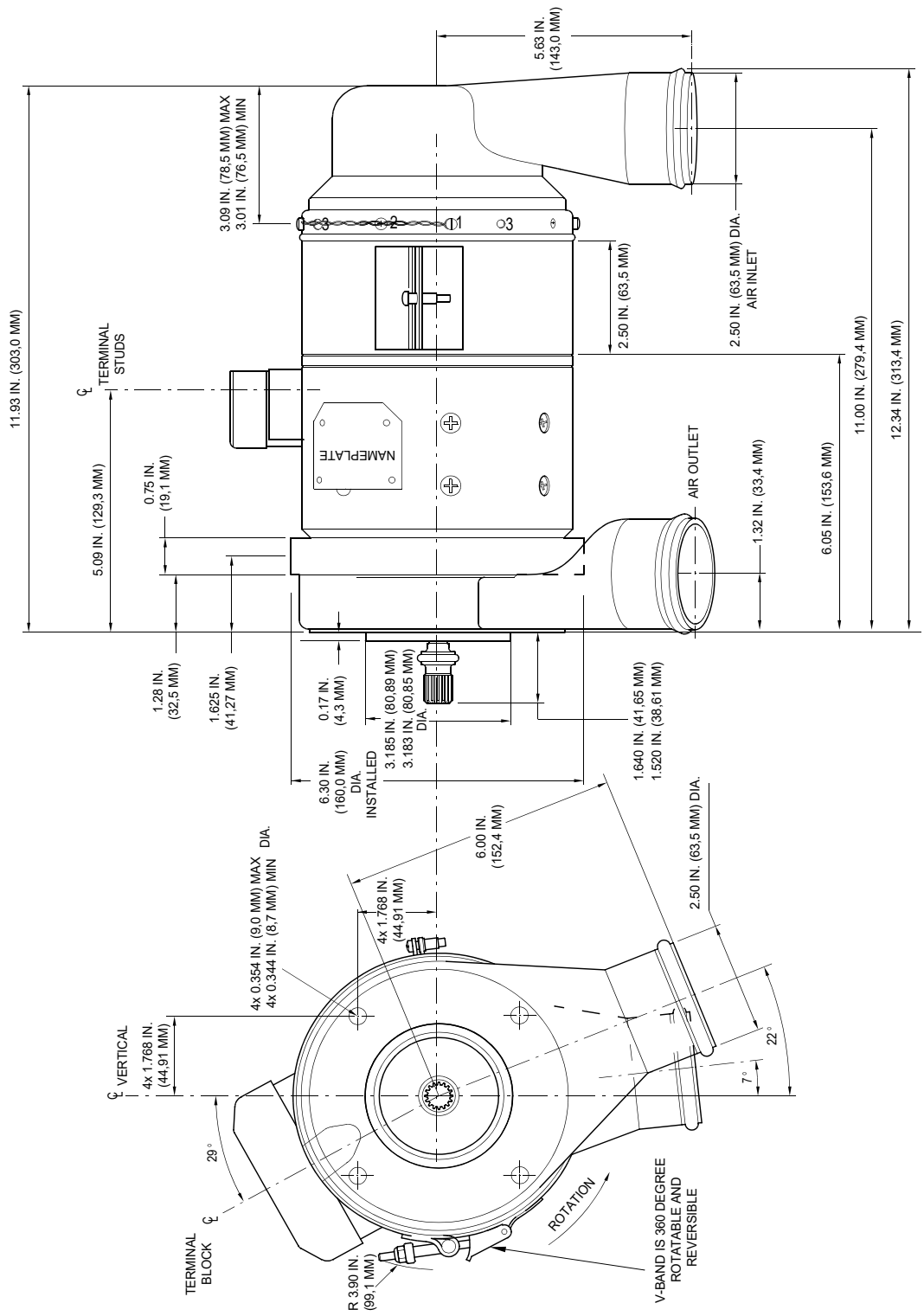

Figure 5 - Model 23085-031 DC Starter-Generator (Generator Position 1) with QAD Kit 23085-524 - Outline Diagram

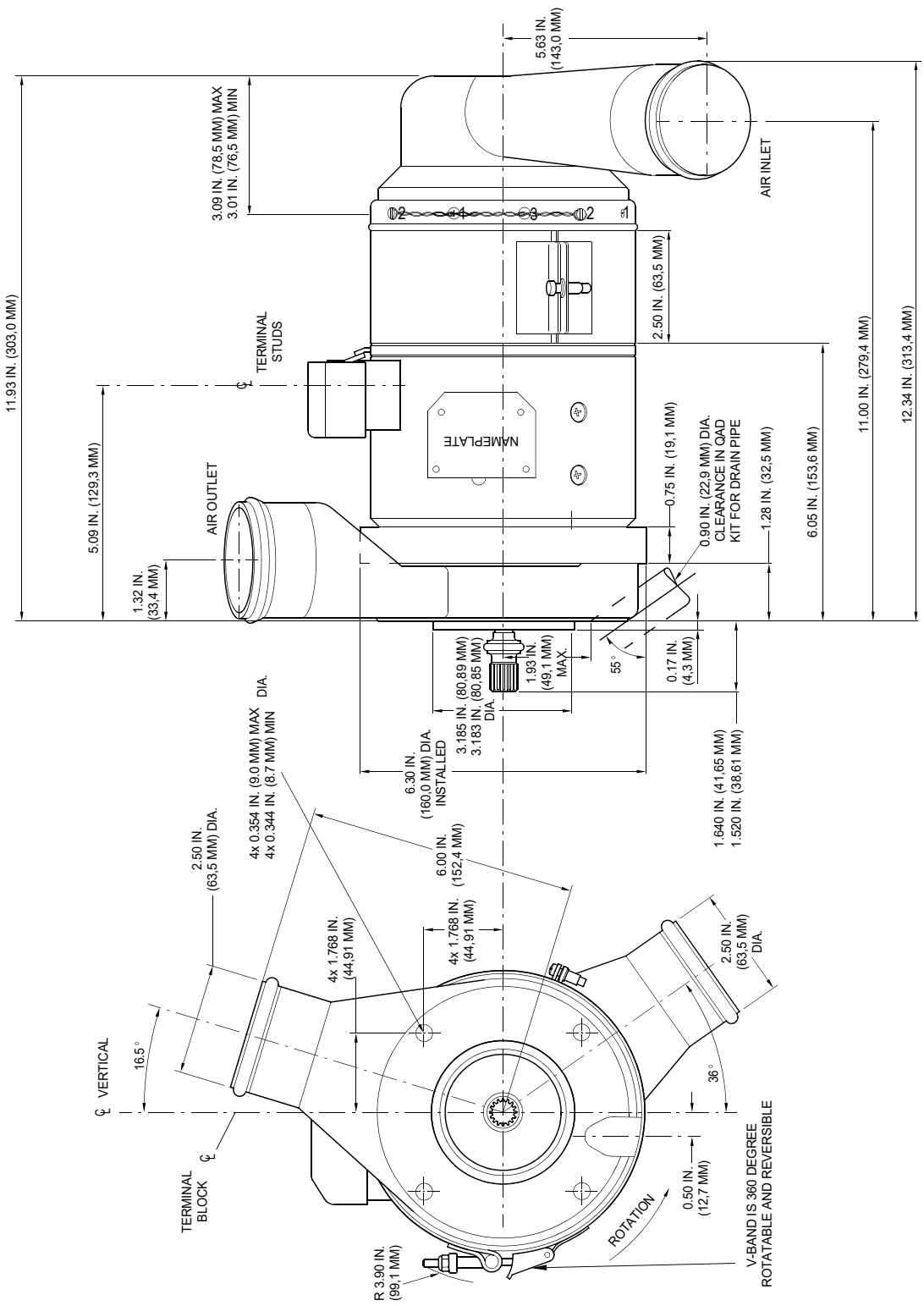

Figure 6 - Model 23085-031 DC Starter-Generator (Generator Position 2) with QAD Kit 23085-525 - Outline Diagram

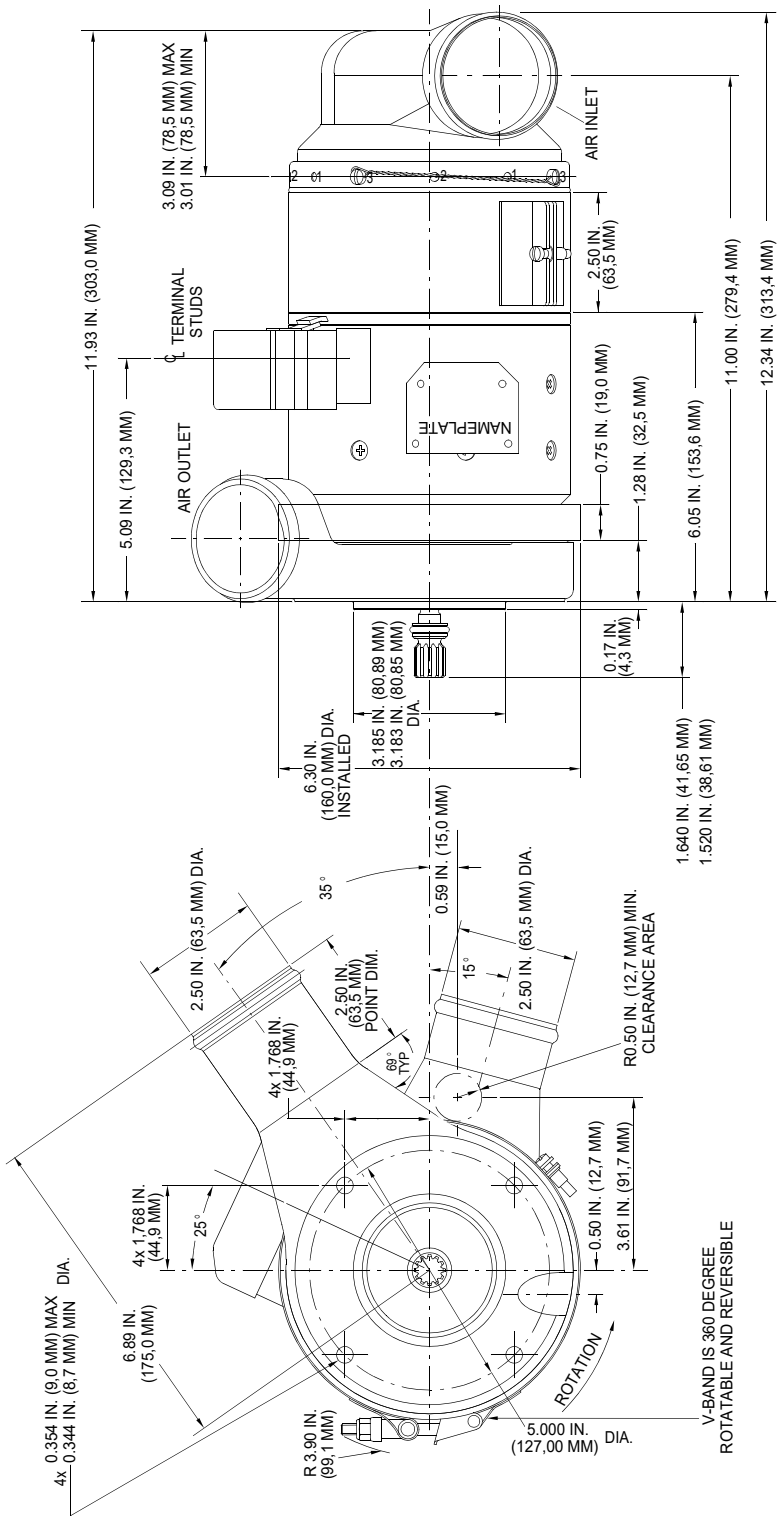

Figure 7 - Model 23085-031 DC Starter-Generator (Generator Position 3) with QAD Kit 23085-507 - Outline Diagram

TESTING AND FAULT ISOLATION

1. Introduction

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

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 tests results on a copy 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.

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
Load Current Tolerance	± 5 A
Speed Tolerance	± 50 rpm
Mounting	Drive shaft must be in horizontal position.
Terminal Voltage Tolerance	± 0.2 VDC

Table 1001 - Performance Test Conditions

Parameter	Operating Condition
Forced Cooling Air	Air pressure equal to 6 inches (15 cm) H_2O, measured 6 inches (15 cm) upstream of starter-generator air inlet.
	Air inlet duct to be straight, 2.5 inches dia. x 12 inches long (63,5 mm dia. x 305 mm long).
Brush Seating	100% in direction of rotation, 75% in axial direction. Refer to Safran Power 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.

NOTE: Airflow meters and pressure gauges used in testing of this unit should be certified and calibrated in accordance with ISO 10012-1, or should have current calibration traceable to a National Bureau of Standards (NBS) standard. If properly calibrated equipment is not available, the unit under test (UUT) should be sent to an authorized Safran Power repair facility for all procedures in this manual.

Equipment	Range and Accuracy or Equipment Rating	Ref. Des.
Commutation Viewing Adapter	Special Tool, Figure 9002	
Ammeter	Range: 0 to 10 A Accuracy: ± 1% of reading	A_1
DC Variable Power Supply	Range: 0 to 30 VDC	
DC Voltage Regulator	Range: 0 to 30 VDC	
DC Voltmeter	Range: 0 to 30 VDC Accuracy: ± 1% of reading	V_4
DC Voltmeter (2 req'd)	Range: 0 to 50 VDC Accuracy: ± 1% of reading	V_2, V_3
DC Voltmeter	Range: 0 to 750 mVDC Accuracy: ± 1% of reading	V_1
Generator Drive Stand	Range: 5,000 to 14,000 rpm at rated load and 15,000 rpm at No Load	
Generator Load Switch	Rating: 30 V, 300 A	SW_1

Table 1002 - Test Equipment

Equipment	Range and Accuracy or Equipment Rating	Ref. Des.
High Potential Tester	Rating: 250 VAC RMS at commercial frequency	
Manometer	Range: 0 to 10 inches (0 to 254 mm) H_20 Accuracy: ± 5% of reading	
Megohm meter	Range: 0 to 50 VDC For Drive Shaft Insulation Resistance Test.	
Oscilloscope	Digital: Bandwidth of 100 MHz Sampling rate of 100 MS/s Analog: Bandwidth of 60 MHz	
Precision Shunt	Rating: 0 to 750 mVDC. 750 A	SH_1
Shunt Field Switch	Rating: 30 VDC, 10 A	SW_3
Dummy Terminal Block	Use dummy terminal block during testing to avoid damage to filter capacitors.	
Thermometer	Range: 65° to 300° F (18° to 150° C) Accuracy: ± 1° F (0,5° C)	
Variable Load Bank	Rating: 30 VDC, 0 to 300 A	
Voltage Regulator Switch	Rating: 30 VDC, 10 A	SW_2

Table 1002 - Test Equipment (Continued)

4. Generator Thermal Stabilization

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

- Temperature of shunt field winding (A-E), as determined by its resistance, rises no more than 2° F (1,1° C) in five minutes.
- Frame temperature measured on side opposite terminal block, does not rise more than 2° F (1,1° C) in five minutes.

5. Test Condition Setpoint Tolerances

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

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

Table 1003 - Setpoint Tolerances

6. Test Setup

NOTE: Numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST, unless specified differently.

A. Perform initial inspection.

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

B. Check brush seating

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

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

(1) Make sure all brushes (200) are correctly seated according to procedures in SPD 1006.

C. Clean the starter-generator.

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

(1) Refer to CLEANING section for details.

D. Attach dummy terminal block or isolate terminal block ground.

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

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

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

Optional: Disconnect the terminal block ground by removing the screw (10004-60), lock washer (10004-70) and washer (10004-80) from the terminal block in front of the D terminal.

E. Install commutation viewing adapter.

(1) Remove brush access cover (170). Refer to DISASSEMBLY section for details.

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

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

(2) Put commutation viewing adapter on anti-drive end bearing and brush support assembly (310).

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

(3) Center brackets of commutation viewing adapter over one rib of anti-drive end bearing and brush support assembly (310).

(4) Insert screw into blind rivet nut on bracket of commutation viewing adapter and tighten screw to a torque of 20.0 to 30.0 lbf.in. (2,3 to 3,4 N·m).

F. Install starter-generator on drive stand.

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

NOTE: The 23085 Series II starter-generators included in this CMM are not supplied with a QAD kit. QAD kits must be ordered separately and used during acceptance testing. Refer to the ILLUSTRATED PARTS LIST Figure 10005 for QAD kit part numbers.

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

(1) Install mounting adapter on drive stand.

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

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

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

G. Connect starter-generator to electrical test circuit.

(1) Turn all power OFF at drive stand.

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

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

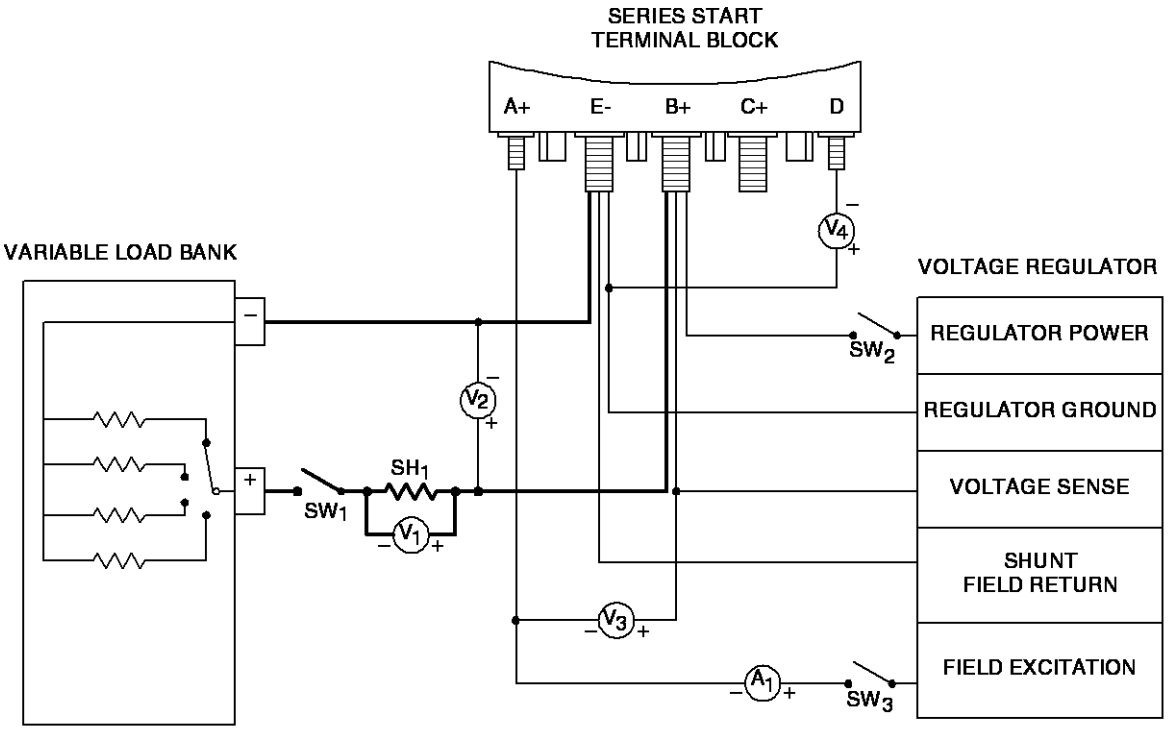

Figure 1001 - DC Starter-Generator Test Connection Diagram

7. Test Procedures

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

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

Tests must be performed in the following sequence.

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

A. Continuous operating speed, equalizing voltage and minimum speed test.

(1) Install thermocouple to outside of housing assembly, on the side opposite the terminal block, adjacent to a main pole of stator.

(2) Operate starter-generator at 12,000 rpm, 30 VDC (V_2), 300 A (V_1/SH_1) for 15 minutes.

(3) Record voltage between terminals "D" and "E" (V_4) air-in temperature, and winding or frame temperature.

(4) Immediately operate generator at minimum speed for regulation, 7,200 rpm, 30 VDC (V_2) and 300 A (V_1/SH_1).

NOTE: Stabilization not necessary.

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

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

(7) Calculate and record resistance between terminals B and A by dividing B to A voltage (V_3) by field current (A_1).

(8) Open field circuit and record residual voltage, B to E.

(9) Acceptance Limits:

(a) D-E Voltage: Must be within limits of Figure 1002.

(b) Field Current: 10 A Max.

(c) External Field Resistance (B to A): 0.5 Ω Min.

(d) Residual Voltage: 0.8 V Min.

NOTE: Continue immediately with minimum speed test.

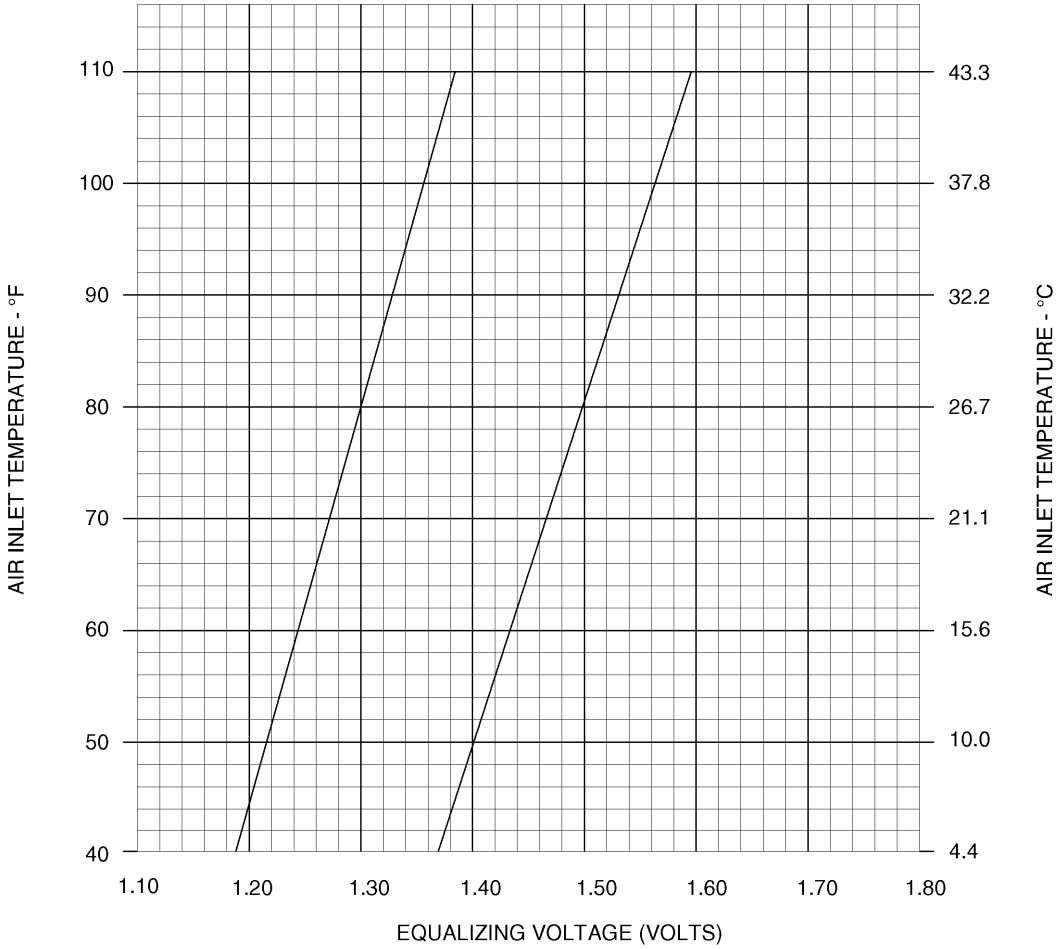

Figure 1002 - Equalizing Voltage Acceptance Limits

B. Minimum speed test.

(1) Operate starter-generator at 6,950 rpm, 28.5 VDC (V_2) and 300 A (V_1/SH_1) for 15 minutes.

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

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

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

(5) Acceptance limits:

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

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

NOTE: Immediately proceed to residual voltage test.

C. Residual voltage test.

(1) Operate the starter-generator at 12,000 rpm with field circuit open.

(2) Record the residual voltage B to E (V_2).

(3) Acceptance Limits:

(a) Residual voltage: 3.6 V Max.

NOTE: Immediately proceed to overspeed test.

D. Overspeed test.

(1) Increase the starter-generator speed to 14,000 rpm (with field switch open) and maintain this speed for 5 minutes.

(2) Acceptance limits:

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

E. Commutation check - See Figure 1003**.**

(1) Operate the starter-generator at 12,000 rpm, 30 VDC (V_2) and 300 A (V_1/SH_1).

(2) Acceptance limits:

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

(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.

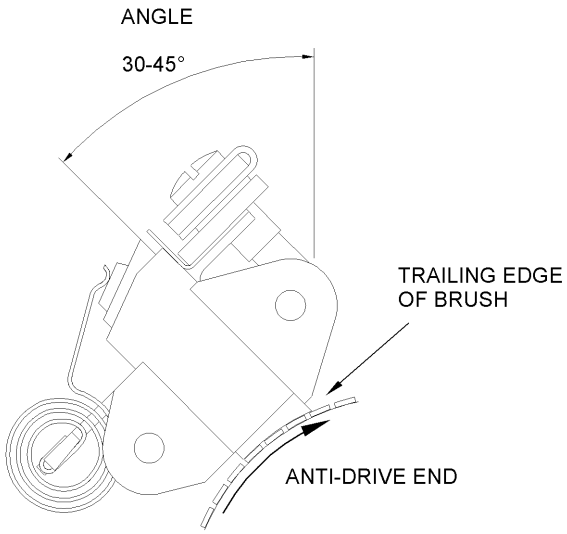

Figure 1003 - Correct Viewing Angles

F. Starter-generator dielectric test.

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

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

(1) Disconnect starter-generator from test circuit.

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

(3) Remove commutation viewing adapter.

(4) Disconnect brush box capacitor leads from anti-drive end bearing and brush support assembly. Insulate slotted terminal lugs with electrical insulating tape or equivalent.

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

(6) Attach positive (red) lead of high potential tester to connected terminal leads.

(7) Attach negative (black) lead of high potential tester to an unfinished surface of the starter-generator housing.

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

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

(8) Apply dielectric test voltage of 250 VAC RMS (commercial frequency) for one minute between the circuit and machine frame. Record the reading.

(9) Slowly decrease voltage to zero.

(10) Turn the power supply OFF.

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

(12) Acceptance limits:

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

(b) Leakage current must not be more than 5mA.

G. Drive shaft insulation resistance test.

(1) Make sure the drive shaft is not touching the armature shaft by centering it in the armature shaft.

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

(2) Apply a voltage of 50 VDC (with a megohm meter) between the drive shaft spline and the starter-generator housing. Record the amperage.

(3) Turn the power supply OFF.

(4) Apply a voltage of 50 VDC (with a megohm meter) between the drive shaft spline and the fan. Record the amperage.

(5) Turn the power supply OFF.

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

(7) Calculate the insulation resistance for each measurement.

(8) Acceptance limits:

(a) The insulation resistance must be greater than 1 MΩ for each measurement.

H. Locked rotor test.

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

(2) Connect 0.2Ω resistor between terminals A and C as shown in Figure 1004.

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

CAUTION: DO NOT ENERGIZE STARTER-GENERATOR MORE THAN 5 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER IS MORE THAN 9.5 V OR 630 A WITH ARMATURE IN LOCKED CONDITION.

(4) Quickly increase voltage between terminals C and E (V_2) until torque is 20.0 lbf.ft (27,1 N·m).

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

(5) Measure and record voltage between terminals C and E ($V_{2)}$.

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

(7) Turn the power supply OFF.

(8) Acceptance limits:

(a) C to E voltage (V_2): 9.5 VDC Max.

(b) Line current (V_1/SH_1): 630 A Max.

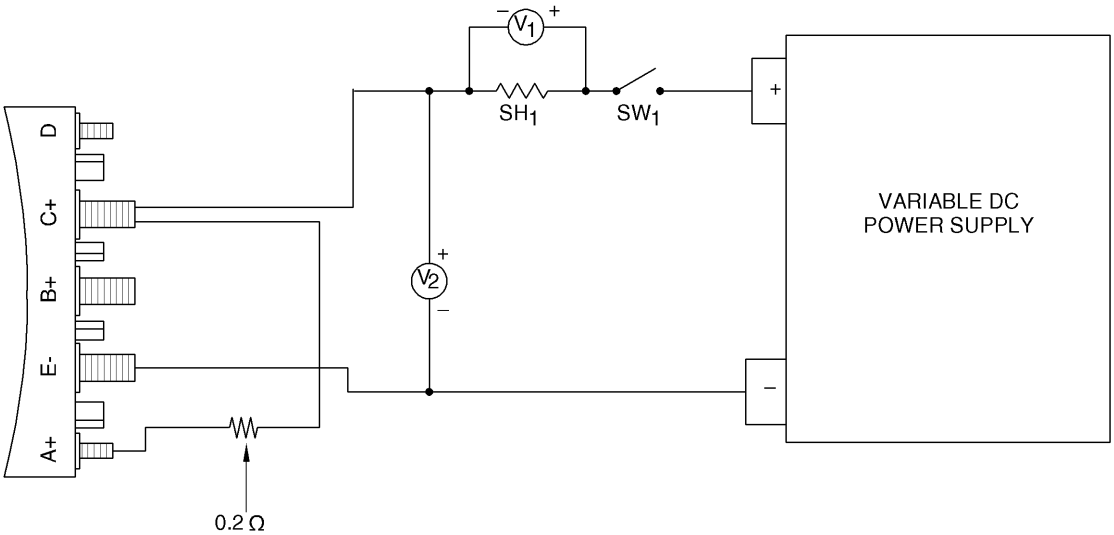

Figure 1004 - Locked Rotor Test Connection Diagram

I. Residual voltage test

(1) Operate the starter-generator at 7,200 rpm with field circuit open.

(2) Record the residual voltage B to E.

(3) Acceptance limits:

(a) Residual voltage: 0.5 V Min.

J. Commutator runout.

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

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

(2) Acceptance limits:

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

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

8. Final Assembly After Acceptance Testing

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

9. Fault Isolation Tables

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

Fault	Probable Cause	Corrective Action
A. Continuous Operating Speed and Equalizing Voltage Test		
High equalizing voltage (V_4).	Cooling air is low.	Check air flow path for obstructions.
	Incorrectly seated or installed brushes	View commutation while test is repeated. If commutation is more than pinpoints, reseat brushes, refer to Safran Power SPD 1006.
	Loose brush lead(s).	If no evidence of arcing, replace or reattach lead to brush holder, refer to ASSEMBLY.
	Brush circuit(s) open.	Inspect all brush leads for an open circuit. If found, replace brush. Overhaul or repair starter-generator as necessary.
	Armature either shorted or grounded.	Perform dielectric test. If armature fails test, replace.
	Stator Assembly either shorted or grounded.	Perform dielectric test. If stator assembly fails test, replace.
B. Minimum Speed Test		
Exceeded field current limit (A_1)	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.
	Brushes not fully seated.	Perform brush run-in procedure, refer to Safran Power SPD1006.
	Brushes hung up in brush holder assemblies.	Inspect for proper positioning.

Table 1004 - Fault Isolation Table

Fault	Probable Cause	Corrective Action
Low external field resistance (continued)	Commutator surface incorrectly filmed or irregular.	Check armature. Repair commutator surface or replace armature. Perform brush run-in procedure, refer to Safran Power SPD 1006.
	Armature either shorted or grounded.	Perform dielectric test. If armature fails test, replace.
	Stator windings either shorted or grounded.	Perform dielectric test on stator assembly. If stator assembly fails test, replace.
C. Residual Voltage Test		
High residual voltage indicated.	Stator windings and/or housing material are incorrect (slight differences in batches of laminations).	Replace the stator assembly. Inspect armature OD, reference SPD 1001 minimum lamination diameter. If stator fails, test the residual voltage.
D. Overspeed Test		
Noisy	Cooling fan blades rubbing or fan is out of balance.	Check fan blades and air inlet for damage. Replace cooling fan or air inlet.
	Defective or incorrectly installed bearings.	Remove brushes from brush holder and inspect bearings. Replace bearings.
Starter-Generator vibrates	Defective or incorrectly installed bearings.	Replace bearings.
	Out of balance armature.	Refer to REPAIR for armature balance. If out of balance condition cannot be repaired, replace armature.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
E. Commutation Check		
Commutator/Brushes show too much sparking with no load.	Incorrectly seated or installed brushes.	Perform brush run-in procedure, refer to Safran Power SPD 1006. Repair commutator surface. Replace armature.
	Loose brush holder(s).	Check attaching hardware. Perform dielectric test on anti-drive end bearing and brush support assembly. Perform brush run-in procedure, refer to Safran Power SPD 1006.
	Brush spring pressure below limit.	Refer to FITS AND CLEARANCES section for brush spring pressure. Replace.
	Partially or completely open armature winding	Replace armature.
	Incorrectly filmed or irregular commutator surface.	Repair commutator surface. Replace armature.
	Shorted or grounded stator assembly.	Perform dielectric test. If stator assembly fails test, replace.
	Armature out of balance.	If correct balance cannot be maintained, replace armature.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
F. Dielectric Test		
Starter-Generator insulation breakdown	Grounded anti-drive end bearing and brush support assembly.	Perform dielectric test. If anti-drive end bearing and brush support assembly fails test, replace insulating sleeves and washers.
	Grounded armature	Perform dielectric test. Replace armature if unit fails test.
	Grounded stator assembly.	Perform dielectric test. Replace stator if unit fails test.
G. Drive Shaft Insulation Resistance Test		
Low insulation resistance	Defective isolator and/or washer assembly.	Replace isolator and/or washer assembly.
H. Locked Rotor Test		
Low or no torque	Stator winding either shorted, grounded or open.	Perform Dielectric test.
		Replace stator assembly if unit fails test.
	Armature winding shorted, grounded or open.	Perform Dielectric test.
		If armature fails test, check for shorts with growler, if shorts are found, replace.
	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 more than in FITS AND CLEARANCES section. Perform brush run-in procedure, refer to Safran Power SPD 1006. Test starter-generator.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Low or no 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 Safran Power SPD 1006. Test starter-generator.
Voltage between terminals C and E (V_2) or line current (V_1,/SH_1) exceeded	Armature winding either shorted, grounded or open.	Perform dielectric test. If armature fails test, check for shorts with a growler, if shorts are found, replace.
	Shorted, grounded or open stator winding.	Check for continuity on all leads of stator winding. Perform dielectric test. If stator assembly fails continuity check or dielectric test, replace.
Exceeded voltage or current limits	Armature winding either shorted, grounded or open.	Perform dielectric test. If armature fails test, check for shorts with a growler, if shorts are found, replace.
Exceeded voltage or current limits (Cont)	Shorted, grounded or open stator winding.	Check for continuity on all leads of stator winding. Perform Dielectric test. If stator and housing assembly fails continuity check or dielectric test, replace.
I. Residual Voltage Test		
Low residual voltage	Stator windings and/or housing material are incorrect.	Replace the stator assembly. Inspect armature OD, reference SPD 1001 minimum lamination diameter.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
J. Commutator Runout Check		
Bar-to-bar runout or total indicator runout exceeded.	Shifted commutator bars.	Repair commutator surface. Replace armature if not repairable.

Table 1004 - Fault Isolation Table (Continued)

10. Component Testing Fault Isolation Table

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

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

Table 1005 - Component Testing Fault Isolation Table

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

Table 1005 - Component Testing Fault Isolation Table (Continued)

23085 SERIES II VERIFICATION / FINAL ACCEPTANCE DATA SHEET

Model Number:23085-_____ Inspected by:_____

Serial Number:_____ Date:_____

Modification Level:_____

Inspection/Test	Requirements/Limits	Measurements	Accept	Reject
Visual Inspection	Check for physical damage			
Continuous Operating Speed, Equalizing Voltage, Minimum Speed Test	Inlet air temperature	°F (°C)		
	Winding or frame temperature	°F (°C)		
	Measured equalizing voltage D to E (V_4)	VDC		
	Voltage between terminals B and A (V_3)	VDC		
	Field current (A_1) (10 A Max)	A		
	Calculated external field resistance (0.5Ω Min) ($V_3/(A_1)$	Ω		
	B to E residual voltage (0.8 VDC Min) (V_2)	VDC		
Minimum Speed Test	Field current (A_1) (10 A Max)	A		
	Voltage between terminals B and A (V_3)	VDC		
	Calculated external field resistance (0.5Ω Min) ($V_3/(A_1)$	Ω		
Residual Voltage Test	B to E residual voltage (3.6 VDC Max) (V_2)	VDC		
Overspeed Test	No sign of electrical or mechanical failure			
Commutation Test	Not to exceed pinpoints			
Starter-Generator Dielectric Test	No indication of insulation breakdown. Leakage (5mA Max)	mA		
Drive Shaft Insulation Resistance Test	Insulation resistance (1MΩ Min)	MΩ		
Locked Rotor Test	Output Torque (20.0 lbf.ft (27,1 N·m))			
	Line Current (V_1/SH_1) (630A Max)	A		
	C to E voltage (V_2) (9.5 VDC Max)	VDC		
Residual Voltage Test	B to E residual voltage (0.5 VDC Min)	VDC		
Commutator Runout Test	Bar-to-bar runout (0.0002 inch (0,005 mm Max)	inch (mm)		
	Total indicated runout (0.0008 inch (0,020 mm Max)	inch (mm)		

SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

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DISASSEMBLY

1. Introduction

This section provides disassembly instructions for 23085 Series II 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.
- During overhaul, replace bearings, brushes and o-rings. Parts that have been removed during disassembly, such as, insulating parts, retaining rings, screws, self-locking nuts and lock washers, must be discarded regardless of their condition. The screws that attach the brush leads to the brush holder do not need to be replaced unless damaged. The insulator (1-270), washer assembly (1-120) and the fan cap plug (1-090) only need replaced if damage is found.

NOTE: When a starter-generator is removed for service, the QAD kit and terminal block cover usually stay on the aircraft.

2. Disassembly Tools

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

Tool Description	Source/Figure Reference
Adapters, Armature Shaft (Drive End, Anti-Drive End)	Figure 9001
Arbor press	Commercially Available
Bearing Puller (Snap-On A78 or equivalent) (Thin Jaw)	Commercially Available
Drivers, Bearing (Inner Race and Outer Race)	Figure 9003
Driver, Dampener Hub	Figure 9011
Mallet, Plastic or Leather	Commercially Available
Pliers, External Snap Ring	Commercially Available
Support, Armature	Figure 9006
Support, Bearing and Brush Support Assembly	Figure 9007
Supports, Hub (Drive End and Anti-Drive End)	Figure 9008
Support, Stator, Horizontal	Figure 9009
Support, Stator, Vertical	Figure 9010

Table 3001 - Disassembly Tools

Tool Description	Source/Figure Reference
Wire Hook Tool	Commercially Available
Wrench, Spanner, Part No TG-1277-1011	Figure 9016
Wrench, Spline	Figure 9013

Table 3001 - Disassembly Tools (Continued)

3. Disassembly Materials

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

NOTE: Disassembly materials are not available from Safran Power. All items can be purchased commercially.

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

Item	Description/Specification	Source (CAGE Code)
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: Numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST unless otherwise specified.

A. Remove QAD mounting kit, if present.

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

(1) Loosen self-locking nut (10005-20) from T-bolt (10005-30) and remove V-retainer coupling (10005-10) from the starter generator.

(2) Remove mounting adapter (10005-40) from starter-generator.

B. Remove identification plate (10), patent notification label (30) and caution decal (40) from stator assembly (480).

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

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

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

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

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

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

(4) Discard the four drive screws (20) from the stator assembly (480).

(5) Keep the identification plate for reference when transferring the information to a replacement identification plate (10).

WARNING: HANDLE THE TOOL CAREFULLY. WEAR EYE PROTECTION.

(6) Remove and discard the patent notification label (30) and caution decal (40) from stator assembly (480).

(a) Lift the corner of the label or decal with a sharp tool.

(b) Peel off and discard the label or decal from the starter-generator.

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

(c) Use alcohol to remove adhesive residue.

(d) Wipe dry with a soft dry cloth.

C. Remove terminal block cover (50), if present.

NOTE: When starter-generator is removed for servicing, terminal block cover usually stays on aircraft.

(1) Remove the two screws (60) that attach the terminal block cover (50) to the terminal block.

(2) Remove the terminal block cover.

D. Remove air inlet (70). See Figure 3001.

NOTE: For model 23085-031, record the position of the air inlet if returned with the generator. There are two positions for installation as shown in Figure 7021.

(1) Where applicable, remove and discard lockwire from attaching screws (80) of air inlet (70).

(2) Remove four screws (80) which attach air inlet to bearing and brush support assembly (310).

(3) Remove air inlet (70).

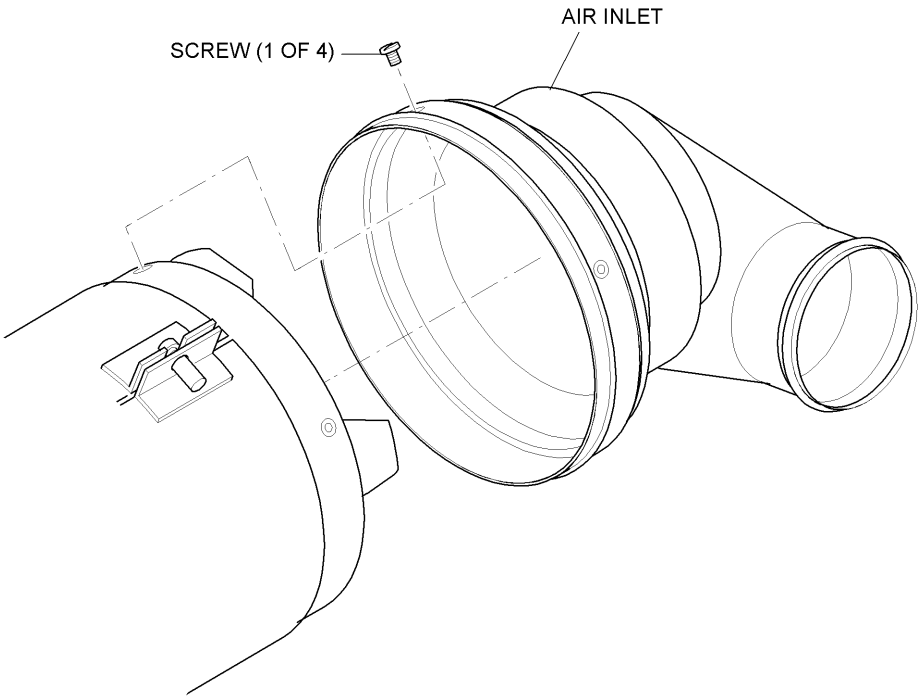


Figure 3001 - Air Inlet Removal

E. Remove brush access cover (170).

(1) Remove screw (180) from self-locking blind rivet nut (190) that secures brush access cover around the bearing and brush support assembly (310).

(2) Remove brush access cover (170).

F. Remove brushes (200) from bearing and brush support assembly (310). See Figure 3002.

NOTE: If brushes (200) are to be reused, identify the brushes and complete brush holders (10002-20) with the numbers 1 through 4.

(1) Remove four screws (210) that attach brush shunt leads to complete brush holders (10002-20).

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

(2) Use a wire hook tool to lift two brush springs (10002-10) away from brush (200). Remove brush from complete brush holder (10002-20).

(3) Slowly return brush springs (10002-10) to a resting position on complete brush holder (10002-20).

(4) Identify brush (200) with the number on complete brush holder (10002-20) from which it was removed.

(5) Repeat Paragraph 4.F.(2) through Paragraph 4.F.(4) for each remaining brush (200).

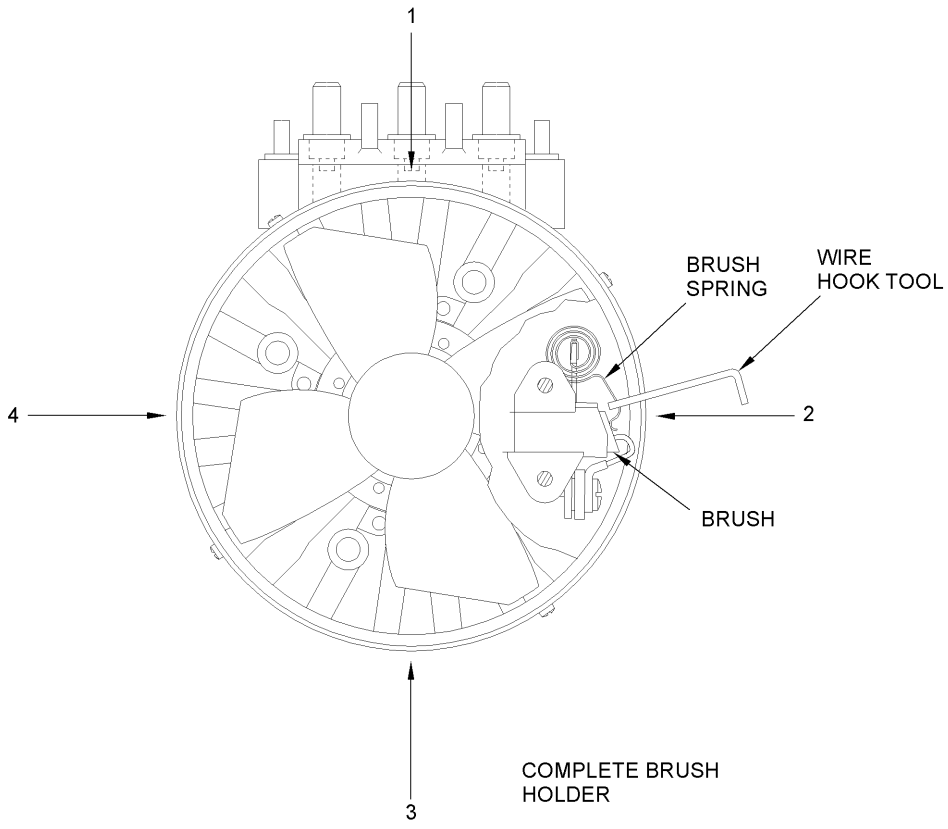


Figure 3002 - Brush Removal

G. Remove fan (100). See Figure 3003.

(1) Remove and retain the fan cap plug (90) from the center of the fan (100).

(2) Put a spline wrench on the drive spline to prevent the drive shaft (220) from turning while removing attaching parts.

(3) Remove self-locking nut (110) and washer assembly (120) from drive shaft (220).

NOTE: Check the washer assembly for re-use. Check for damage and that both washers are secured together.

(4) Bend back the tab on bearing retainer key washer (140).

(5) Remove spanner nut (130) with the spanner wrench. Also remove and retain the key washer (140).

(6) Slide the fan (100) off the armature (430) shaft.

(7) Remove the straight headless pin (150) from the armature (430) shaft keyway.

(8) Slide the ADE bearing shield (160) off the armature (430) shaft.

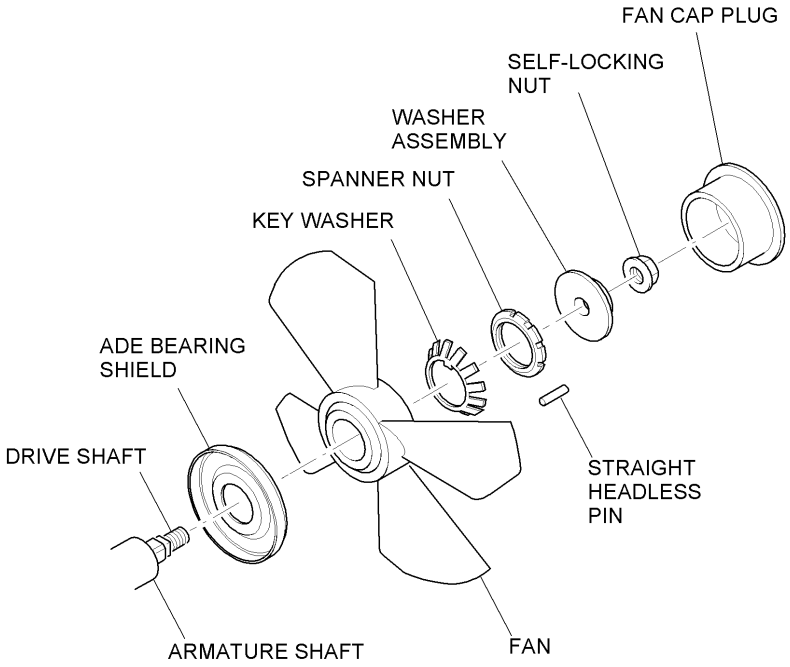


Figure 3003 - Removing the Fan

H. Remove drive shaft (220) with the attached O-ring (230), dampener hub (240), dampener plate (250), isolator (270) and friction ring (260) from armature (430) shaft.

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

(1) Lightly tap the anti-drive end of drive shaft (220) with a plastic or leather mallet to disengage it from armature (430) shaft.

(2) Pull drive shaft (220) out of drive end of the starter-generator. See Figure 3004.

(3) Remove friction ring (260) from drive shaft (220).

(4) If present, remove and retain isolator (270) from drive shaft (220).

NOTE: Isolator can remain in armature (430) shaft when drive shaft is removed. If this occurs use a suitable probe to remove the isolator.

(5) Remove dampener plate (250) from dampener hub (240) on drive shaft (220).

(6) If present, remove and discard O-ring (230) from drive shaft (220).

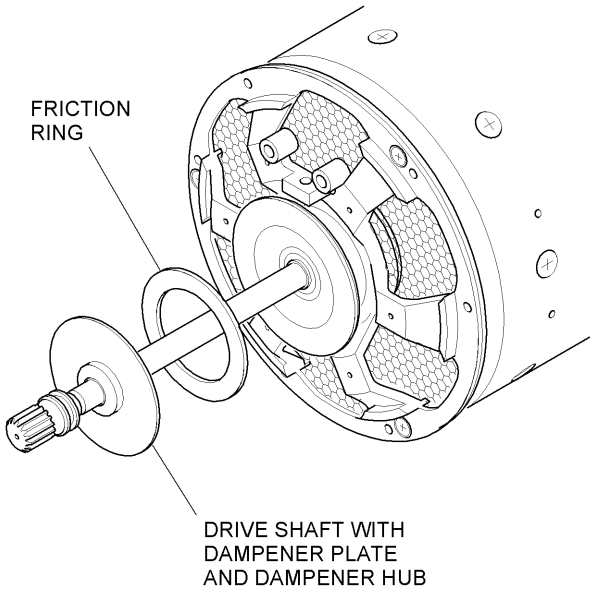


Figure 3004 - Removing the Drive Shaft, Friction Ring and Dampener Plate

I. Remove dampener hub (240) from drive shaft (220). See Figure 3005.

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

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

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

CAUTION: TAKE EXTRA CARE TO NOT DAMAGE THE BLUE XYLAN® COATING ON THE DAMPENER HUB.

(2) Put a sheet of protective paper on top of the dampener plate driver where the dampener hub will seat against.

NOTE: This is to protect the blue Xylan® coating on the back face of the dampener hub.

(3) Set dampener hub driver on the flat side of dampener hub (240).

(4) Insert drive shaft (220) through the center of the hub support until dampener hub driver is installed on the hub support.

(5) Install a nut on the end of the drive shaft to prevent damage when tapping.

(6) Quickly tap with an arbor press on the drive shaft (220) down into the hub support until dampener hub (240) disengages from drive shaft.

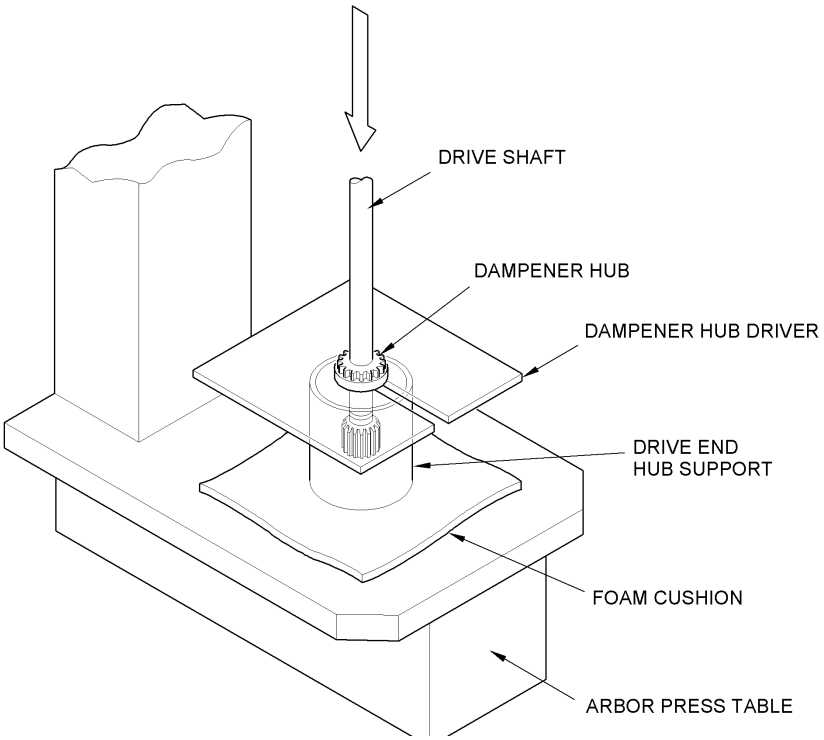


Figure 3005 - Removing the Dampener Hub from the Drive Shaft

J. Remove dampener back plate (280) from armature (430) shaft. See Figure 3006.

CAUTION: FAILURE TO USE THE DRIVE END ARMATURE SHAFT ADAPTER WHEN REMOVING THE DAMPENER BACK PLATE CAN CAUSE PERMANENT DAMAGE TO THE ARMATURE SHAFT.

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

CAUTION: TAKE EXTRA CARE TO NOT DAMAGE THE BLUE XYLAN® COATING ON THE DAMPENER BACKPLATE.

(1) Put drive end armature shaft adapter into drive end of armature (430) shaft.

(2) Remove dampener back plate (280) from armature (430) shaft using a suitable bearing puller.

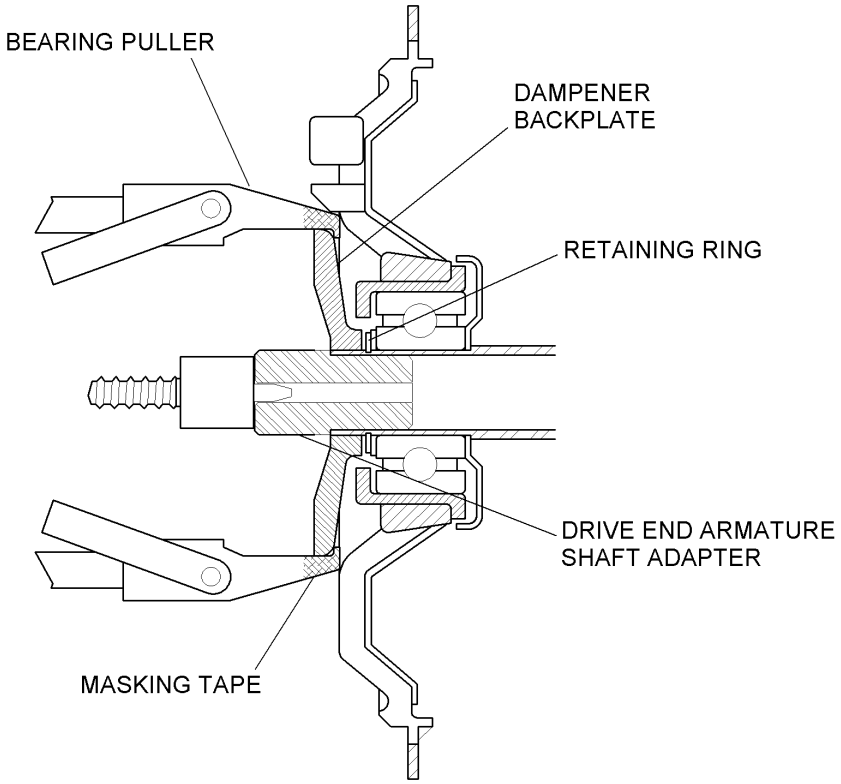


Figure 3006 - Dampener Back Plate Removal

K. Remove bearing and brush support assembly (310) and attached armature (430) from stator assembly (480). See Figure 3007**.**

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

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

(2) Remove eight screws (320), eight flat washers (340) and eight spring lock washers (330) that attach the bearing and brush support assembly (310) to stator assembly (480).

(3) Set the starter-generator on a horizontal stator support. Insert the drive end armature shaft adapter into the drive end of the armature (430) shaft.

(4) Gently tap on the drive end armature shaft adapter with a plastic or leather mallet until the bearing and brush support assembly (310) separates from the stator assembly (480).

(5) Carefully remove the bearing and brush support assembly (310) and attached armature (430) from the stator assembly (480).

(6) Remove retaining ring (290) with external snap ring pliers and spacer (300) from armature (430) shaft.

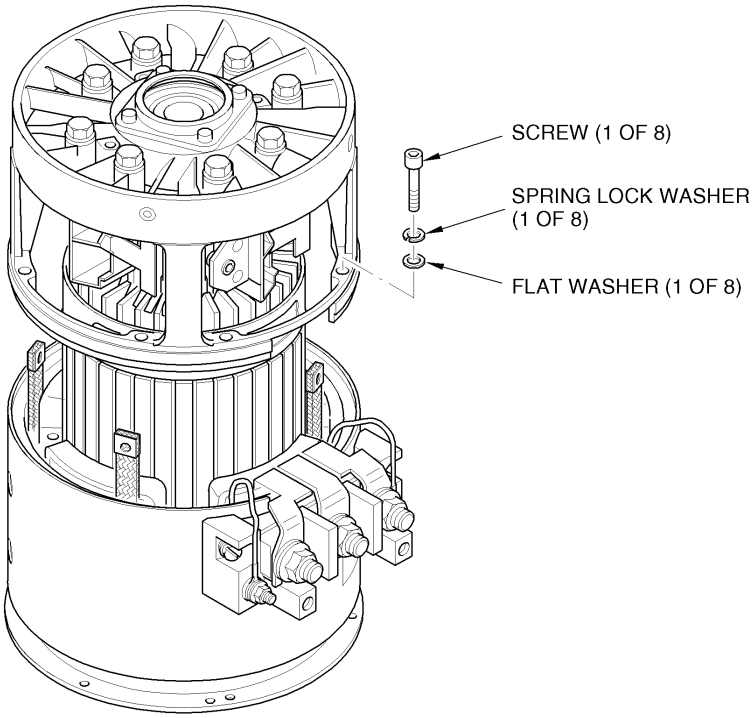


Figure 3007 - Remove the Bearing and Brush Support Assembly with Attached Armature

L. Remove drive end bearing support assembly (370) from stator assembly (480). See Figure 3008.

(1) Remove three screws (380) from stator assembly (480).

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

(2) Lightly tap the drive end bearing support assembly (370) with a plastic or leather mallet from the inside out to loosen it from the stator assembly (480).

(3) Remove drive end bearing support assembly (370) from stator assembly (480).

(4) Remove spring wave washer (390) and shims (400, 410, 420) from drive end bearing support assembly (370).

NOTE: The spring wave washer (390) can be re-used if it passes the inspection criteria given in the CHECK section.

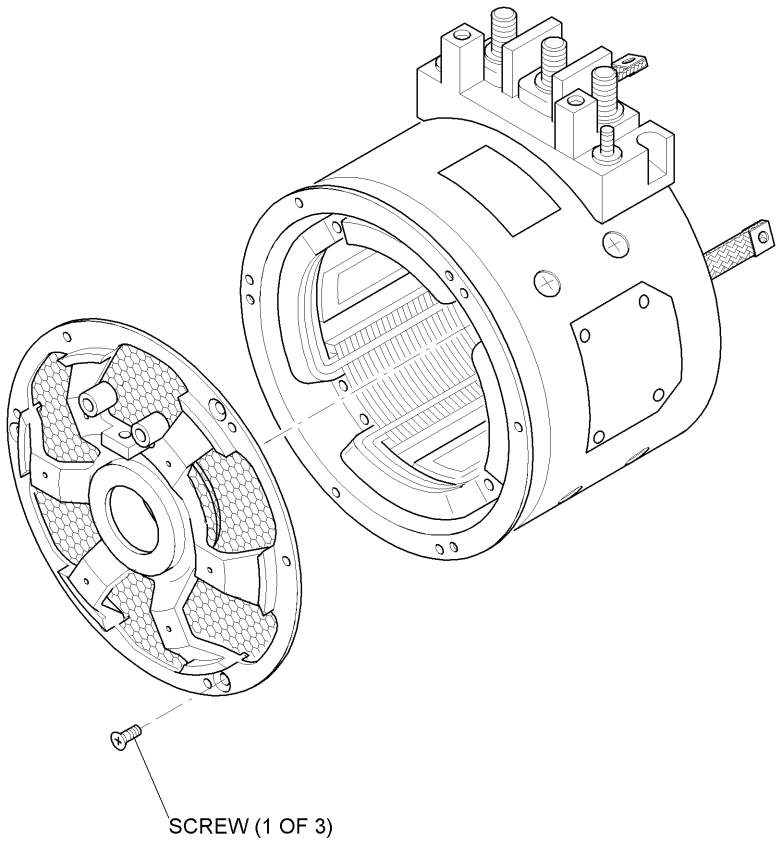


Figure 3008 - Drive End Bearing Support Assembly Removal

M. Remove armature (430) from bearing and brush support assembly (310). See Figure 3009.

CAUTION: TO PREVENT DAMAGE TO ARMATURE SHAFT, PLACE A FOAM CUSHION AT BASE OF BEARING AND BRUSH SUPPORT ASSEMBLY SUPPORT.

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

(2) Put bearing and brush support assembly (310) with attached armature (430) onto bearing and brush support assembly support.

CAUTION: TO AVOID PERMANENT DAMAGE TO ARMATURE SHAFT, USE ANTI-DRIVE END ARMATURE SHAFT ADAPTER WHEN PRESSING ARMATURE FROM BEARING AND BRUSH SUPPORT ASSEMBLY.

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

CAUTION: HOLD ARMATURE SECURELY SO ARMATURE IS NOT DAMAGED WHEN PRESSED OUT OF BEARING AND BRUSH SUPPORT ASSEMBLY.

(4) While supporting armature securely with one hand, carefully press armature (430) shaft down and away from bearing and brush support assembly (310).

(5) Carefully remove armature (430) from inside of bearing and brush support assembly support.

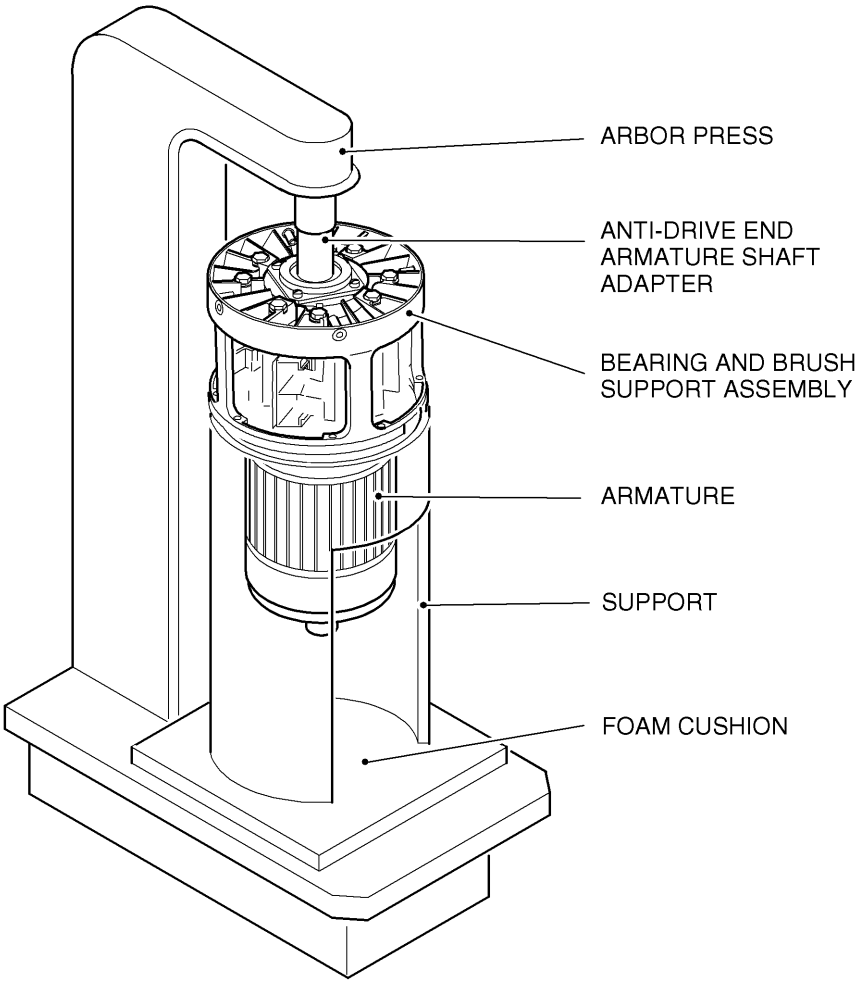


Figure 3009 - Armature Removal

N. Remove bearing retainer (450) from bearing and brush support assembly (310). See Figure 3010.

(1) Remove four screws (460) attaching bearing retainer (450) to bearing and brush support assembly (310).

(2) Remove bearing retainer (450).

(3) Remove four screws (350) and lock washers (360) which attach the filter leads to the bearing and brush support assembly (310).

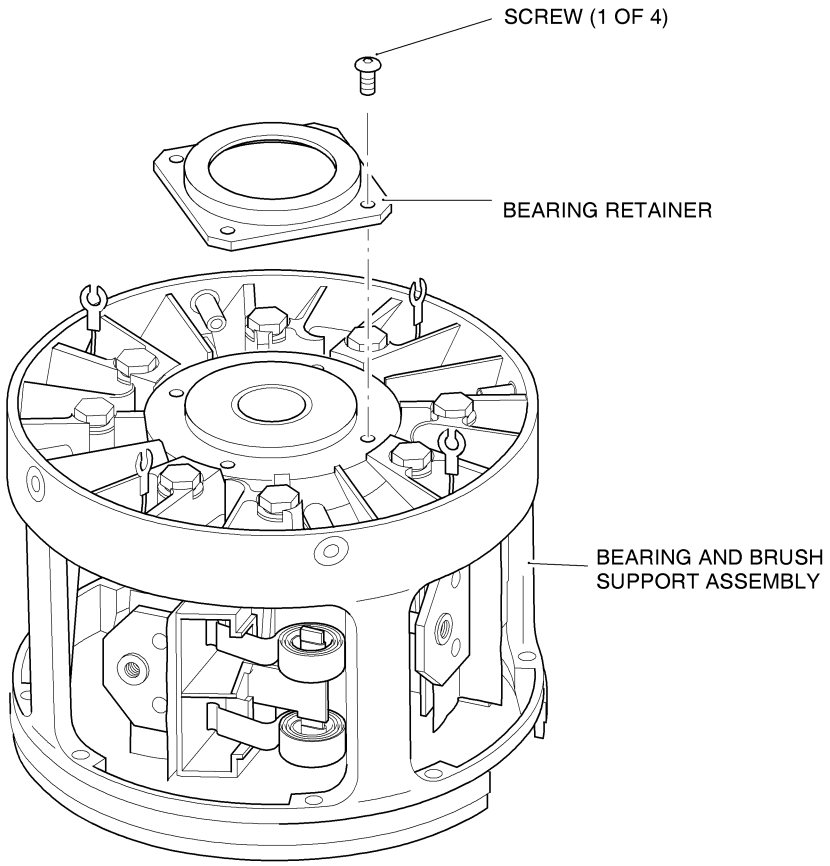


Figure 3010 - Bearing Retainer Removal

O. Remove ball bearing (440) from bearing and brush support assembly (310). See Figure 3011.

CAUTION: TO AVOID PERMANENT DAMAGE TO BEARING AND BRUSH SUPPORT ASSEMBLY, USE A BEARING HUB SUPPORT WHEN BEARING IS PRESSED.

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

(2) Set bearing and brush support assembly (310) on anti-drive end hub support with outboard side facing down.

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

(4) Slowly press bearing (440) from bearing and brush support assembly (310) and into anti-drive end hub support.

(5) Remove bearing from inside of anti-drive end hub support. Discard bearing (440).

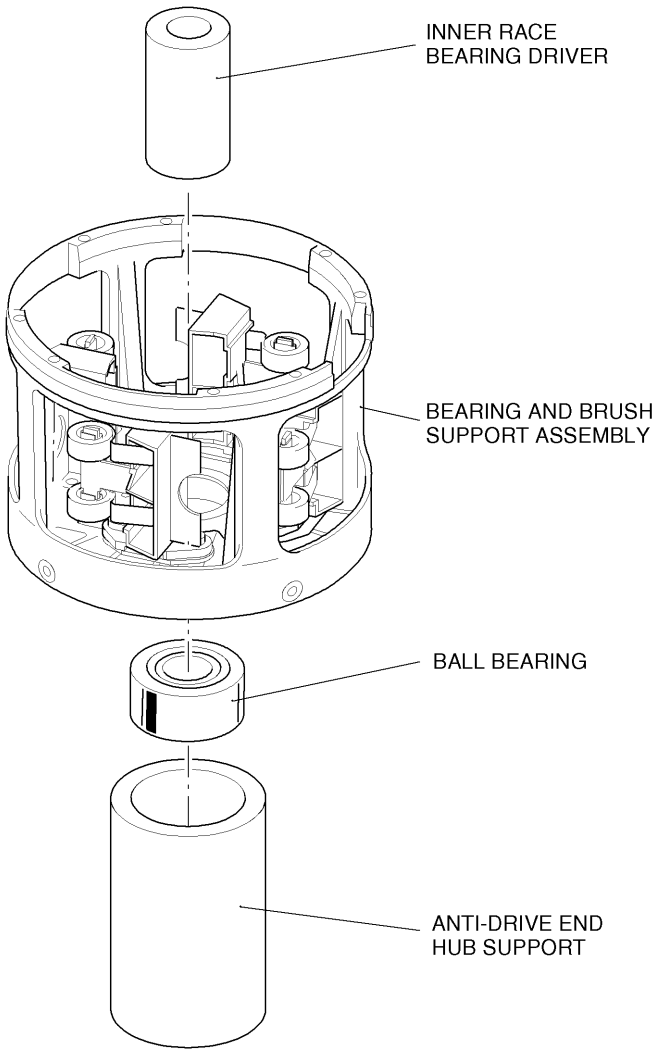


Figure 3011 - Ball Bearing Removal

P. Remove drive end ball bearing (440) and drive end bearing shield (470) from armature (430) shaft. See Figure 3012.

CAUTION: TO AVOID PERMANENT DAMAGE TO ARMATURE SHAFT, USE ARMATURE SHAFT ADAPTER WHEN REMOVING BEARING.

(1) Place armature (430) into armature support.

(2) Insert a drive end armature shaft adapter into drive end of armature (430) shaft.

(3) Remove bearing (440) from armature (430) shaft using a suitable bearing puller.

(4) Discard bearing (440).

(5) Remove and retain drive end bearing shield (470) from armature (430) shaft.

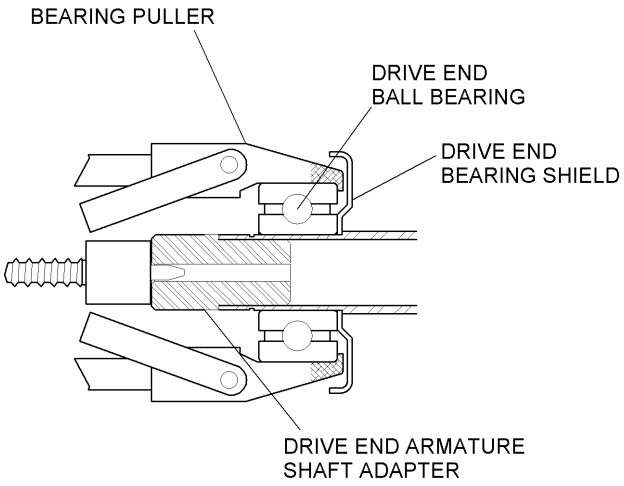


Figure 3012 - Ball Bearing and Drive End Bearing Shield

5. Disassembly of Bearing and Brush Support Assembly

NOTE: Numbers in parentheses ( ) refer to item numbers in Figure 10002 in the ILLUSTRATED PARTS LIST, unless otherwise specified.

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

A. Remove complete brush holders (20) from anti-drive end end bell. See Figure 3013.

(1) Remove two bolts (30), flat washers (40), and non-metallic washers (50) from bearing and brush support assembly.

(2) Remove brush holder assembly (20) and filter assembly (150) from anti-drive end end bell.

(3) Remove two insulation sleeves (100) from mounting holes in anti-drive end end bell.

(4) Discard non-metallic washers (50) and insulation sleeves (100).

(5) Remove two brush springs (10) from complete brush holder (20).

(6) Repeat Paragraph 5.A.(1) through Paragraph 5.A.(5) as required for remaining complete brush holders (20).

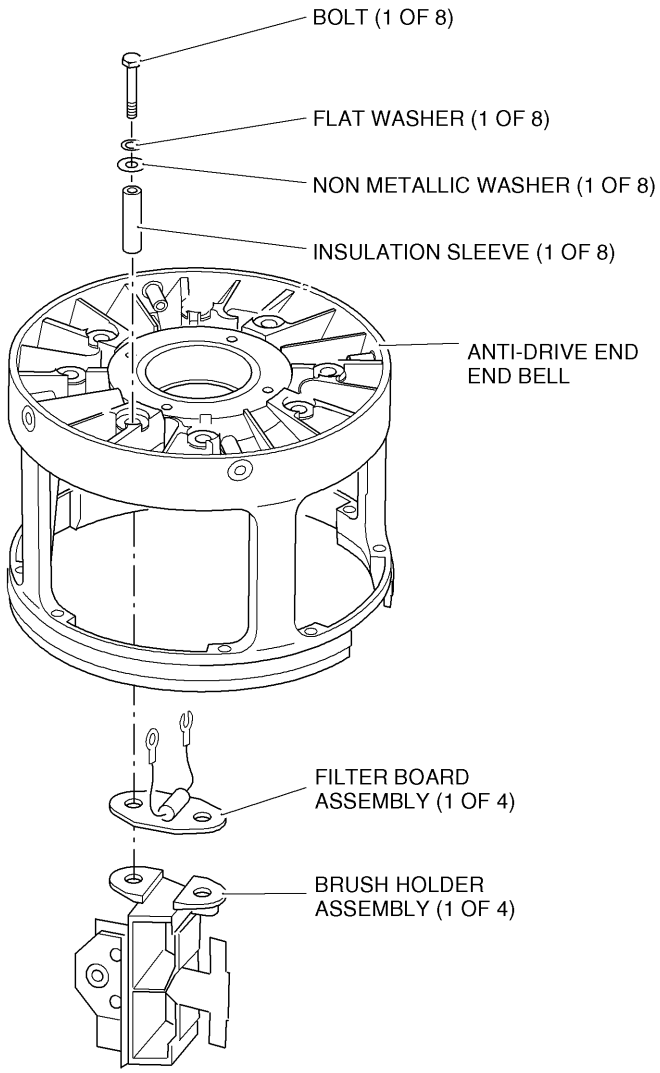


Figure 3013 - Brush Holder Removal

B. Disassemble each complete brush holder (20).

NOTE: Do not disassemble complete brush holders unless necessary.

(1) Refer to the REPAIR section for complete brush holder (20).

6. Disassembly of Drive End Bearing Support Assembly.

NOTE: Numbers in parentheses ( ) refer to item numbers in Figure 10003 in the ILLUSTRATED PARTS LIST, unless otherwise specified.

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

A. Remove guard screen (10) from drive end end bell (40).

NOTE: Do not remove guard screen from drive end end bell unless damaged.

(1) Remove and discard attaching drive screws (20) and flat washers (30) from the drive end end bell (40).

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

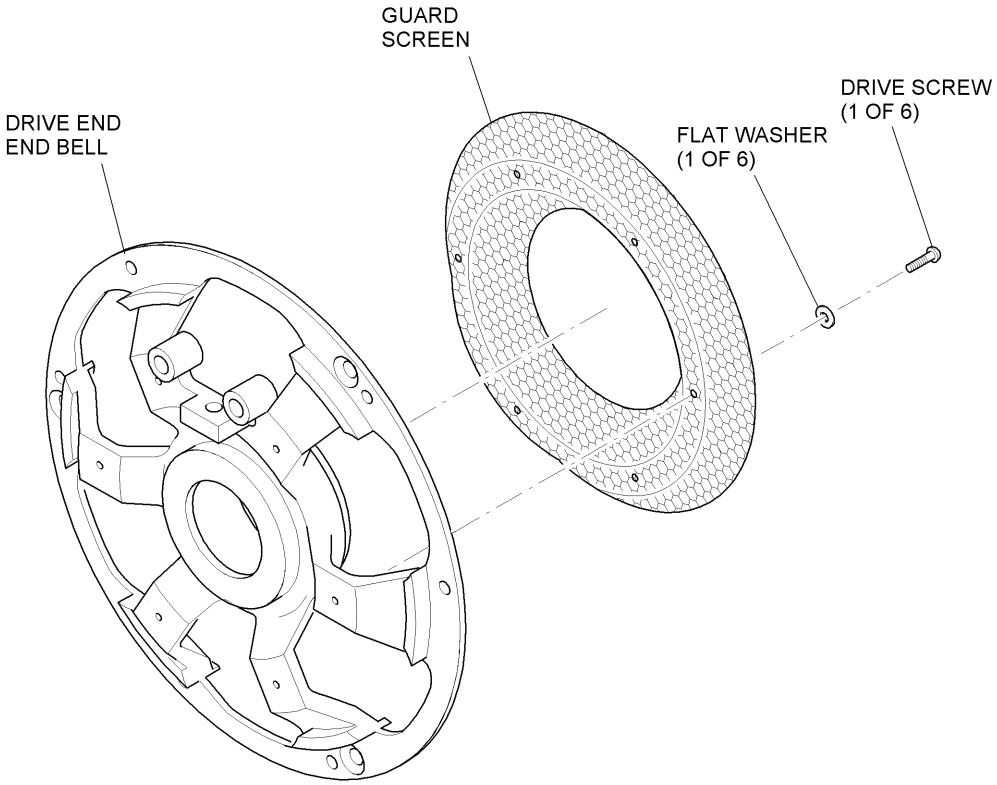


Figure 3014 - Guard Screen Removal

7. Disassembly of Stator Assembly

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

NOTE: Do not disassemble stator assembly more than necessary to remove terminal block for check, repair or replacement of parts.

A. Remove hardware from terminal block (50) if present. (See Figure 3015).

(1) Remove three self-locking nuts (10) and plain washers (20) from terminal studs C, B and E.

(2) Remove two self-locking nuts (30) and plain washers (40) from terminal studs A and D.

(3) Discard the self locking nuts and plain washers.

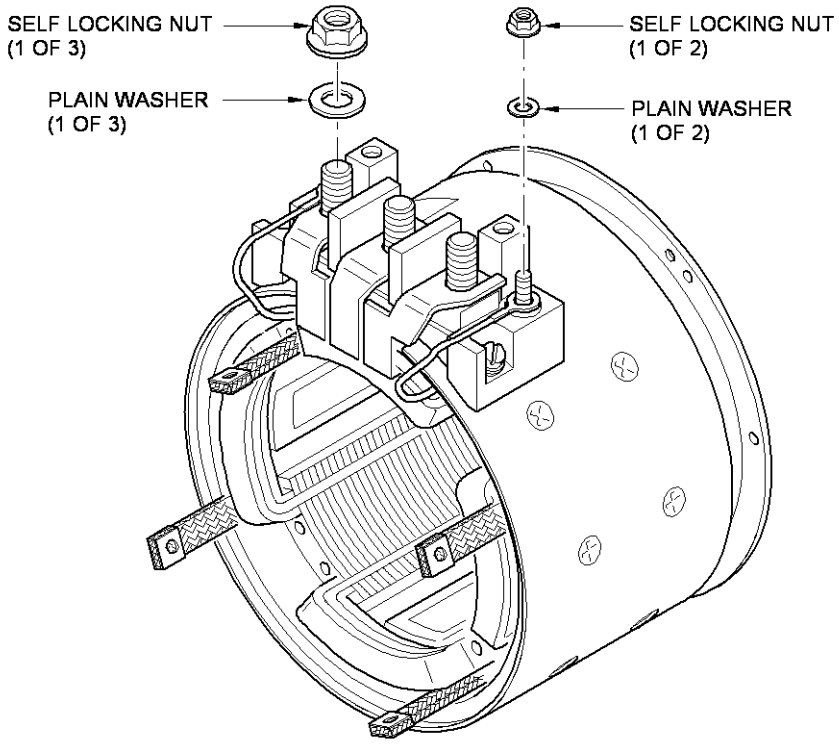


Figure 3015 - Hardware Removal from Terminal Block

B. Remove terminal block (50) from stator housing. See Figure 3016.

(1) Remove the two screws (60), two spring lock washers (70) and two flat washers (80).

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

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

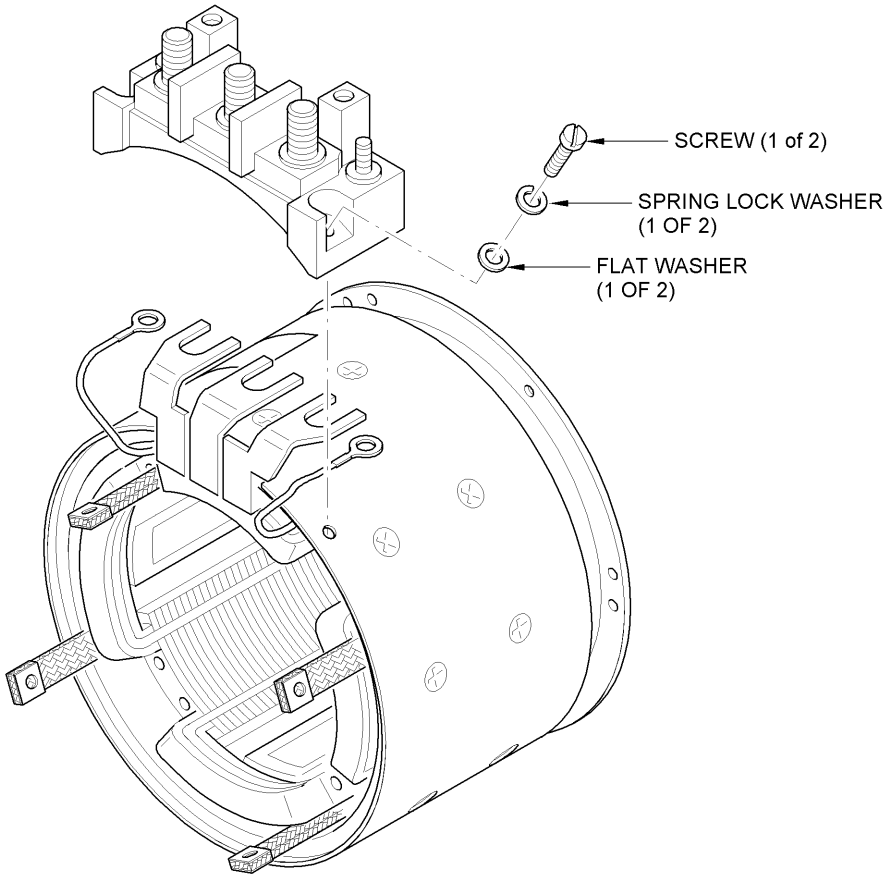


Figure 3016 - Terminal Block Removal

CLEANING

1. Introduction

This section contains the cleaning procedures for 23085 Series II DC Starter-Generators.

2. Cleaning Materials

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

WARNING: YOU MUST OBEY THE MATERIAL/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 or 815 GD-NF Applications: Hot tanks - aluminum safe Steam Cleaning Pressure Sprayers Ultrasonic Cleaning Formula 1990 GD Application: Spray Wash Cleaning	The Brulin Corporation 2920 Dr. Andrew J Brown Ave. Indianapolis, Indiana 46205-4066 USA Phone:(1) 317/923-3211 FAX: (1) 317/925-4596 www.brulin.com (V94058)
Isopropyl Alcohol	TT-I-735, Grade A See **WARNING** before using this material. Flash Point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available

Table 4001 - Cleaning Materials and Equipment (Continued)

3. Cleaning Procedures

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

A. Blow out dirt particles.

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

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

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

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

B. Clean the parts.

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

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

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

Table 4002 - Cleaning Procedures (Continued)

C. Rinse the parts.

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

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

E. Dry the parts.

(1) Remove moisture that remains on the parts with a dry lint-free cloth.Sep 03/08

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

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

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

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

4. Corrosion Preventive

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

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

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

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

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

5. Cleaning After Liquid Penetrant Inspection

A. Description

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

B. Procedure

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

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

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

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

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

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

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

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

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

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

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

(b) Use compressed air to remove rinse water.

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

(c) Immediately put the washed and rinsed part(s) in a vented 240° to 260° F (115,5° to 126,7° 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 it is 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 testing or disassembly. The results of this inspection will determine if a starter-generator is in satisfactory condition for a verification test or if it will need further disassembly, inspection, and/or replacement of parts.

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

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

2. Necessary Tools and Materials

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

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

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

Table 5001 - Inspection Tools and Materials

Tool Description	Reference
V-blocks	Commercially Available
Dampener Plate Gauge Tool, P/N 19-601076	Figure 9017

Table 5001 - Inspection Tools and Materials (Continued)

A. Use of Growler

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

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

3. General Information

Check Acceptance Limit Measurements for individual components are found in 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
- Foreign matter obstructions in air flow paths

B. Examine electrical components visually for:

- Loose or defective attaching parts
- Damage caused by too much heat
- Electrical arcing paths
- Corroded contacts or terminals
- Loose or defective electrical contacts or terminals
- Loose, broken or shorted terminations

4. Initial Inspection

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

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

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

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

B. Clean the exterior of the starter-generator.

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

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

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

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

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

5. Non-Destructive Test (NDT) Inspections

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

B. Unless otherwise specified, do liquid penetrant inspections IAW ASTM-E-1417 type 1 Method A or B, sensitivity 2 or higher. Unless otherwise specified, acceptance criteria must be IAW MIL-STD-1907 Table II, Grade C.

6. Replace Service Parts and Common Hardware

A. Overhaul

During overhaul, replace bearings, brushes and o-rings. Parts that have been removed during disassembly, such as, insulating parts, retaining rings, screws, self-locking nuts and lock washers, must be discarded regardless of their condition. The screws that attach the brush leads to the brush holder do not need to be replaced unless damaged. The isolator (1-270), washer assembly (1-120) and the fan cap plug (1-090) only need replaced if damage is found.

B. Service repair

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

7. Inspection guidelines

A. Repair or service inspection

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

B. The following terms are referenced in this section:

- DISCARD

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

- REPAIR

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

- DISASSEMBLE

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

- REPLACE

  If damage occurs that causes a part to be outside of the acceptance limits in the FITS AND CLEARANCES section or there is no repair procedure for that part, replace the part. Retain the following parts to submit for remanufacture: armature and stator 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: Numbers in parentheses ( ) refer to item numbers in Table 10001 of the ILLUSTRATED PARTS LIST, 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-Retainer coupling (10005-10) and T-bolt (10005-30).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(a) REPLACE if damage is found.

(4) Examine mounting adapter (10005-40) for damaged or missing guide pin(s) (10005-50).

(a) REPAIR pin(s) (10005-50) if damage exists or they are not within limits of the FITS AND CLEARANCES section.

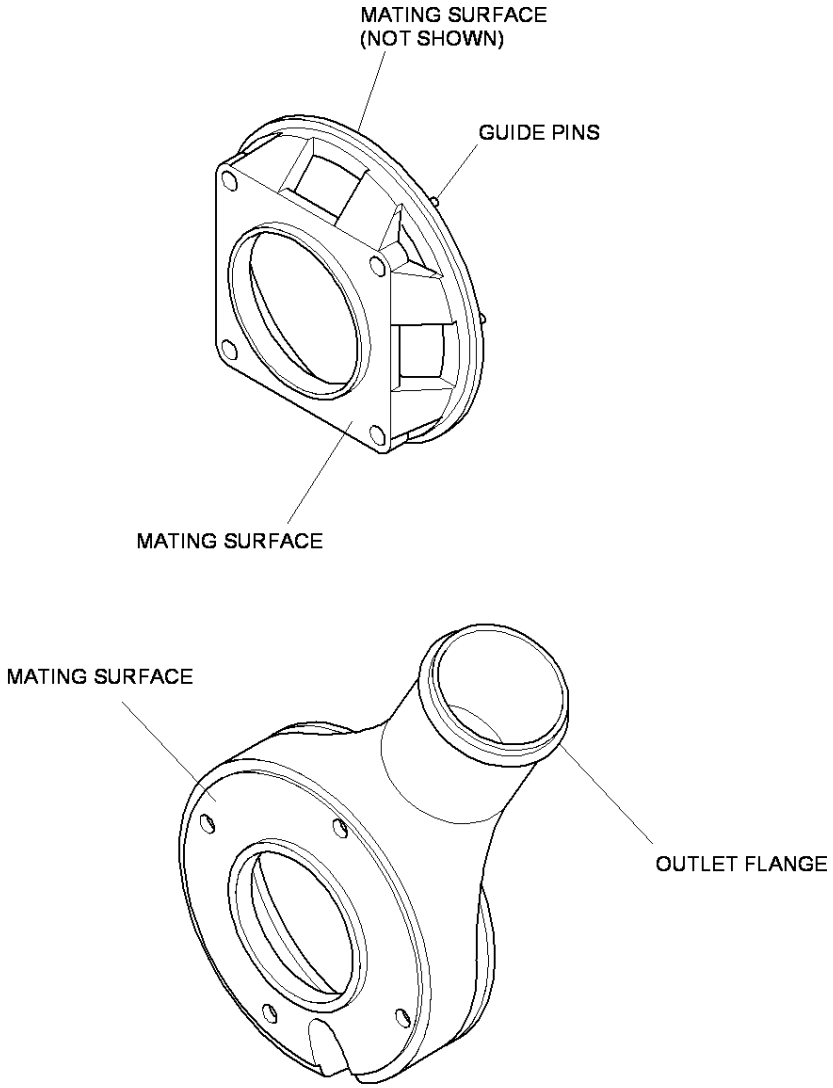


Figure 5001 - Mounting Adapter

C. Identification plate (10). See Figure 5002.

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

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

If damage exists or the information is faded or unreadable:

(a) Retain the original identification plate.

(b) Transfer the information from the original identification plate to a replacement identification plate (10).

(c) DISCARD the original identification plate.

(2) Make sure that the drive screws (20) are tight and in place.

(a) DISCARD loose drive screws (20).

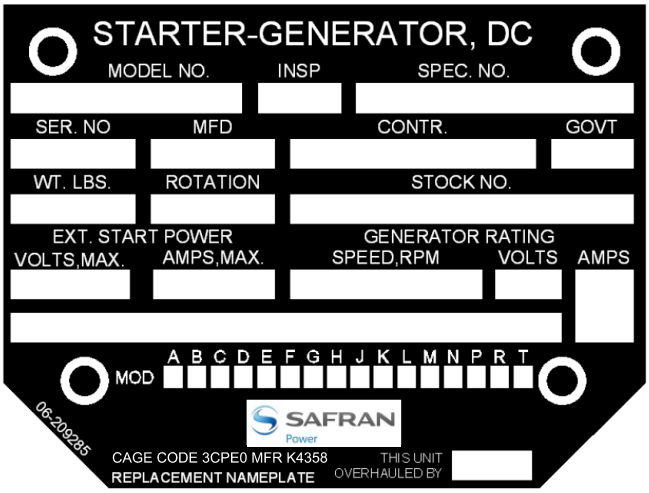


Figure 5002 - Replacement Identification Plate

D. Terminal block cover (50).

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

(a) DISCARD the part if damage exists.

E. Air inlet (70). See Figure 5003.

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

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

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

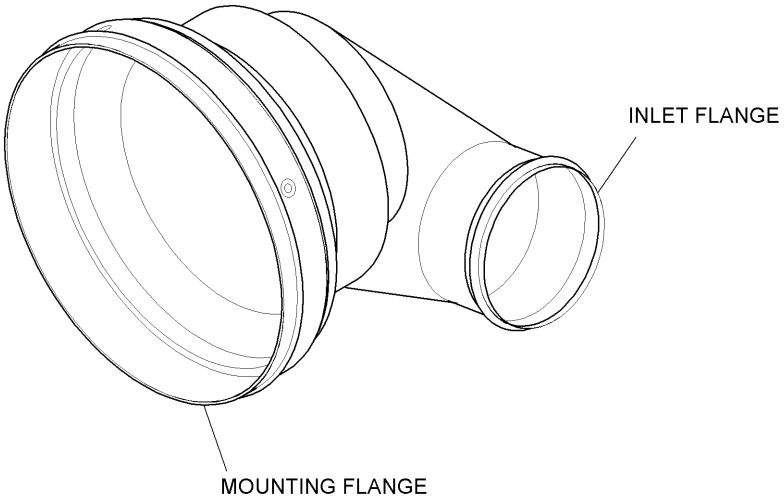


Figure 5003 - Air Inlet

F. Fan cap plug (90).

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

(a) DISCARD the part if damage exists.

G. Fan (100). Figure 5004**.**

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

NOTE: Pay particular attention to the blade edges, inner fan keyway, surfaces and shaft mating surface.

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

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

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

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

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

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

(a) REPLACE if damage is found.

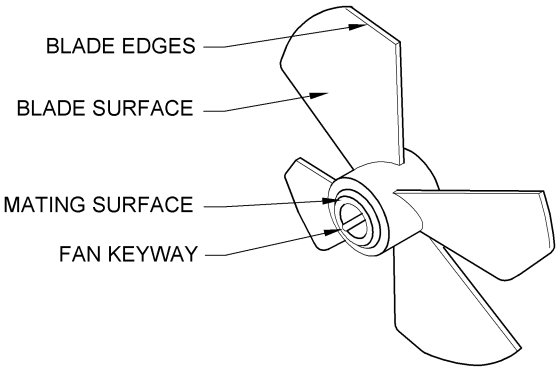


Figure 5004 - Fan

H. Washer assembly (120)

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

(a) REPLACE the part if damage is found.

(2) Examine the bond line of the two parts.

(a) REPLACE the part if the two washers are not firmly attached.

I. Key washer (140)

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

(a) REPLACE the part if cracks are found.

(2) Examine the tangs of the key washer, see Figure 5005.

(a) REPLACE the part if tangs are missing.

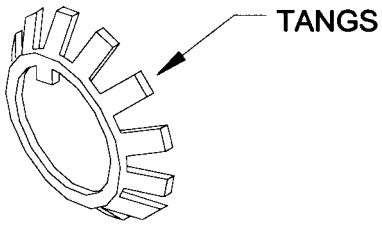


Figure 5005 - Key Washer

J. ADE bearing shield (160). See Figure 5006.

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

(a) DISCARD the part if damaged.

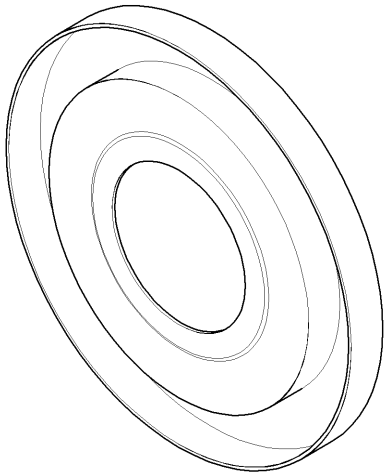


Figure 5006 - Anti-Drive End Bearing Shield

K. Brush access cover (170). See Figure 5007.

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

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

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

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

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

(3) Examine the screw (180) threads IAW the procedures found in Paragraph 3.A.

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

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

(4) Make sure that the blind rivet nut (190) on the bracket is tightly attached.

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

(5) Examine the blind rivet nut (190) threads IAW the procedures found in Paragraph 3.A.

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

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

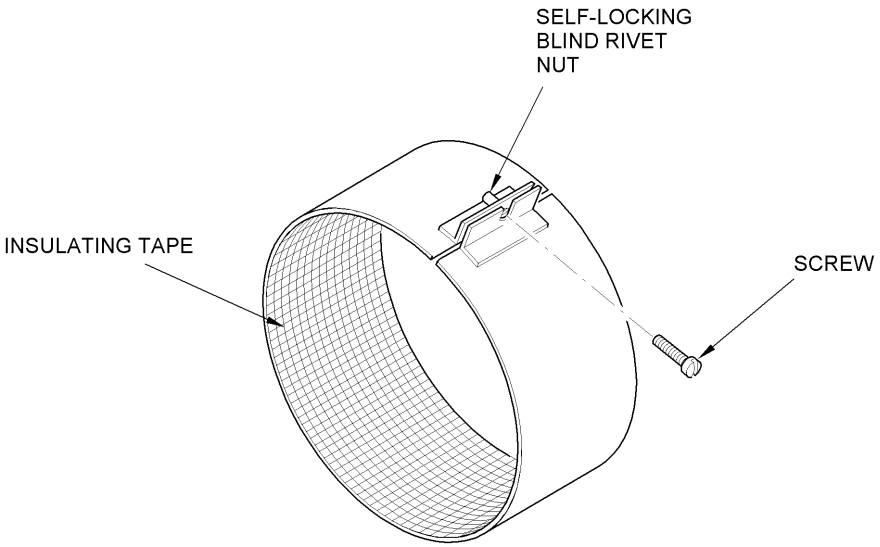


Figure 5007 - Brush Access Cover

L. Brushes (200). See Figure 5008**.**

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.

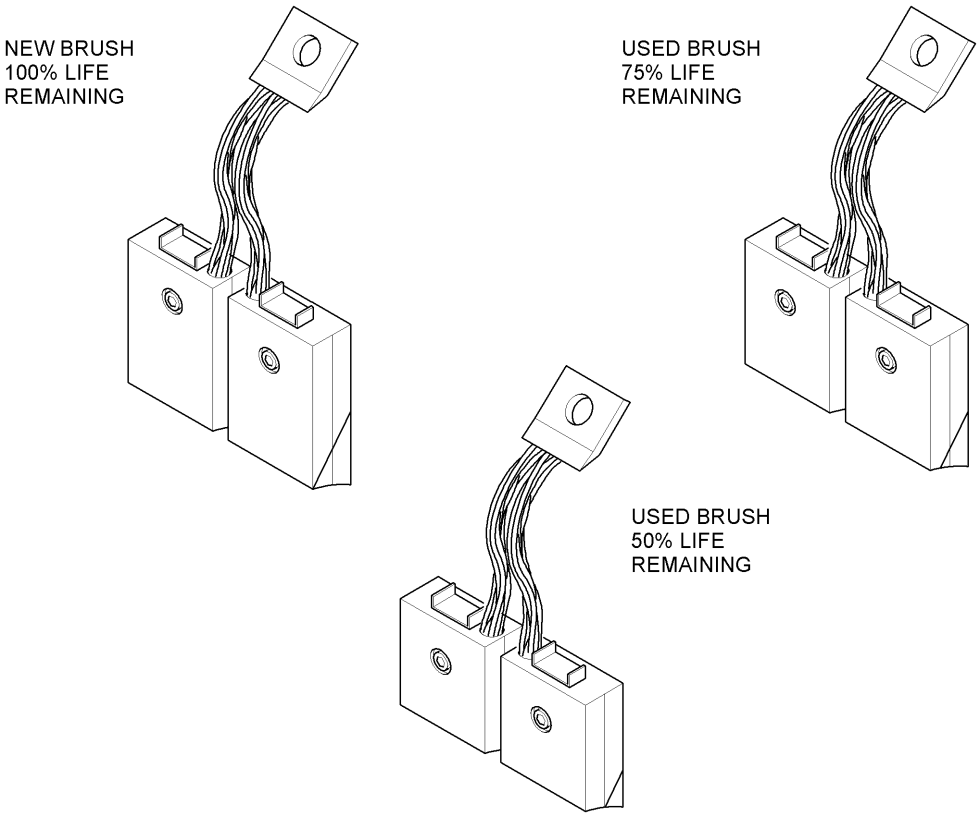


Figure 5008 - Brush Wear (Typical)

M. Drive shaft (220), dampener hub (240) and isolator (270). See Figure 5009.

(1) Examine the drive shaft (220) and dampener hub (240) IAW the procedures found in Paragraph 3.A.

(a) DISASSEMBLE the drive shaft (220) and dampener hub (240) if cracks or thread damage beyond two threads exist.

(b) REPAIR the drive shaft (220) and dampener hub (240) if dents, nicks and scratches exist.

(c) REPAIR the dampener hub if deep scratches or chips are found on the blue Xylan® coated surfaces.

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

(a) DISASSEMBLE drive shaft (220) and dampener hub (240) if damaged.

(b) DISCARD the damaged part.

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

(a) DISASSEMBLE the drive shaft (220) and dampener hub (240) if the diameter is not within the limits in the FITS AND CLEARANCES section.

(b) DISCARD the out of specification part.

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

(a) DISCARD the drive shaft (220) and/or dampener hub (240) if damage is found.

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

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

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

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

(6) Examine the isolator (270) IAW the procedures found in Paragraph 3.A.

(a) DISCARD the part if damage is found.

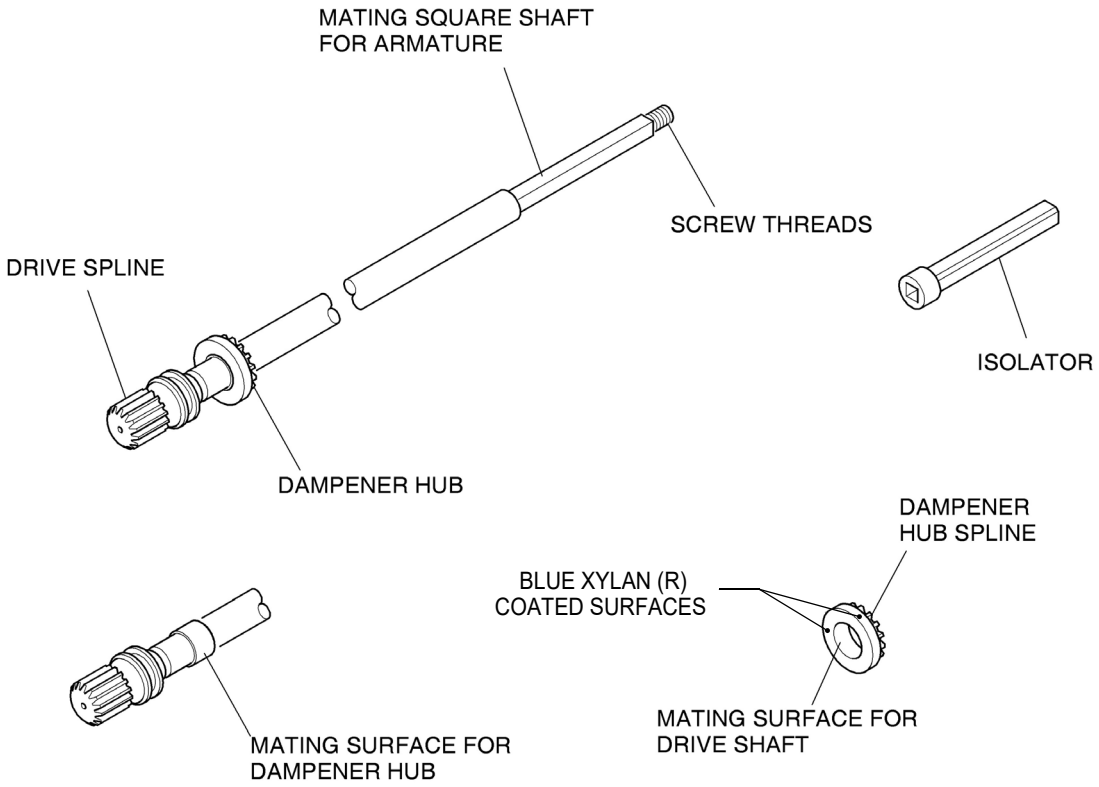


Figure 5009 - Drive Shaft and Dampener Hub

N. Dampener plate (250). See Figure 5010.

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

(a) DISCARD the part if cracks exist.

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

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

(a) DISCARD the part if damaged.

(3) Measure the dampener plate (250) thickness.

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

(4) Use the dampener plate gauge (19-601076) (See Figure 9017) to check the splines of the dampener plate (250), or measure the distance between pins of the spline teeth.

(a) The dampener plate (250) is acceptable if the plate has a tight fit on the dampener plate gauge or does not fit.

(b) The dampener plate (250) must be discarded if the plate fits easily on the dampener plate gauge or is loose.

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

(5) If suspect cracks are found during the visual inspection of the dampener plate, then the dampener plate must be magnetic particle inspected IAW the procedures found in Paragraph 5.A.

(a) Discard the dampener plate, if it does not pass the magnetic particle inspection.

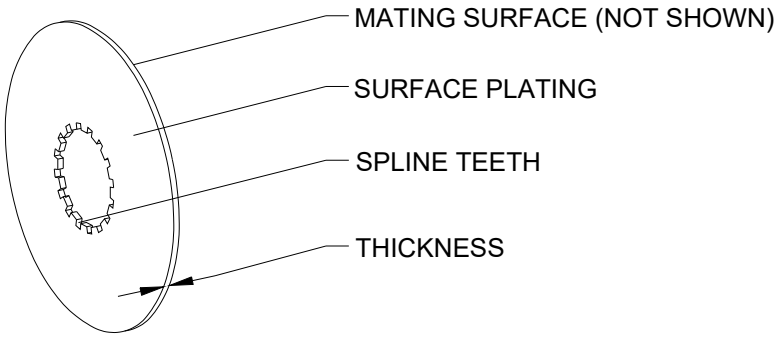


Figure 5010 - Dampener Plate

O. Friction ring (260). See Figure 5011.

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

(a) DISCARD the part if damage is found.

(2) Measure the friction ring (260) thickness.

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

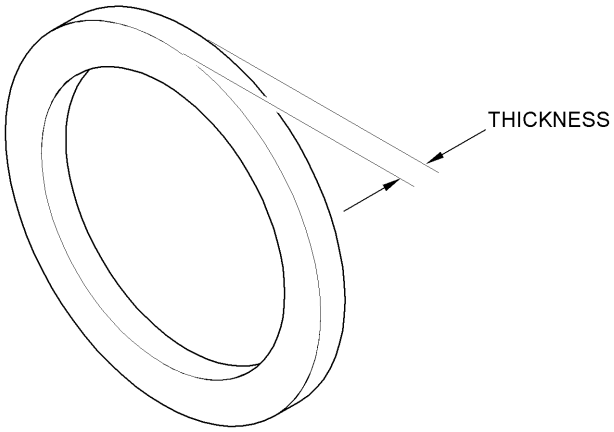


Figure 5011 - Friction Ring

P. Dampener back plate (280). See Figure 5012.

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

(a) DISCARD the part if cracks exist.

(b) REPAIR if minor nicks or scratches exist on the black phosphate coated surfaces.

(c) REPAIR the dampener back plate if deep scratches or chips are found on the blue Xylan® coated surfaces.

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

(2) If suspect cracks are found during the visual inspection of the dampener back plate, then the dampener back plate must be magnetic particle inspected IAW the procedures found in Paragraph 5.A.

(a) Discard the dampener back plate, if it does not pass the magnetic particle inspection.

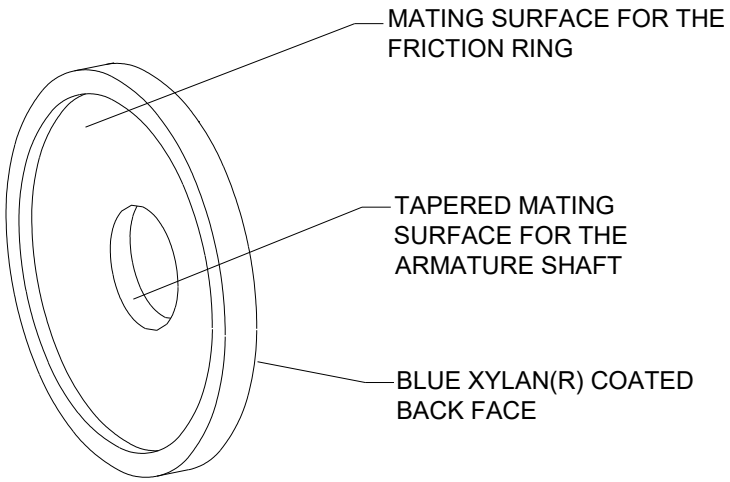


Figure 5012 - Dampener Back Plate

Q. Bearing and brush support assembly (310). See Figure 5013 through Figure 5014.

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

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

(b) REPAIR if minor dents, scratches and nicks or gouging, scoring or glazing on the mating surfaces (marked 1,2,3 and 6 on Figure 5013) are found.

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

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

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

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

(a) REPLACE if damage is found.

(4) Measure bearing liner diameter “A”. See Figure 5013.

(a) DISASSEMBLE the bearing and brush support assembly (310) if damage exists.

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

(5) Examine the helicoil inserts (10002-120, 10002-130) (marked 4 and 5 on Figure 5013) for damage.

(a) REPAIR the part if damage to the helicoil inserts is found.

(6) Visually examine blind rivet nut (10002-140) (marked 7 on Figure 5013) for crossed or stripped threads.

(a) REPAIR the part if damage to the blind rivet nut is found.

(7) Hand tighten a machine screw into the blind rivet nut in each complete brush holder (10002-20) to assure that the self-locking feature is functional. The machine screw should bind in the blind rivet nut before it is fully engaged. Inspect the brush lead terminal board (10002-60) for damage.

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

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

(c) REPAIR the complete brush holder (10002-20) if the brush lead terminal board is damaged.

(8) Examine the brush holders (10002-90), including the brush spring supports and center supports for cracks, warping, and discoloration caused by electrical arcing. Inspect the insulation sheets (10002-80) for damage.

(a) DISCARD the complete brush holder (10002-20) if damage to the brush holder exists.

(b) REPAIR the complete brush holder (10002-20) if the insulation sheet is damaged.

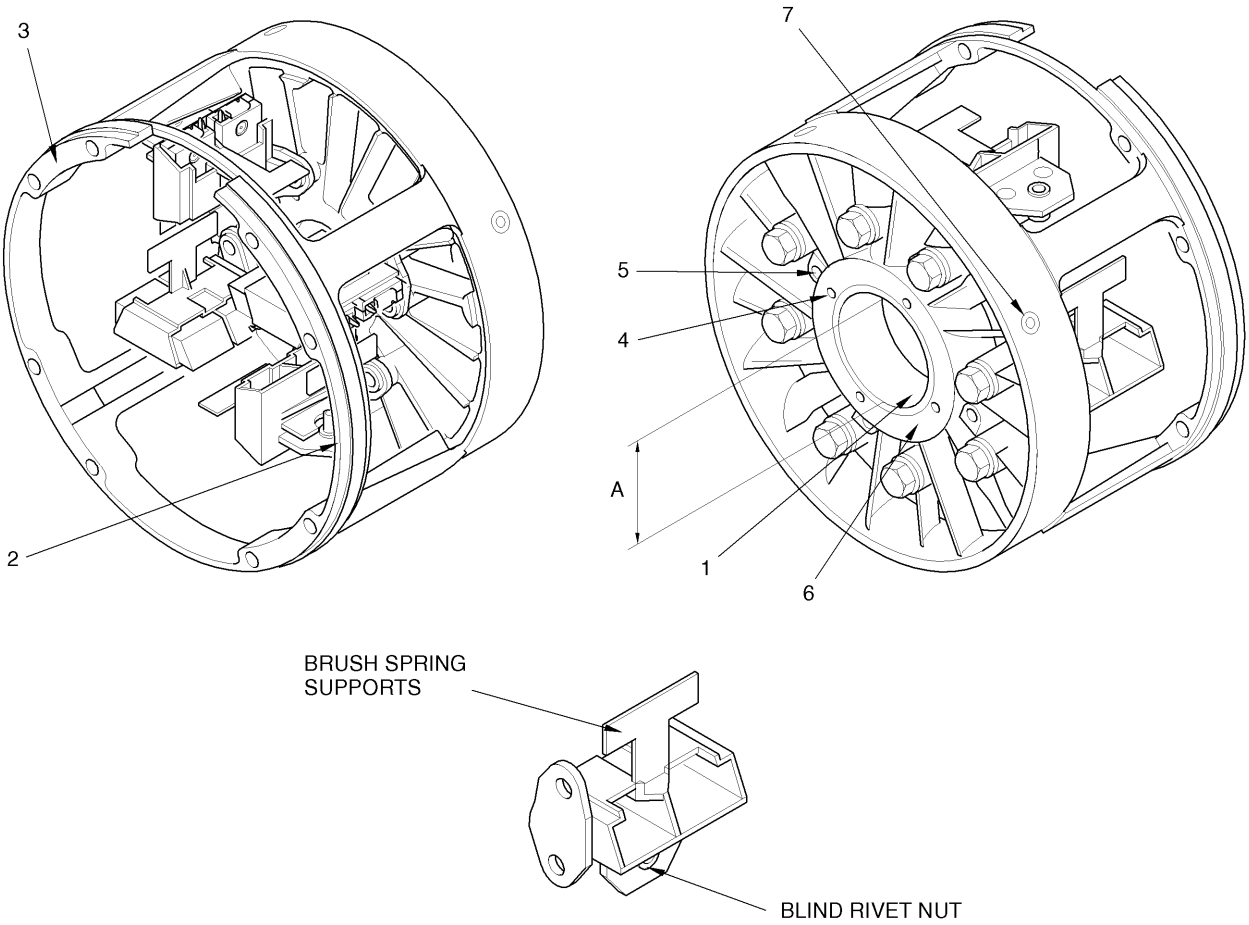


Figure 5013 - Bearing and Brush Support Assembly

(9) Measure the capacitor capacitance value on each filter assembly (10002-150) at a frequency of 900 to 1100 Hz, 77° F (25° C).

(a) DISCARD the filter assembly (10002-150) if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

(10) Measure brush spring (10002-10) force using pull scale with harness. See Figure 5014.

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

(a) Take six measurements.

(b) Calculate an average from the measurements.

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

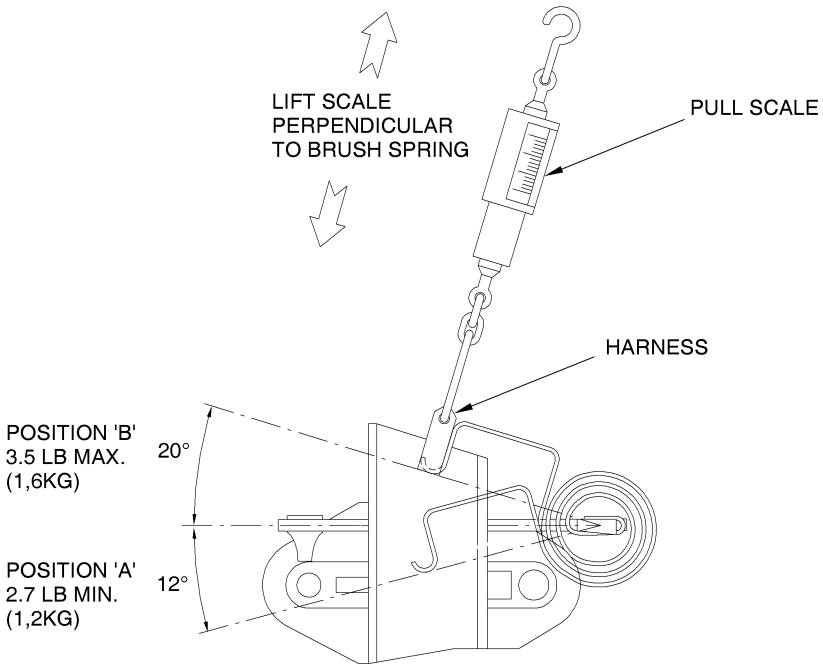


Figure 5014 - Determine Spring Force

(11) Perform a dielectric test.

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

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

CAUTION: BEARING AND BRUSH SUPPORT ASSEMBLY (310) MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

CAUTION: MAKE SURE FILTER ASSEMBLY LEADS ARE ISOLATED FROM FRAME OF STARTER-GENERATOR.

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

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

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

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

(e) Turn high potential tester power OFF.

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

(g) Acceptance Limits:

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

If bearing and brush support assembly (310) fails dielectric test, clean bearing and brush support assembly, and repeat dielectric test.

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

If bearing and brush support assembly (310) fails dielectric test, replace bearing and brush support assembly.

R. Drive end bearing support assembly (370). See Figure 5015.

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

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

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

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

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

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

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

(a) REPLACE if damage is found.

(4) Measure bearing liner diameter “A”. See Figure 5015.

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

(5) Examine guard screen (10003-10) for tears.

(a) DISASSEMBLE drive end bearing support assembly (370) if damage is found.

(b) DISCARD drive screws (10003-20), flat washers (10003-30) and damaged guard screen (10003-10).

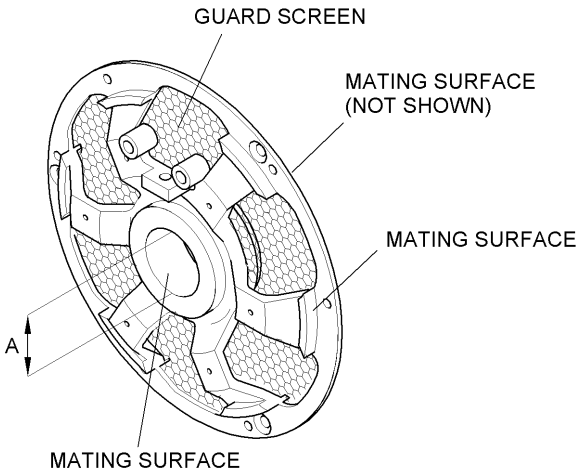


Figure 5015 - Drive End Bearing Support Assembly

S. Spring wave washer (390). See Figure 5016.

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

(a) DISCARD the spring wave washer (390) 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 5016.

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

Free Height (H_F)	Compressed Height (H_C)	Acceptance Limits
0.125 inch (3,18 mm)	0.062 inch (1,58 mm)	27 to 35 lbs (12,2 to 15,9 kg)

Table 5002 - Spring Wave Washer inspection

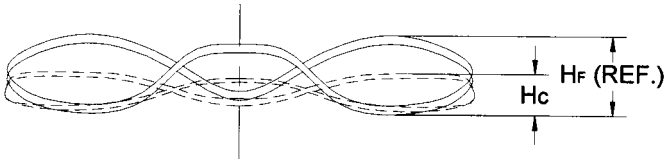


Figure 5016 - Spring Wave Washer Load Inspection

T. Armature (430). See Figure 5017.

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

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

(a) REPLACE armature (430) 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) Perform a visual inspection of the armature shaft surfaces IAW the procedures found in Paragraph 3.A.

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

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

(3) Measure bearing journal diameters, A and C, as shown in Figure 5017.

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

(b) REPLACE armature if damage is not repairable.

(4) Measure commutator diameter B, as shown in Figure 5017.

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

(5) Examine internal square spline for rounding or uneven wear.

(a) Check the drive shaft (220) square cross-section for too much wear by engaging a new drive shaft (with isolator (270)) into the armature internal drive spline.

1 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.

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

(a) REPLACE armature if damaged.

(7) Examine commutator bars for burning and discoloration.

(a) REPAIR commutator if damaged.

(b) REPLACE armature if damage is not repairable.

(8) Measure commutator undercut.

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

(b) REPLACE armature if damage is not repairable.

(9) 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 (430) if a short exists.

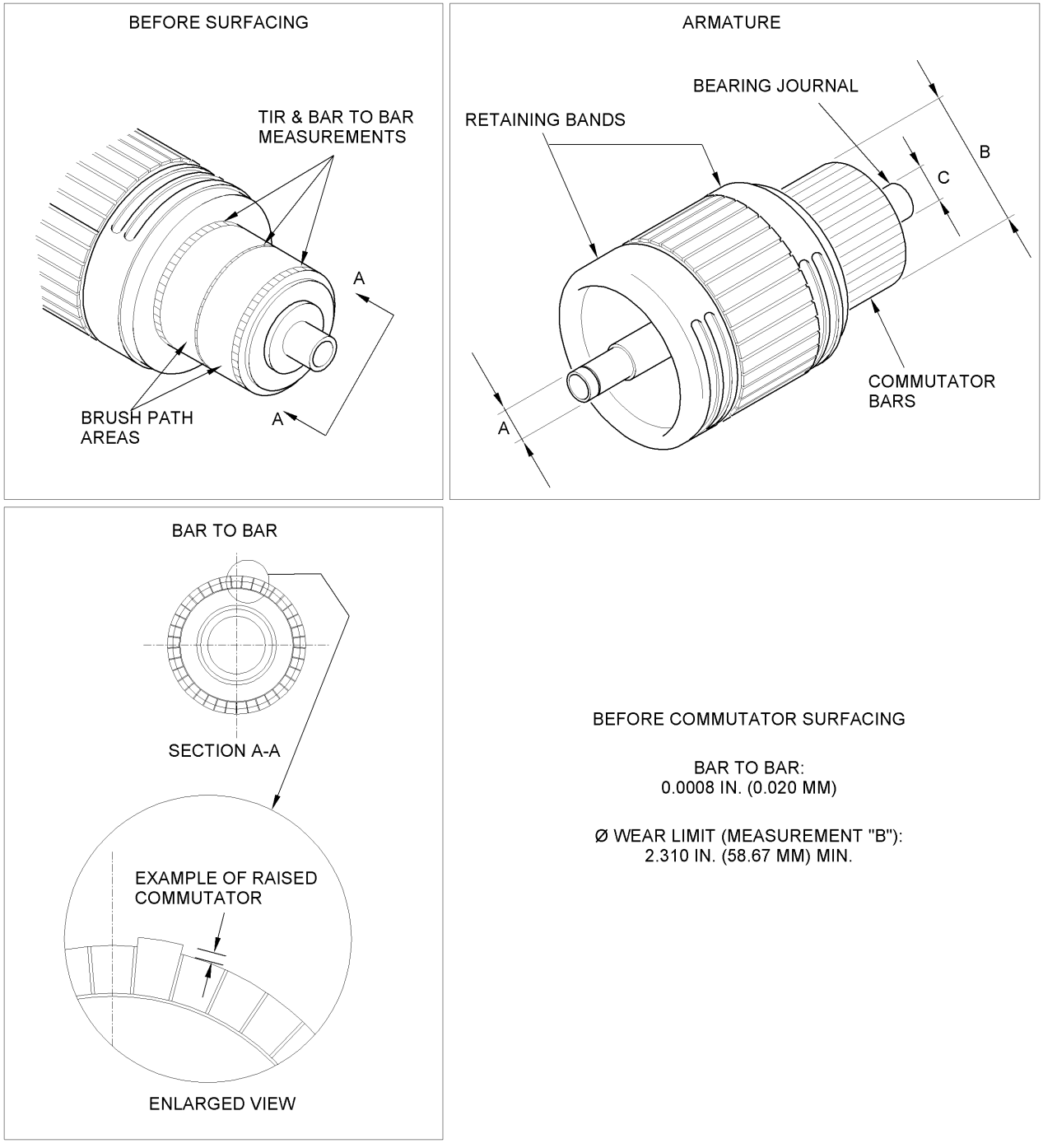


Figure 5017 - Armature Check

U. Do a dielectric test on the armature.

WARNING: **BEFORE YOU OPERATE 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. THESE PRECAUTIONS PREVENT POSSIBLE DEATH OR INJURY FROM ELECTRIC SHOCK.**

CAUTION: YOU CAN CAUSE SERIOUS DAMAGE TO THE ARMATURE IF YOU DO NOT TURN OFF THE HIGH POTENTIAL TESTER BEFORE YOU CONNECT THE HIGH VOLTAGE ELECTRICAL LEADS.

CAUTION: THE ARMATURE MUST BE FULLY CLEANED BEFORE YOU DO A DIELECTRIC TEST.

(1) Set the power to the OFF position. Connect the positive test lead of the high potential tester to a commutator riser.

(2) Set the power to the OFF position. Put the negative test lead on the armature shaft.

(3) Set the high potential tester output voltage to 0. Turn the power to the ON position.

CAUTION: INCREASE AND DECREASE TEST VOLTAGES SLOWLY (100 VOLTS PER SECOND, MAXIMUM). IF THE VOLTAGE IS INCREASED AND/OR DECREASED TOO QUICKLY IT CAN CAUSE DAMAGE TO THE ARMATURE.

(4) At a rate that is not more than 100 V/sec., slowly adjust the output voltage to 250 V RMS, commercial frequency for 1 minute. Slowly decrease the voltage back to 0.

(5) Turn high potential tester power to the OFF position.

(6) Remove negative test lead.

(7) Keep the positive test lead connected to the commutator.

(8) Connect the negative lead to the drive end retaining band.

(9) Do the dielectric test again between the retaining band and commutator riser.

(10) Turn high potential tester power to the OFF position.

(11) Remove negative test lead.

(12) Keep the positive test lead connected to the commutator.

(13) Connect the negative lead to the anti-drive end retaining band.

(14) Do the dielectric test again between retaining band and commutator riser.

(15) Turn high potential tester power to the OFF position.

(16) Disconnect all test leads.

(17) Acceptance limits:

(a) There must not be indication of moist, dirty, weak or defective components. An indication is flash-over (surface discharge), spark-over (air discharge) or breakdown (puncture discharge). The leakage current must not be more than 2 mA.

(b) If the armature does not pass the acceptance limits, clean the armature and do the test again.

(c) If the armature does not pass the acceptance limits of the dielectric test after cleaning, replace the armature.

V. Bearing retainer (450). See Figure 5018.

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

(a) DISCARD the part if damaged.

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

(a) DISCARD the part if damaged.

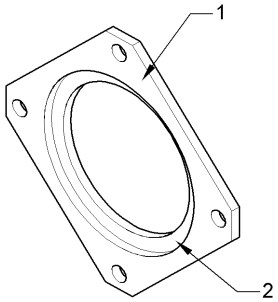


Figure 5018 - Bearing Retainer

W. Drive end bearing shield (470) and spacer (300). See Figure 5019.

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

(a) DISCARD the part if damaged.

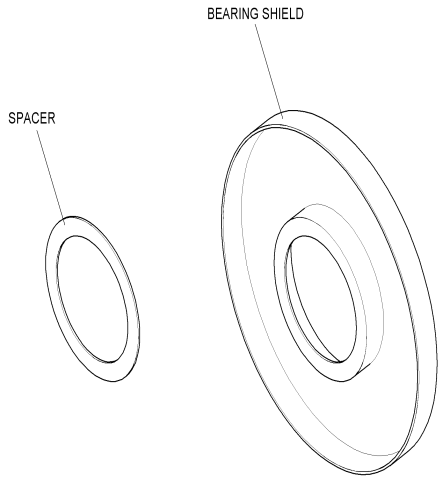


Figure 5019 - Spacer and Bearing Shield

X. Stator assembly (480). See Figure 5020.

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

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

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

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

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

(d) REPAIR the part if other damage exists.

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

(a) If brush lead damage is more than 5 percent of the brush lead, REPLACE the stator assembly (480).

(b) If stator lead damage is found, REPLACE the stator assembly (480).

(3) Perform a dielectric test.

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

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

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

(a) Jumper all stator leads together.

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

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

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

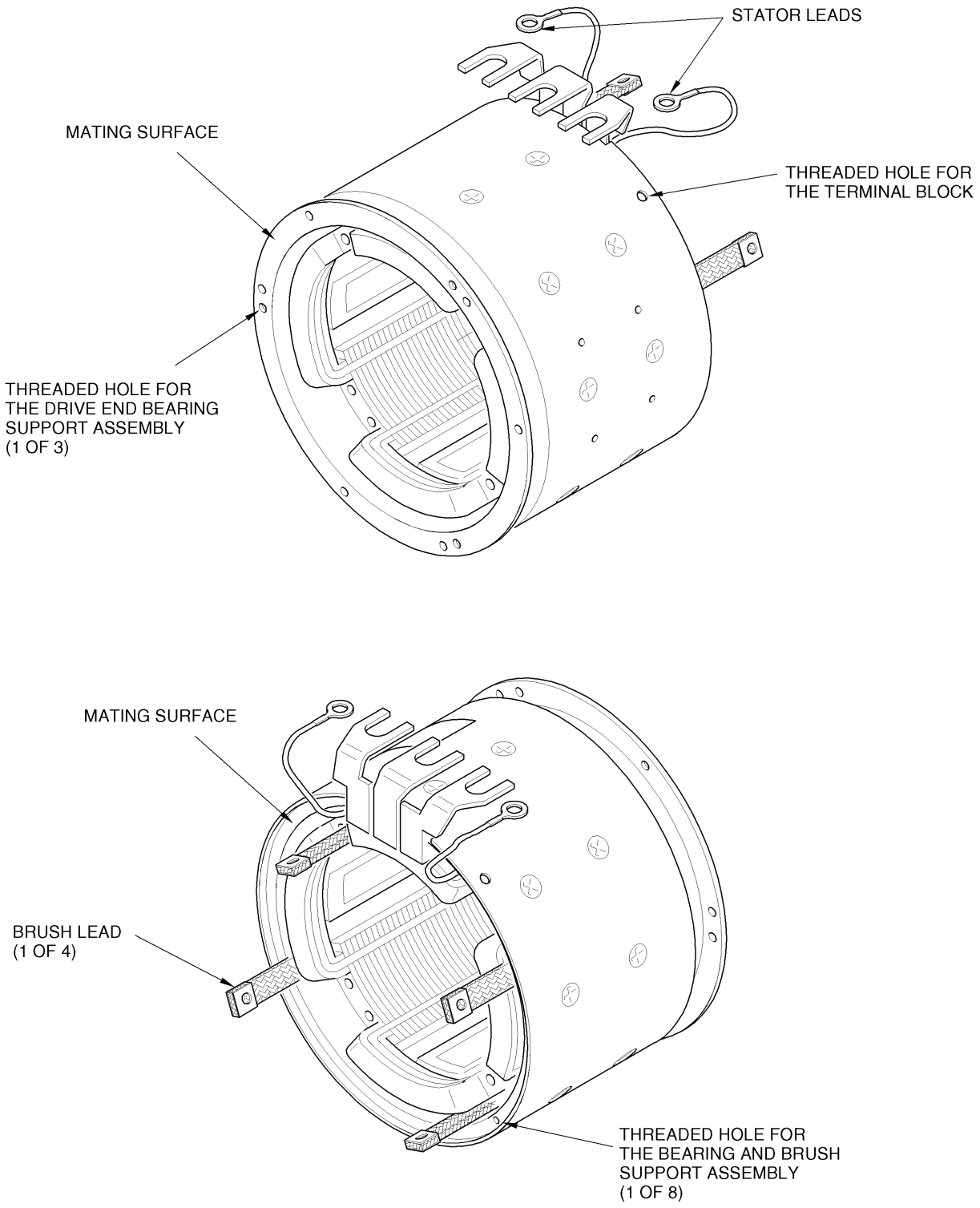


Figure 5020 - Stator Assembly

(e) At a rate not to be more than 100 V/sec., slowly adjust output voltage to 250 VAC 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 Arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current that is more than 2mA is evidence of damp, dirty, weak or defective components and constitutes a failure.

If stator assembly (480) fails dielectric test, clean stator and housing assembly and repeat dielectric test.

2 If stator assembly (480) fails dielectric test after cleaning, replace stator and housing assembly.

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

(a) REPLACE the stator assembly (480) if an open circuit exists.

Y. Terminal block (10004-50). See Figure 5021**.**

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

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

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

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

(c) DISCARD the terminal block (10004-50) if thread damage of more than two turns exists.

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

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

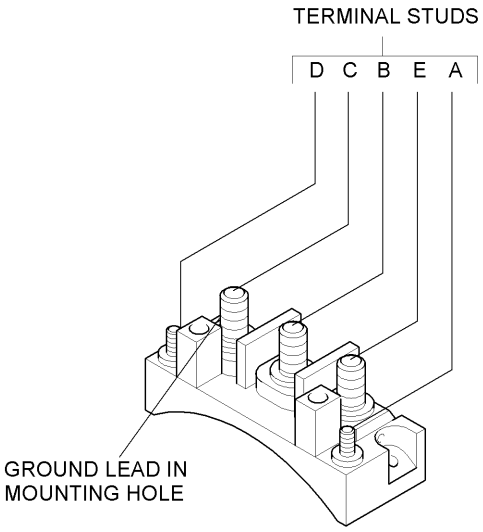


Figure 5021 - Terminal Block

9. Terminology

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

Term	Definition	Probable Cause
Corrosion	The chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.	Environmental condition that causes deterioration.
Crack	A break in material.	Severe stress from overload or shock; possible extension of a scratch.
Dent	A small, smoothly rounded depression.	A sharp blow or too much 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.

Table 5003 - Terminology

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

Table 5003 - Terminology (Continued)

REPAIR

1. Introduction

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

Repairs are limited to:

- Repairing damaged surfaces
- Repairing damaged threads
- Replacing helical coil inserts
- Bearing liner and journal overhaul
- Commutator refinishing
- Armature balancing
- Restoring surface coatings of parts and assemblies
- Restoring the blue Xylan® coating on the dampener back plate and hub
- Correcting output voltage polarity
- Replacing brush access cover insulating tape
- Replacing brush access cover self-locking blind rivet nut
- Repair of complete brush holder
- Replacing rivet nut in anti-drive end end bell
- Repair and replacement of QAD mounting adapter guide pins

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

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

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

2. Repair Tools

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

Tools	Reference
Commutator Turning Fixture	Figure 9004
Crimp Tool	Commercially Available
Bump Switch (Flash Field Switch)	Rating: 30 VDC, 10 A
Helicoil Insert Removal and Installation Tool	Commercially Available
India Stone	Commercially Available
PlusNut® Fastener Headers P/N C1000-832 P/N C1000-1032	Figure 9014
Rivet Alignment and Press Fixture	Figure 9005
6 V Battery or Equivalent DC Power Source	Commercially Available
Thread Chasers	Commercially Available
Torque Wrench	Commercially Available
V-blocks	Commercially Available

Table 6001 - Repair Tools

3. Repair Materials

WARNING: YOU MUST OBEY THE MATERIAL/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.

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

NOTE: Repair materials are not available from Safran Power. All items can be purchased commercially.

Item	Description/Material Specification	Source
Chemical Film Solution Alodine 1200	Chemical Film Solution MIL-C-5541, Class 1A or Class 3	Henkel Surface Technology Madison Heights, MI 48071-0000 www.hstna.com (V1N6B3)
Coating, Xylan	Xylan® 1014DF Product Code: P01931E 524 Deep Medium Blue	Whitford Corporation P.O.Box 80 Elverson, PA 19520 Ph: 610.286.3500 Fax: 610.286.3510 sales@whitfordww.com
Coating, Zinc Phosphate	TT-C-490, Type 1	Commercially Available
Isopropyl Alcohol	TT-I-735, Grade A See **WARNING** before using this material. Flash Point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available
Oil, Machine	N/A	Commercially Available
Pads, Cleaning	Lint-free cotton	Commercially available
Primer, Zinc Chromate	TT-P-1757 Composition G, Color Yellow.	Commercially Available
Abrasive paper	400/600 grit (non-aluminum oxide only)	Commercially Available

Table 6002 - Repair Materials

Item	Description/Material Specification	Source
Tape, Insulating	P/N SG13-06R 8 mil, PTFE coated fiberglass, acrylic adhesive	Philpott Brunswick, Ohio www.philpottrubber.com (V1T7E9)
Primer	Activator, Adhesive Sealant ASTM D5363, AN0321	Loctite Corp. Hartford, CT United States
Retaining Adhesive	Loctite® 648	Loctite Corp. Rocky Hill, CT United States

Table 6002 - Repair Materials (Continued)

4. Surface Repair

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

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

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

5. Thread Repair

A. Repair damaged threads as follows:

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

(1) Use thread chaser to repair damaged threads.

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

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

6. Helical Coil Insert Replacement

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

A. Remove and replace damaged helical coil inserts (120 and 130) as needed.

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

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

WARNING: **ZINC CHROMATE PRIMERS 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 ZINC CHROMATE PRIMER, PUT ON A RESPIRATOR, RUBBER APRON, RUBBER GLOVES AND EYE PROTECTION. THIS WILL PREVENT INJURY FROM SPILLS AND FROM THE FUMES.**

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

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

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

(5) Break off helical coil insert installation tang.

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.**

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

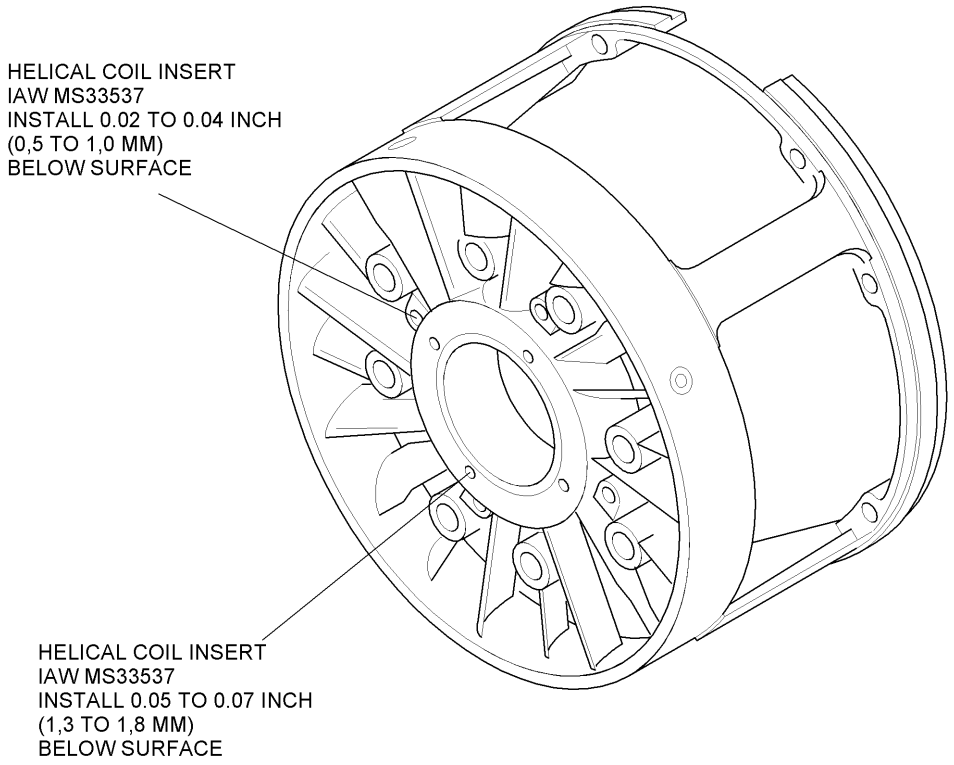


Figure 6001 - Helical Coil Insert Replacement

7. Bearing Journal and Liner Restoration

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 in Figure 6002 and Figure 6003 must be reworked, or replaced.

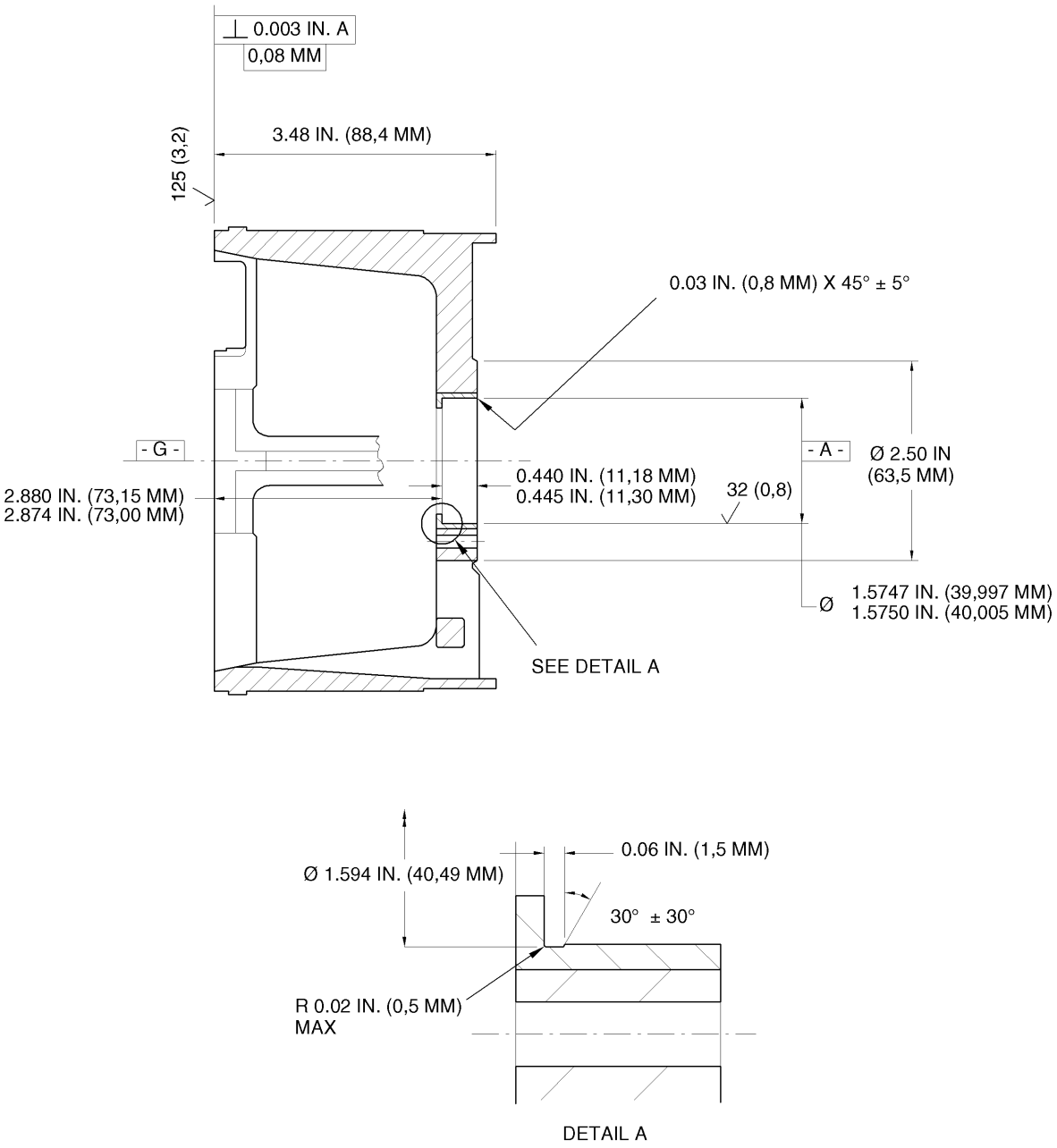


Figure 6002 - Anti-Drive End End Bell Dimensions

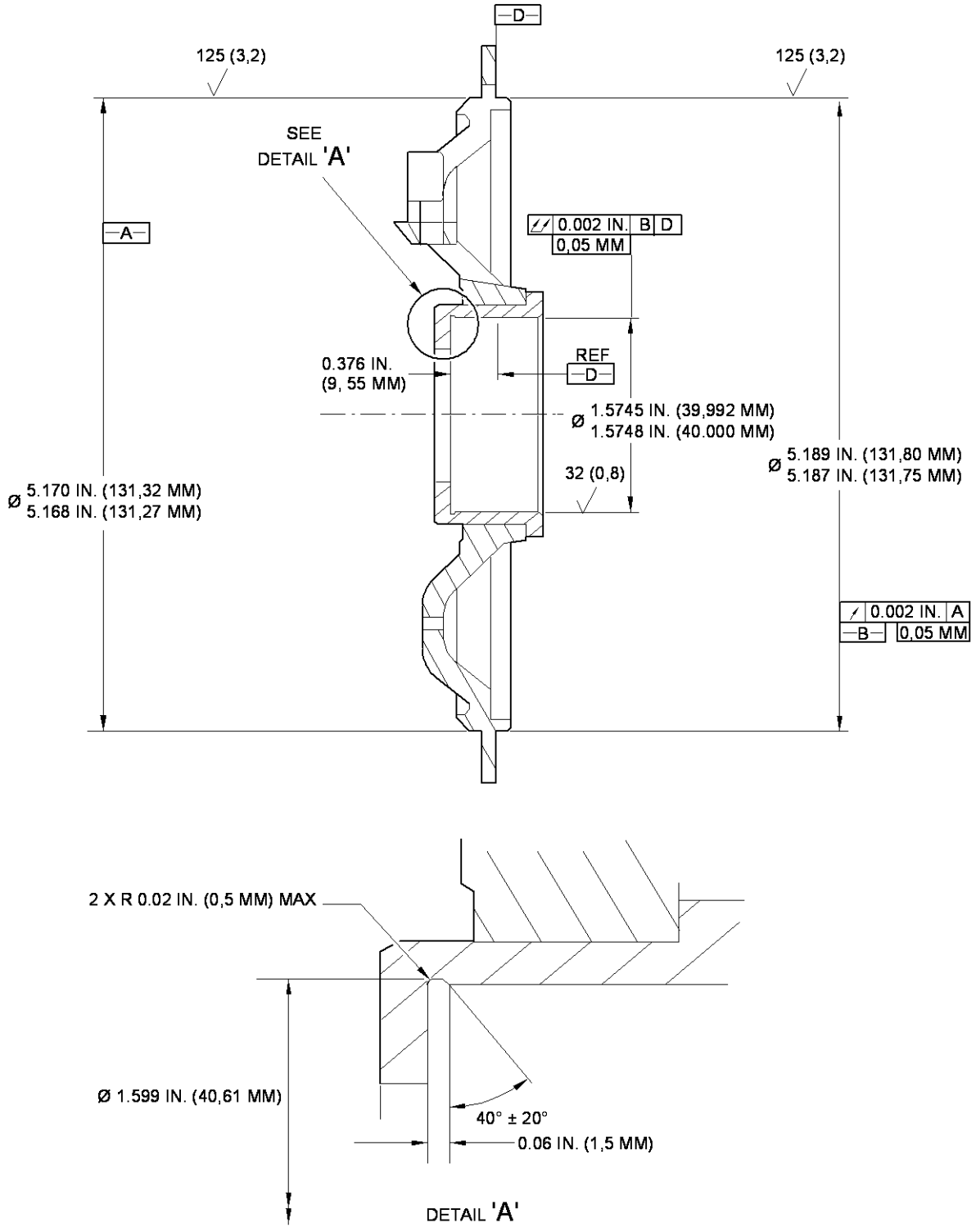


Figure 6003 - Drive End End Bell Dimensions

8. Commutator Refinishing

NOTE: Numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST, 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 (440) into the commutator turning fixture.

(2) Position the drive end of the armature (430) shaft at the lathe chucking head and the commutator turning fixture in a tail stock.

(3) Insert the commutator end of the armature (430) into the commutator turning fixture.

B. Repair Procedure. See Figure 6004.

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

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

(1) Cut the commutator to a surface finish of 64 to 100 microinches (1,6 to 2,5 microns) RMS. The finish surface must extend from the end of the full undercut to within 0 to 0.060 inches (0 to 1,5 mm) of the outboard end of the commutator.

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

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

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

(2) Clean the armature (430) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

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

(4) If the undercut is out of limits, use a 0.31 to 0.50 inch (7,9 to 12,7 mm) diameter cutter wheel to undercut the mica to a depth of 0.050 to 0.070 inch (1,27 to 1,78 mm) and a width of 0.040 to 0.050 inch (1,02 to 1,27 mm).

(a) The beginning of mica undercut must be from 0.01 to 0.03 inch (0,25 to 0,76 mm) max. from the finished face of the risers.

(b) 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.

(c) All mica must be removed from the edges of the undercut.

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

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

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

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

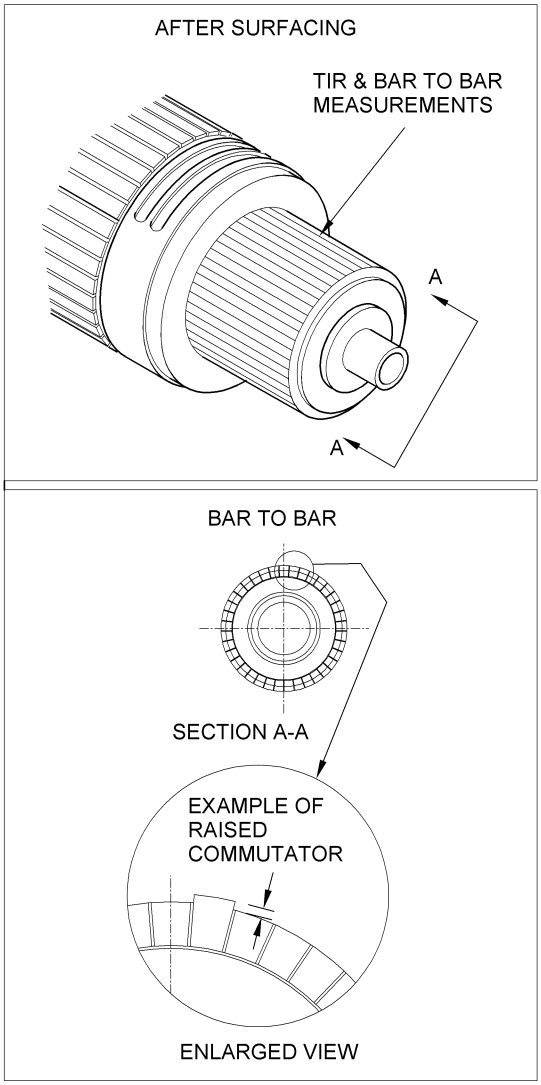
(7) Clean the armature (430) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(8) After the commutator is refinished:

(a) Measure the commutator bar-to-bar and total indicator reading (TIR) run-out in full circumference of the commutator. Support the armature (430) on two V-blocks.

(b) Make sure that the armature (430) is balanced IAW procedures found in Paragraph 9.

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



AFTER COMMUTATOR SURFACING

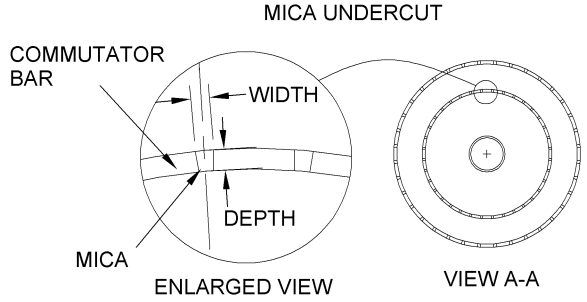
BAR TO BAR:
0.0001 IN. (0.003 MM)

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

MICA UNDERCUT:
DEPTH: 0.050 MIN. to 0.070 IN. (1.27 TO 1.78 MM) MAX.
WIDTH: 0.040 TO 0.050 IN. (1.02 TO 1.27 MM) MAX.

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

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



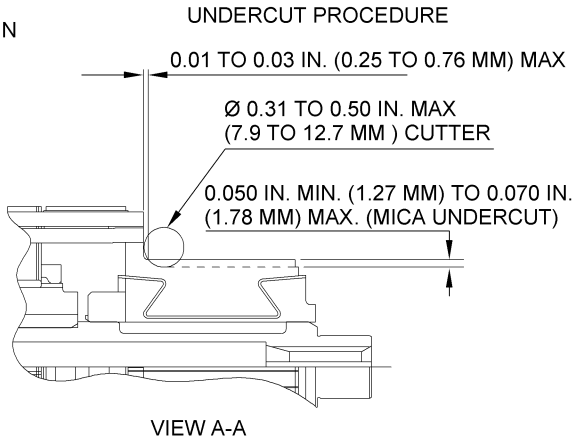


Figure 6004 - Armature Repair

9. Balancing the Armature

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

Balance the armature (430) to the requirements listed in the FITS AND CLEARANCES section of this CMM according to the procedure in SPD 1001.

10. Restoring the Surface Coatings of Parts and Assemblies

A. Removal of surface coatings.

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

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

B. Restoration of surface coatings.

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

Clean all parts. Refer to CLEANING section of this CMM.

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

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

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

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

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Item Number	Nomenclature	Process	Coating Repair
10005-40	Mounting Adapter	Refinish	Chemical Film touch-up IAW MIL-C-5541, Class 3
10001-70	Air Inlet	Refinish	Chemical Film touch-up or Wash Primer and touch up paint
10001-170	Brush Access Cover	Refinish	Chemical Film touch-up or Wash Primer and touch up paint
10001-280	Dampener Back Plate See Paragraph 10.C. for blue Xylan® coated surface	Refinish phosphate	Re-phosphate IAW TT-C-490 or Phosphate touch-up
10001-480	Stator and Housing Assembly	Refinish	Chemical Film touch-up or Wash Primer and touch up paint
10002-110	Anti-drive end end bell	Refinish	Chemical Film touch-up IAW MIL-C-5541, Class 3
10003-10	Guard Screen	Refinish Chem Film	Chemical Film touch-up IAW MIL-C-5541, Class 1A
10003-40	Drive end end bell	Refinish	Chemical Film touch-up IAW MIL-C-5541, Class 3

Table 6003 - Refinishing Procedures

C. Restoration of the blue Xylan® coating on the dampener hub (10001-240) and dampener back plate (10001-280). See Figure 6005.

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.

(1) Clean the surface of the dampener back plate (10001-280) or dampener hub (10001-240) using isopropyl alcohol.

WARNING: BEFORE YOU USE XYLAN®, MAKE SURE TO PUT ON A RESPIRATOR, RUBBER APRON, RUBBER GLOVES AND EYE PROTECTION. THIS WILL PREVENT INJURY FROM SPILLS, VAPOR INHALATION, SKIN AND EYE IRRITATION.

(2) Following the manufacturers recommendations for Xylan®, touch up any areas that were scratched or chipped and as follows:

(a) Mix the Xylan® coating in its container thoroughly by shaking or stirring.

(b) At ambient room temperature, use a soft bristle brush to apply the Xylan® coating as shown in Figure 6005.

1 The coating must have a thickness from 0.0005 to 0.0020 in. (0,013 to 0,05 mm).

NOTE: The coating might need applied in two or three passes to achieve a uniform coating.

2 The coating must be uniform in color, free from runs and blisters.

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

(3) Let the Xylan® cure in an air circulated oven at a temperature of 400 to 420°F (204° to 216° C) for 25 to 30 minutes.

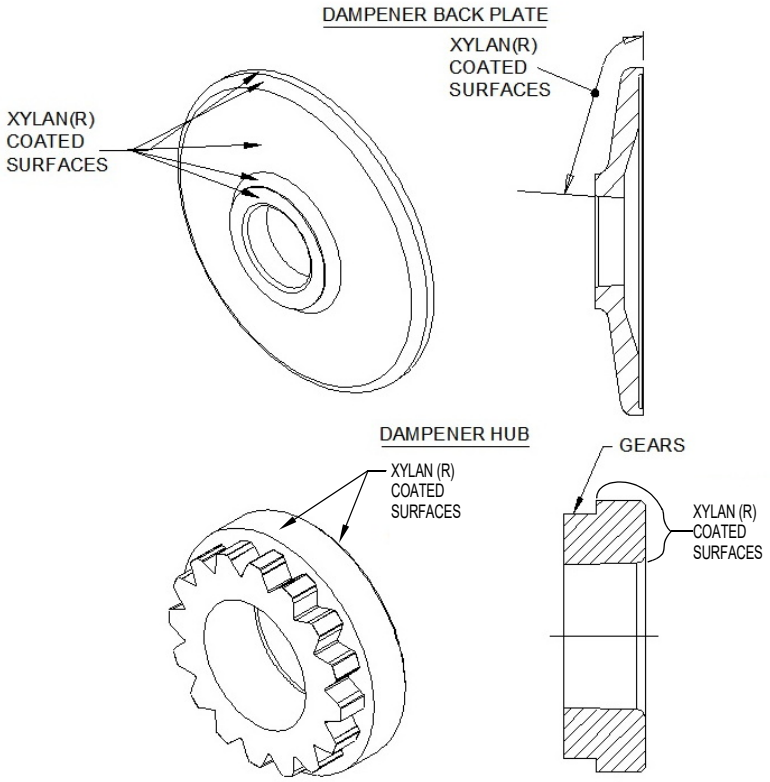


Figure 6005 - Restoration of the Blue Xylan® Coating on the Dampener Back Plate or Hub

11. Polarizing the Output Voltage

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

A. Setup

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

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

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

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

B. Procedure

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

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

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

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

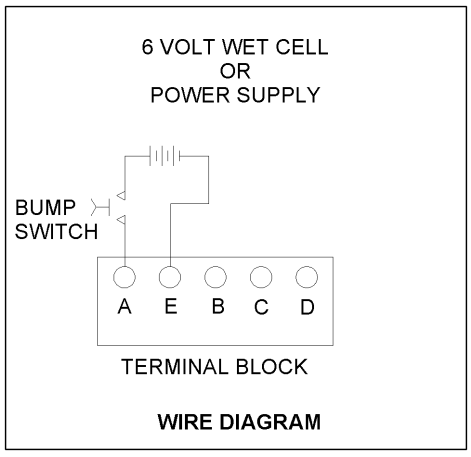


Figure 6006 - Terminal Block Schematic for Polarizing the Output Voltage

12. Brush Access Cover

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

A. Repair the brush access cover (170) as follows:

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

(a) Remove all signs of the insulating tape and clean the inside surface of the brush access cover (170). Refer to the CLEANING section.

(b) If the plating on the inner surface of the brush access cover (170) is damaged, coat the surface IAW the instructions in Paragraph 10.

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

(d) Starting at one of the two sides of the brush access cover (170), line up the sides of the roll with the side of the brush access cover.

(e) Apply the insulating tape directly from the roll to the inner surfaces of the brush access cover (170).

NOTE: Installed insulating tape must be within 0.06 inch (1,5 mm) of the brush access cover (170), edges and ends. The insulating tape can overlap the brush access cover (170) edges by 0.02 inch (0,5 mm) on one side only. However, overlap is not permitted at the brush access cover (170) ends.

(f) Cut off unwanted insulating tape at the brush access cover (170) ends.

(2) Replace self-locking blind rivet nut (190) as follows. See Figure 6007.

(a) Remove self-locking blind rivet nut (190) from brush access cover (170) by drilling a 0.250 inch (6,35 mm) hole through self-locking blind rivet nut (190). The inboard and outboard sides of self-locking blind rivet nut (190) should become loose and fall off.

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

(b) Turn 1/2 inch nut in a counterclockwise direction until stud is fully extended. Engage all threads on stud in self-locking blind rivet nut (190) until nut is tight against tool face.

(c) Insert fastener header tool into hole in brush access cover (170).

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

NOTE: Do not overtighten self-locking blind rivet nut (190). Over-tightening can cause damage to threads.

(e) Turn nut until firm resistance is felt. Self-locking blind rivet nut (190) should be physically reformed. If self-locking blind rivet nut (190) is loose, tighten nut until self-locking blind rivet nut (190) is secure. Loosen nut by turning counterclockwise.

(f) Remove fastener header tool from self-locking blind rivet nut (190) by turning counterclockwise.

(g) Torque test self-locking blind rivet nut (190) to 60 lbf.in. (6,8 N·m).

(h) If the plating on the outer surface of the blind rivet nut (190) is damaged, coat the surface IAW the instructions in Paragraph 10.

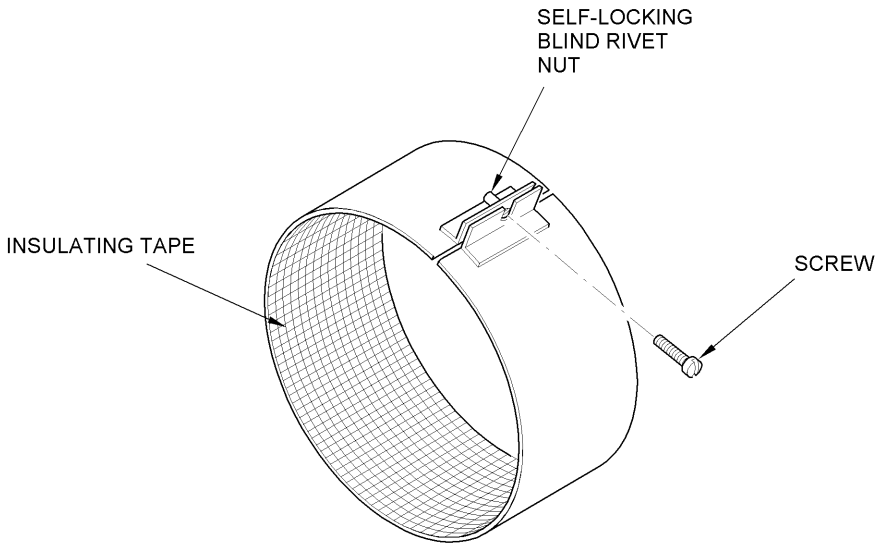


Figure 6007 - Brush Access Cover

13. Repair of the Complete Brush Holder

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

A. Repair the complete brush holder (20) as follows:

(1) Disassembly of complete brush holder (20).

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

(b) Remove and discard brush lead terminal board (60) and insulation sheet (80).

(c) Repeat Paragraph 13.A.(1)(a) and Paragraph 13.A.(1)(b) for each brush holder (20).

(2) Assembly of complete brush holder (20). See Figure 6008.

(a) Secure rivet alignment fixture to press table.

(b) Secure rivet press tool to arbor press.

(c) Place insulation sheet (80) and brush lead terminal board (60) onto the brush holder (90) and insert two rivets (70) through the holes.

NOTE: When parts are correctly aligned, the section of insulation sheet (80) which extends outside the brush lead terminal board (60) will fold up against the brush holder (90).

(d) Set the brush holder (90) upside down onto rivet alignment fixture and align the rivets (70) with the two cones on the fixture.

(e) Press rivets (70) as shown in Figure 6008. The diameter of the rivet head must be a minimum of 1.5 times the diameter of the rivet.

(f) Repeat Paragraph 13.A.(2)(a) through Paragraph 13.A.(2)(e) for the remaining complete brush holder (20) assemblies.

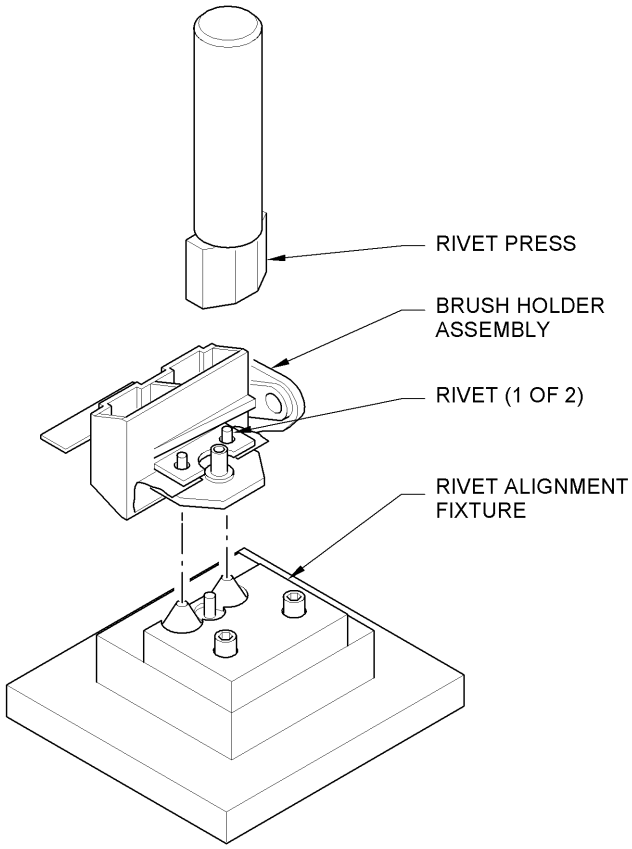


Figure 6008 - Brush Holder Rivet Alignment

14. Anti-Drive End End Bell Blind Rivet Nut Replacement

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

A. Procedure.

(1) Remove blind rivet nut (140) from anti-drive end end bell (110) using a No. 2 drill. Drill a hole through the blind rivet nut (140). The inboard and outboard sides of the blind rivet nut should become loose and fall off.

WARNING: THE PRIMER IS FLAMMABLE. DO NOT OPERATE NEAR OPEN FLAMES, WELDING AREAS OR ON HOT SURFACES.

(2) Apply a layer of primer to the mating surfaces of blind rivet nut (140) and anti-drive end end bell (110).

WARNING: DO NOT GET RETAINING ADHESIVE ON YOUR SKIN. IF YOU GET SOME ON YOUR SKIN, FLUSH WITH CLEAN WATER. REFER TO THE APPLICABLE MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION.

(3) Apply sufficient amount of retaining adhesive Loctite® 648 to the contact surfaces of blind rivet nut (140) and anti-drive end end bell (110).

(4) Using a PlusNut® fastener header tool, turn 1/2 inch nut in a counterclockwise direction until stud is fully extended.

(5) Insert fastener header tool completely into blind rivet nut (140). Tighten 1/2 inch nut until hand tight against washer and tool body.

(6) Making sure key of blind rivet nut is engaged in key slot on end bell, insert blind rivet nut (140) into hole in anti-drive end end bell (110).

(7) Use a 3/4 inch open ended wrench on tool body and a 3/4 inch socket wrench on 1/2 inch nut. While holding tool perpendicular to hole, turn tool clockwise.

NOTE: Do not overtighten blind rivet nut (140). Over-tightening can cause damage to threads.

(8) Turn nut until firm resistance is felt. Blind rivet nut (140) should be physically reformed. If blind rivet nut (140) is loose, tighten nut until blind rivet nut is secure.

(9) Loosen nut by turning counterclockwise. Remove fastener header tool from blind rivet nut.

(10) Torque test blind rivet nut (140) to 25 lbf.in. (2,8 N·m).

NOTE: Apply torque in the clockwise direction with screw seated on the rivet nut flat and there must be no rotation of blind rivet nut (140).

(11) Touch up plating on the anti-drive end end bell (110), if necessary, IAW the instructions in Paragraph 10.

15. Terminal Lug Replacement

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

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

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

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

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

16. Removal and replacement of the Mounting Adapter Guide Pin

NOTE: Numbers in parentheses ( ) refer to item numbers in Figure 10005 of ILLUSTRATED PARTS LIST, unless otherwise specified.

Use the following repair procedure to remove and replace the mounting adapter guide pin(s) (50).

A. Tools

A set of pliers, vice grips or suitable tool that lets you grip the guide pin (50) and pull it out.

B. Procedure. See Figure 6009.

(1) Secure the mounting adapter (40) in a vice making sure it is secured enough to handle the force required to pull the guide pin (50).

(2) Using the suitable tool, twist and pull on the guide pin (50) until it releases from the mounting adapter (40).

WARNING: ZINC CHROMATE PRIMERS 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 ZINC CHROMATE PRIMER, PUT ON A RESPIRATOR, RUBBER APRON, RUBBER GLOVES AND EYE PROTECTION. THIS WILL PREVENT INJURY FROM SPILLS AND FROM THE FUMES.

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

(3) Apply zinc chromate primer to the new guide pin (50) before inserting into the mounting adapter (40).

(4) Insert a new guide pin (50) into the hole in the mounting adapter (40) while primer is still wet.

(5) Using an arbor press or light hammer, lightly tap the guide pin (50) into the hole. Refer to Table 6004 for finished height of guide pin (50).

Mounting Adapter Part No.	Height of Pin from Surface
23085-1020	0.14 to 0.16 inch (3,56 to 4,06 mm)
23085-1830 23085-2090 23085-2091	0.16 to 0.18 inch (4,06 to 4,57 mm)

Table 6004 - Guide Pin Height

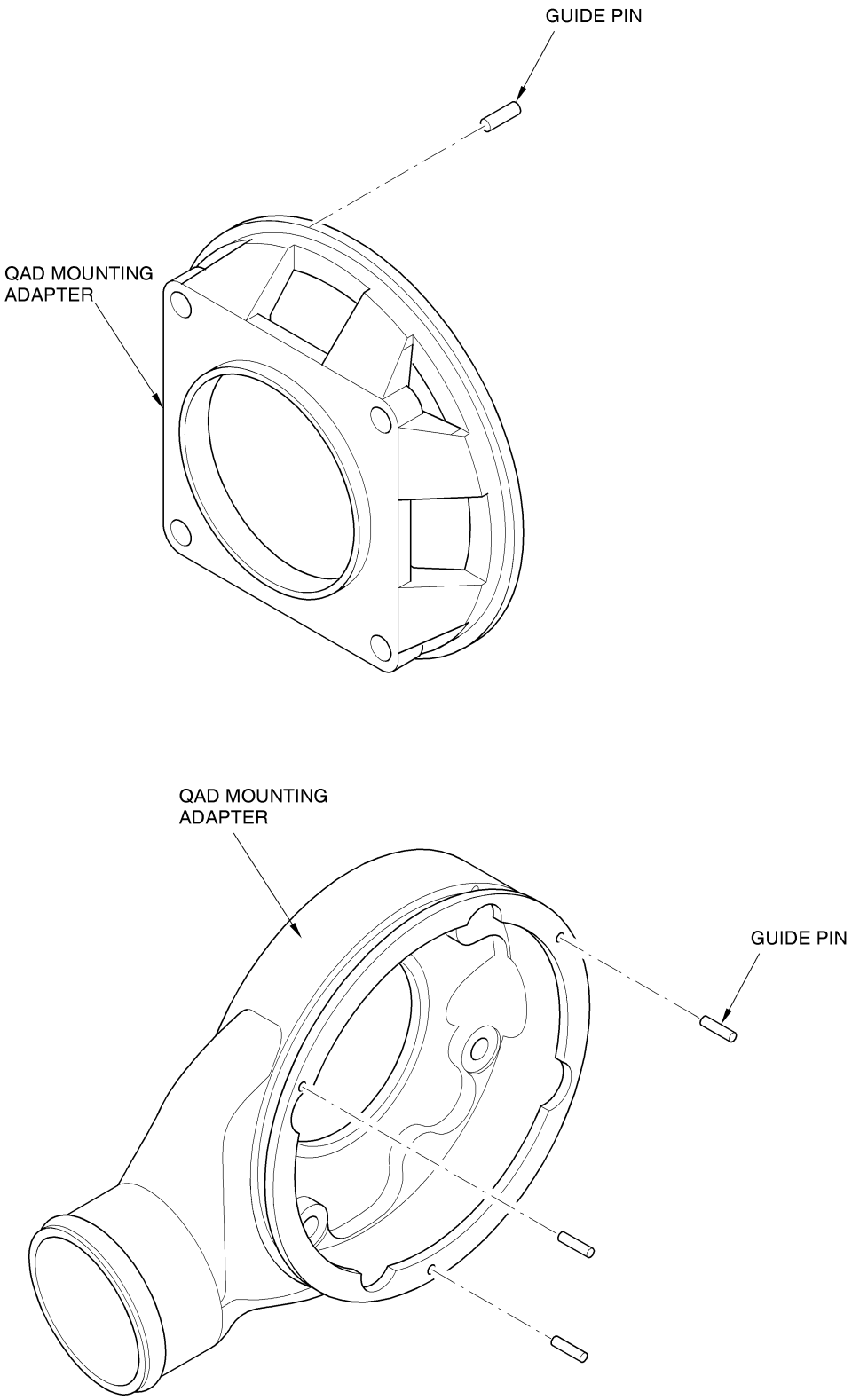


Figure 6009 - Repair of the Mounting Adapter Guide Pin

ASSEMBLY

1. Introduction

This Section gives assembly instructions for DC Starter-Generators 23085 Series II. Assemble the unit in a clean work area away from machining or other metal removing operations. Clean all parts in accordance with (IAW) instructions in the CLEANING section before final assembly.

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

- Surface Repair and Coating - Refer to SPD 1002.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Assembly Tools

In addition to normal shop tools, specific tools for assembly of the starter-generator are listed in Table 7001.

Tool Description	Reference
Arbor Press	Commercially Available
Bearing Drivers, Bearing (Inner Race and Outer Race)	Figure 9003
Brush Holder Alignment Fixture	Figure 9015
Dampener Plate Driver	Figure 9012
Heat Gun	Commercially Available
Horizontal Stator Support	Figure 9009
Leather or Plastic Mallet	Commercially Available
Pliers, Snap Ring	Commercially Available
Spanner Wrench, Part No. TG-1277-1011	Figure 9016
Spline Wrench	Figure 9013
Support, Armature	Figure 9006
Supports, Hub (Drive End and Anti-Drive End)	Figure 9008
Support, Vertical Stator	Figure 9010
Terminal Block - unserviceable	None
Torque wrench	Commercially Available
Wire Hook Tool	Commercially Available

Table 7001 - Assembly Tools

3. Assembly materials

Materials necessary for starter-generator assembly are listed in Table 7002.

NOTE: Assembly materials are not available from Safran Power. All items can be purchased commercially.

WARNING: BEFORE USING ONE 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)
Acrylic Coating	HumiSeal Type 1B31, Type AR MIL-I-46058	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 Fax: (718) 932-4345 www.humiseal.com (V0SR97)
Cloth	Lint-free	Commercially Available
Epoxy Bonding Cement	Two Part Kit: P/N 02-7001-27 (50mL Dual-Pack)	Ellsworth Adhesives P.O. Box 1002 W129 N10825 Washington Dr. Germantown, WI 53022-8202 Ph: (800) 888-0698 Fax: (262) 253-8619 www.ellsworth.com (V0PYJ1)
Grease, Synthetic Aviation	MIL-G-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
Lockwire	NAS20995C32	Commercially Available

Table 7002 - Assembly Materials

Item	Description/Specification	Source (CAGE Code)
Lubricating and Assembly Paste	Altemp QNB 50	Klueber Lubrication Londonderry, NH Ph: (603) 647-4104 www.klueber.com (V3EZL6)
Masking Tape	N/A	Commercially Available
Protective Paper	MIL-B-121A, Grade A, Type II, Class I	National Paper and Packaging Co. Cleveland, OH 44103 www.nationalpaper.com (V0LAX1)
Sandpaper	180 Grit, non-aluminum oxide	Commercially Available
Thread Locking Adhesive, Grade D	Loctite® Grade D MIL-S-22473 (Alt: Loctite® 263)	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com (V7V827)
Thread Sealing Compound	Lead Free/Soft Set Gasoila	GSA Supply on-line www.gsasupplyco.com or Federal Process Co. 4620 Richmond Rd. Beachwood, OH 44128

Table 7002 - Assembly Materials (Continued)

4. Assembly of Stator Assembly

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

A. Attach terminal block (50) to the stator assembly.

CAUTION: BEFORE ACCEPTANCE TESTING, ATTACH AN UNSERVICEABLE TERMINAL BLOCK TO THE STATOR AND HOUSING ASSEMBLY. ACCEPTANCE TESTING CAN DAMAGE THE INTERNAL CAPACITORS OF A TERMINAL BLOCK (50).

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

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

CAUTION: MAKE SURE SMALL TERMINAL LEADS A AND D ARE NOT UNDERNEATH TERMINAL BLOCK AS IT IS PUSHED INTO POSITION.

(2) Set terminal block (50) onto the stator assembly and slide it into position in the large stator leads, C, B and E.

(3) Put the small stator lead terminal lugs (90) on studs A and D.

(4) Put a lock spring washer (70) and flat washer (80) onto each of the two screws (60).

(5) Put the two screws (60) into the holes of the terminal block (50) and tighten two screws (60) to a torque of 20.0 to 25.0 lbf.in (2,3 to 2,8 N·m).

B. Install hardware on terminal block (50). See Figure 7001.

(1) Secure stator lead to terminals A and D with plain washer (40) and self-locking nut (30) at each location.

NOTE: Do not tighten the nuts (30) on terminal block (50) studs A and D. They will be tightened at the time of installation into the aircraft. It is necessary to install the wires from the GCU at that time.

(2) Install one plain washer (20) and one self-locking nut (10) on each terminal stud, C, B and E.

NOTE: Do not tighten the nuts (10) on terminal block studs, C, B and E. They will be tightened at the time of installation into the aircraft.

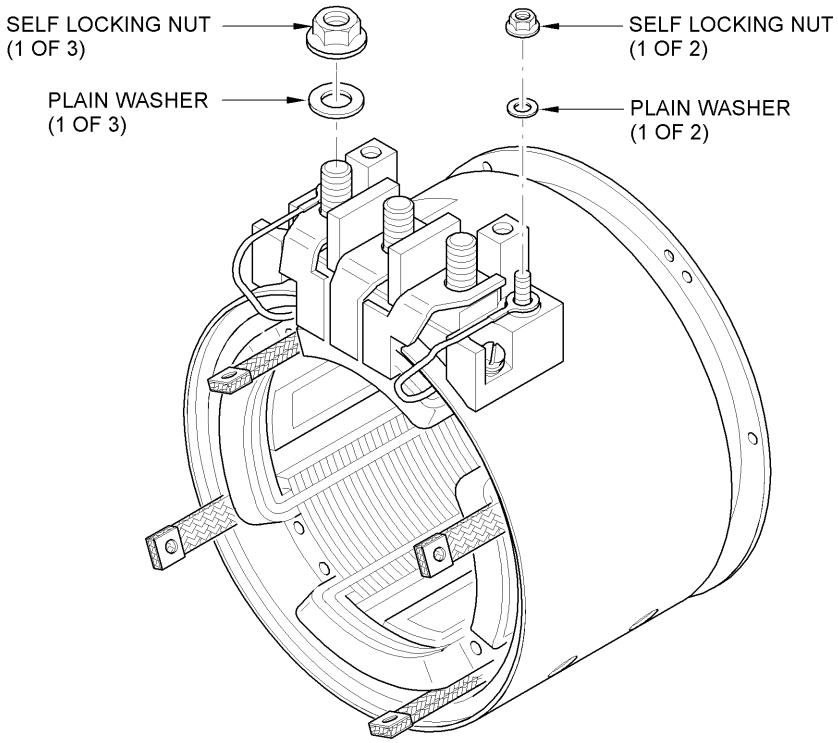


Figure 7001 - Installing Terminal Block Hardware

5. Assembly of Drive End Bearing Support Assembly

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

A. Attach the guard screen (10) to the drive end end bell (40).

WARNING: DO NOT GET EPOXY RESINS ON YOUR SKIN OR IN YOUR EYES. PUT ON PROTECTIVE GLOVES AND EYE PROTECTION. REFER TO THE APPLICABLE MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION.

(1) Using a spatula, mix parts A and B of epoxy bonding cement equally on a smooth, flat surface until fully mixed.

(2) Apply a thin layer of mixture on each rib of drive end end bell (40).

(3) Put a flat washer (30) on each drive screw (20).

(4) Attach screen (10) to drive end end bell (40) in six places with drive screws (20) and flat washers (30).

(5) Place drive end bearing support assembly in oven and allow epoxy bonding cement to cure for 40 minutes at 200° F (97° C).

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

(6) Remove drive end bearing support assembly from oven.

(7) Allow drive end bearing support assembly to cool to room temperature.

6. Assembly of the Bearing and Brush Support Assembly

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

A. Check to make sure the latest configuration of the anti-drive end end bell is used. See Figure 7002 for details.

NOTE: The anti-drive end end bell P/N 23085-1810 used in the bearing and brush support assembly P/N 23085-355 must conform to the latest machining standard.

(1) Make sure the heli-coils and spotfaces are present so the filter leads have a connection.

(2) Make sure the rivnuts to attach the radial air inlet are at the correct angle of 10 degrees in four locations.

NOTE: Older versions of the anti-drive end end bell have the Rivnuts at 25 degrees and do not have the spotfaces and heli-coil inserts for the filter lead connections.

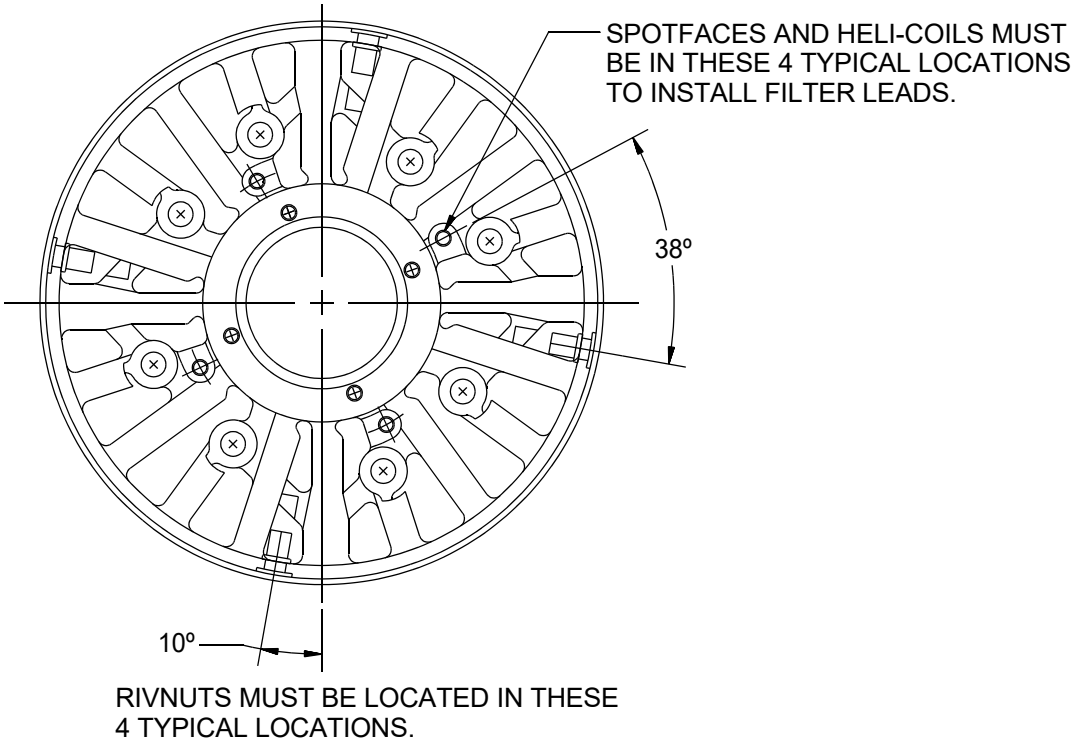


Figure 7002 - Identification of the Latest Configuration of the Anti-Drive End End Bell P/N 23085-1810

B. Install the brush springs (10) on the complete brush holder (20). See Figure 7003.

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

Wind the brush springs (10) about 3/4 turn and put two brush springs onto each complete brush holder (20) as shown in Figure 7003.

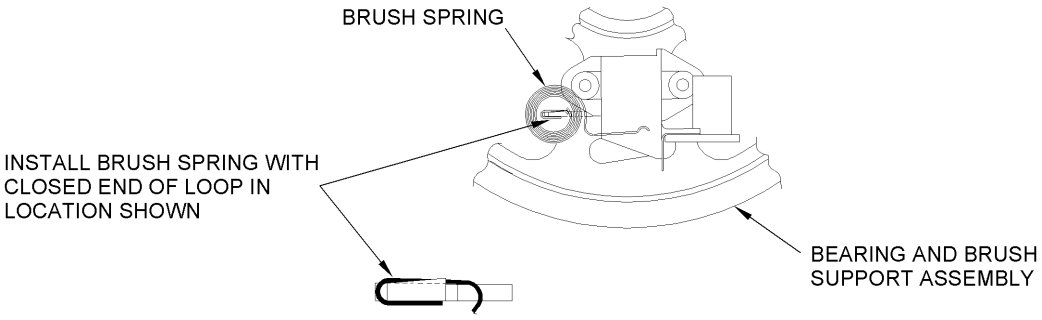


Figure 7003 - Brush Spring Installation

C. Attach each complete brush holder (20) to the anti-drive end end bell (110). See Figure 7004 and Figure 7005.

CAUTION: CORRECT INSTALLATION OF THE INSULATION SLEEVES IS CRITICAL. USE GREAT CARE WHEN INSERTING THE INSULATION SLEEVES INTO THE ANTI-DRIVE END END BELL. IF AN INSULATION SLEEVE IS PINCHED BETWEEN THE ANTI-DRIVE END END BELL AND A COMPLETE BRUSH HOLDER, CARBON DUST WILL COLLECT IN THE AREA WHERE THE INSULATION SLEEVE IS DAMAGED, CAUSING A PATH TO GROUND AND EQUIPMENT FAILURE. THE DAMAGE IS NOT DETECTABLE DURING THE DIELECTRIC TEST AFTER ASSEMBLY.

(1) Insert two insulation sleeves (100) at a brush holder location into two adjacent through holes in the anti-drive end end bell (110). Make sure the insulation sleeves (100) extend out of the through holes on both sides of the anti-drive end end bell (110).

(2) Put a filter assembly (150) onto the ends of the exposed insulation sleeves (100) on the inboard side of the anti-drive end end bell (110). Install the filter assembly (150) so that the side with the open end terminal lug is closest to the bearing liner.

(3) Put a non-metallic washer (50) onto the ends of each exposed insulation sleeve (100) on the outboard side of the anti-drive end end bell (110). Make sure the insulation sleeves (100) do not slide and that the filter assembly (150) does not fall off.

(4) Bend the soldered terminal lug (160) of the filter assembly (150) approximately 45° and position the lug on the nearest non-metallic washer (50) already in place on the anti-drive end end bell (110).

(5) Put one flat washer (40) on each of two bolts (30).

(6) Insert one bolt (30) into each of two insulation sleeves (100) on the outboard side of the anti-drive end end bell (110). Make sure that the insulation sleeves (100) do not slide and that the filter assembly (150) does not fall off.

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

(7) Apply thread locking adhesive, Grade D or Loctite® 263, to the threads of the two bolts (30).

(8) Put a complete brush holder (20) against the two bolts (30) on the inboard side of the anti-drive end end bell (110).

(9) Attach the complete brush holder (20) to the anti-drive end end bell (110) with the two bolts (30). Attach loosely. Do not tighten the bolts (30) at this time.

(10) Repeat Paragraph 6.C.(1) through Paragraph 6.C.(9) for remaining brush holder locations.

(11) Lower the bearing and brush support assembly (10001-310) onto the brush holder alignment fixture as shown in Figure 7005.

CAUTION: MAKE SURE THE COMPLETE BRUSH HOLDERS ARE PROPERLY ALIGNED IN THE BRUSH HOLDER ALIGNMENT FIXTURE. IMPROPER ALIGNMENT CAN CAUSE ELECTRICAL FAILURE.

(12) Adjust all complete brush holders (20) until they are properly aligned.

(13) Tighten bolts (30) to a torque of 25.0 to 30.0 lbf.in. (2,8 to 3,4 N·m).

(14) Remove the bearing and brush support assembly (10001-310) 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.**

(15) If insulating enamel is damaged, apply insulating enamel to bearing and brush support assembly according to the procedure in SPD 1002.

D. Perform a dielectric test.

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

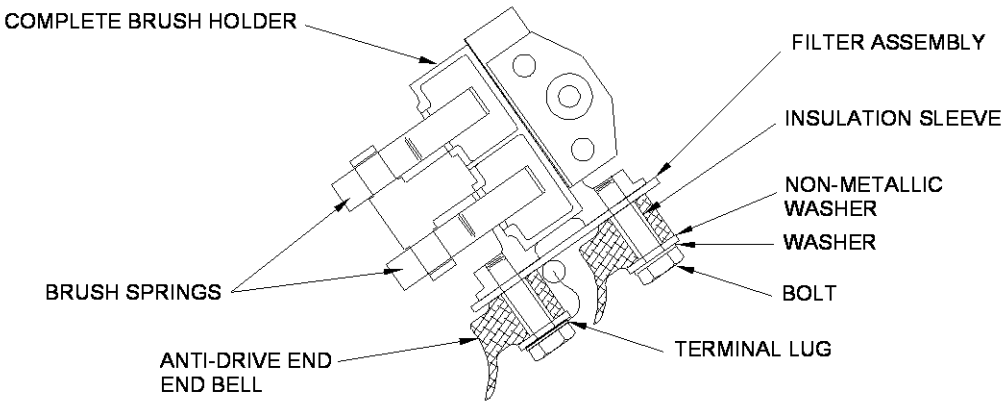


Figure 7004 - Bearing and Brush Support Assembly Detail

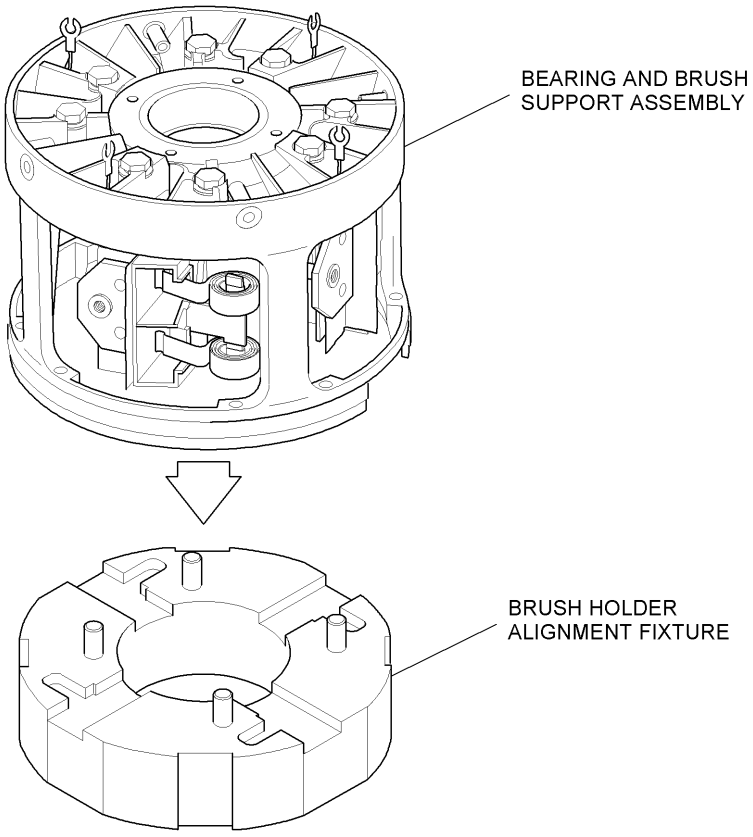


Figure 7005 - Aligning the Brush Holders

7. Final Assembly of the DC Starter-Generator

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

A. Install drive end bearing shield (470) and ball bearing (440) on drive end of armature (430) shaft. See Figure 7006.

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

(1) Set armature support on arbor press table.

(2) Set armature (430), commutator end down, on armature support.

(3) Put drive end bearing shield (470) on drive end of armature shaft with part marked side facing down towards the armature.

(4) Set ball bearing (440) onto armature shaft.

NOTE: The Safran Power part marking on the ball bearing (440) must be facing towards the inside of the starter-generator.

(5) Set inner race bearing driver on ball bearing (440).

(6) Press ball bearing onto armature shaft.

(7) Make sure that ball bearing is fully seated against drive end bearing shield.

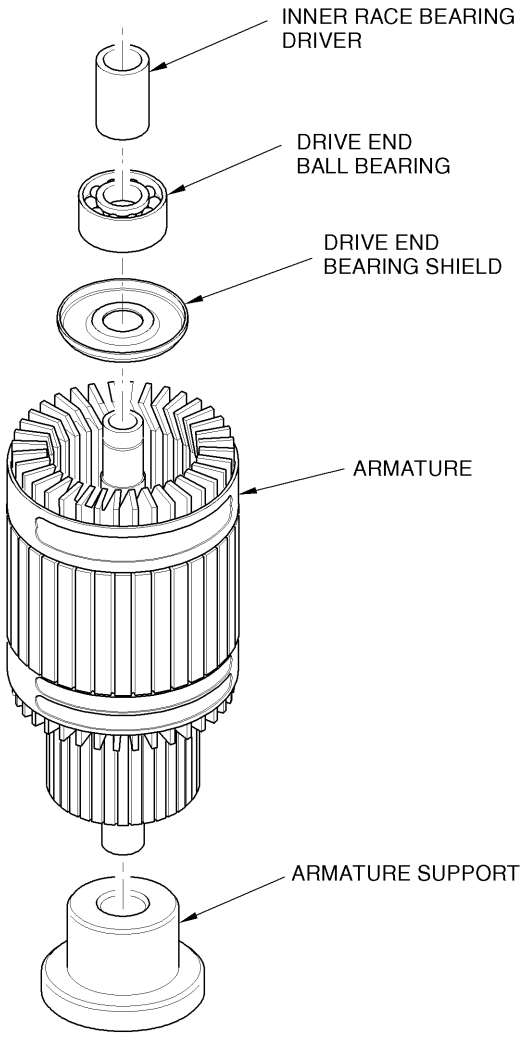


Figure 7006 - Installing Drive End Bearing Shield and Ball Bearing on the Armature Shaft

B. Installing spacer (300) and retaining ring (290) onto drive end of armature (430) shaft. See Figure 7007.

(1) Install a spacer (300) onto drive end of armature shaft.

(2) Using snap ring pliers, put retaining ring (290) in groove on drive end of armature (430) shaft making sure retaining ring is fully engaged in groove and the sharp edges are facing outwards.

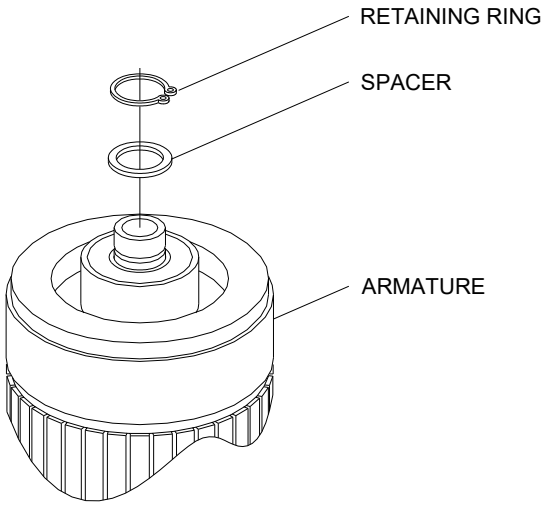


Figure 7007 - Spacer and Retaining Ring Installation

C. Press anti-drive end ball bearing (440) into bearing and brush support assembly (310). See Figure 7008.

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

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

(2) Set bearing and brush support assembly (310), brush holders down, on anti-drive end hub support.

WARNING: DO NOT LET PASTE TOUCH THE EYES OR SKIN. OBEY THE MANUFACTURER'S INSTRUCTIONS. REFER TO MSDS SHEET BEFORE PASTE IS USED.

(3) Apply a thin coat of lubricating and assembly paste to the inside diameter of the bearing liner of bearing and brush support assembly (310).

(4) Set anti-drive end ball bearing on bearing liner of bearing and brush support assembly.

NOTE: The Safran Power part marking on the anti-drive end ball bearing (440) must be facing towards the inside of the starter-generator.

(5) Set outer race bearing driver onto anti-drive end ball bearing (440).

(6) Press anti-drive end ball bearing (440) into bearing and brush support assembly (310) bearing liner.

(7) Make sure that anti-drive end ball bearing (440) is fully installed against inner lip of bearing liner.

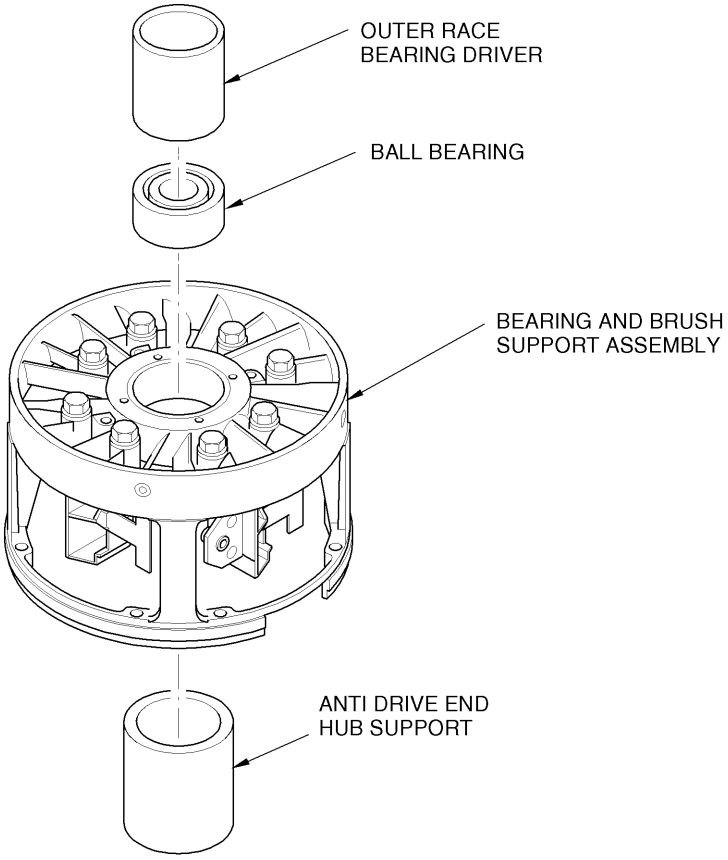


Figure 7008 - Anti-Drive End Bearing Installation

D. Attach bearing retainer (450) to bearing and brush support assembly (310).

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

(1) Apply thread sealing compound to threads of four screws (460).

(2) Attach bearing retainer (450) to bearing and brush support assembly (310) with four screws (460). Torque screws from 13.5 to 18.0 lbf.in (1,5 to 2,0 N·m).

(3) Insulate slotted terminal lugs (10002-170) of filter board assemblies (10002-150) with electrical insulating tape or equivalent.

NOTE: Slotted terminal lugs must not be attached until after acceptance testing.

E. Prepare armature (430) for coarse brush seating.

(1) Prepare the armature for coarse brush seating. Refer to SPD 1006.

NOTE: Make sure taped end of sandpaper is in the normal direction of rotation and abrasive side of sandpaper faces away from the commutator. See Figure 7009.

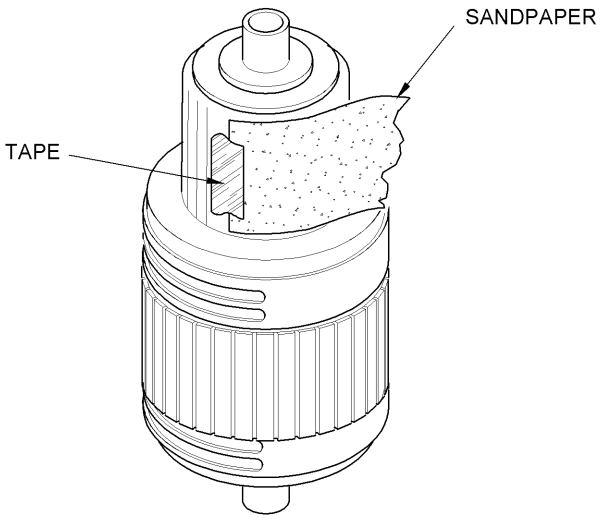


Figure 7009 - Preparing Armature for Rough Seating

F. Press bearing and brush support assembly (310) onto armature (430) shaft. See Figure 7010.

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

(1) Place the armature (430) on an armature support on an arbor press table with the commutator pointing upward.

(2) Set bearing and brush support assembly (310), brush holders down, on commutator end of armature shaft.

(3) Set inner race bearing driver on anti-drive end ball bearing (440).

(4) Press anti-drive end ball bearing onto armature shaft.

(5) Make sure that anti-drive end ball bearing is fully installed against shoulder of armature shaft.

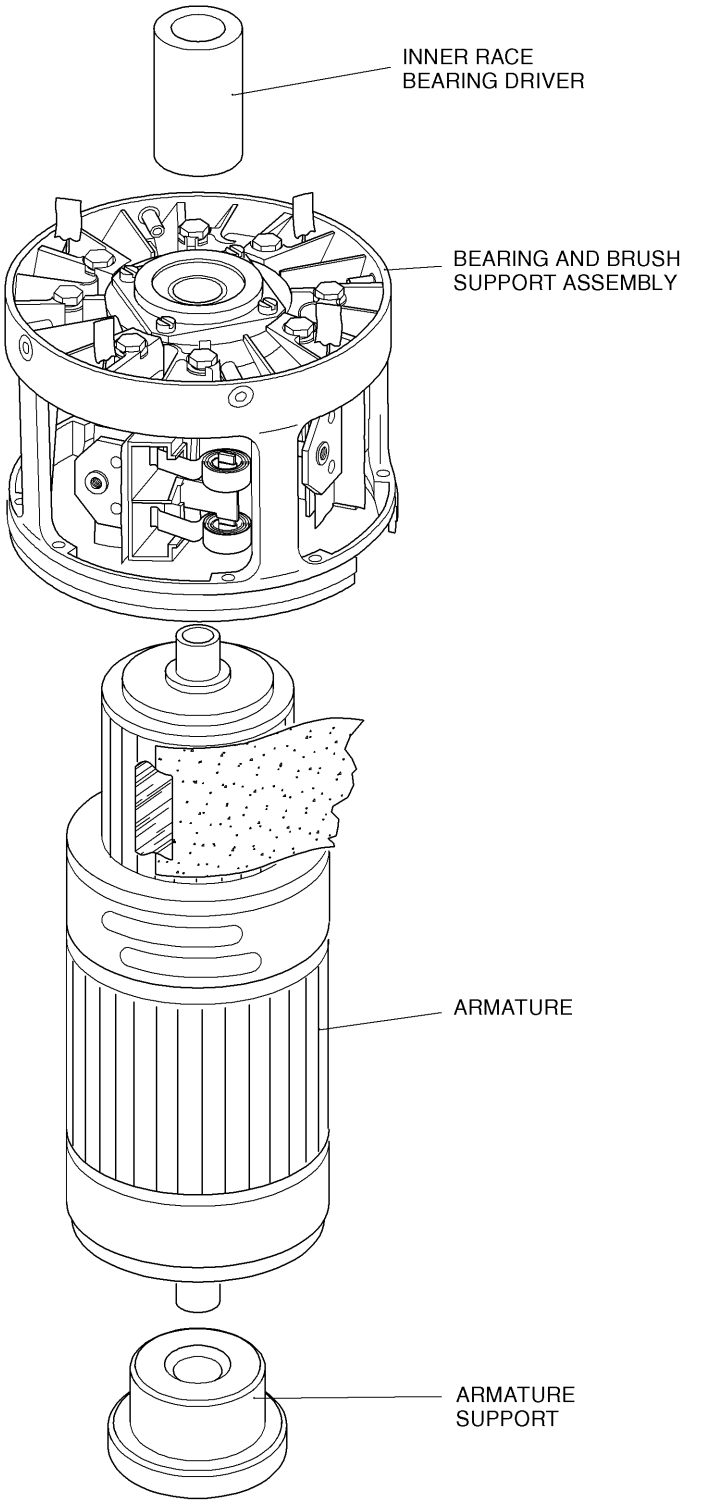


Figure 7010 - Attaching Armature

G. Assemble the drive end bearing support assembly (370) to the stator assembly (480). See Figure 7011.

(1) Put the stator assembly (480) in the vertical stator support with the drive end up.

(2) Put the drive end bearing support assembly (370) on the stator and housing assembly (480).

(3) Align and orient through holes in drive end bearing support assembly (370) with threaded holes in stator assembly (480) making sure drive end bearing support assembly is fully engaged with pilot bore of stator assembly.

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

(4) Apply thread sealing compound to threads of three screws (380).

(5) Attach the drive end bearing support assembly (370) to the stator assembly (480) with the screws (380).

(6) Tighten the three screws (380) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m).

NOTE: Make sure that the head of the screws (380) are flush or below face of the drive end bearing support assembly (370) when installed.

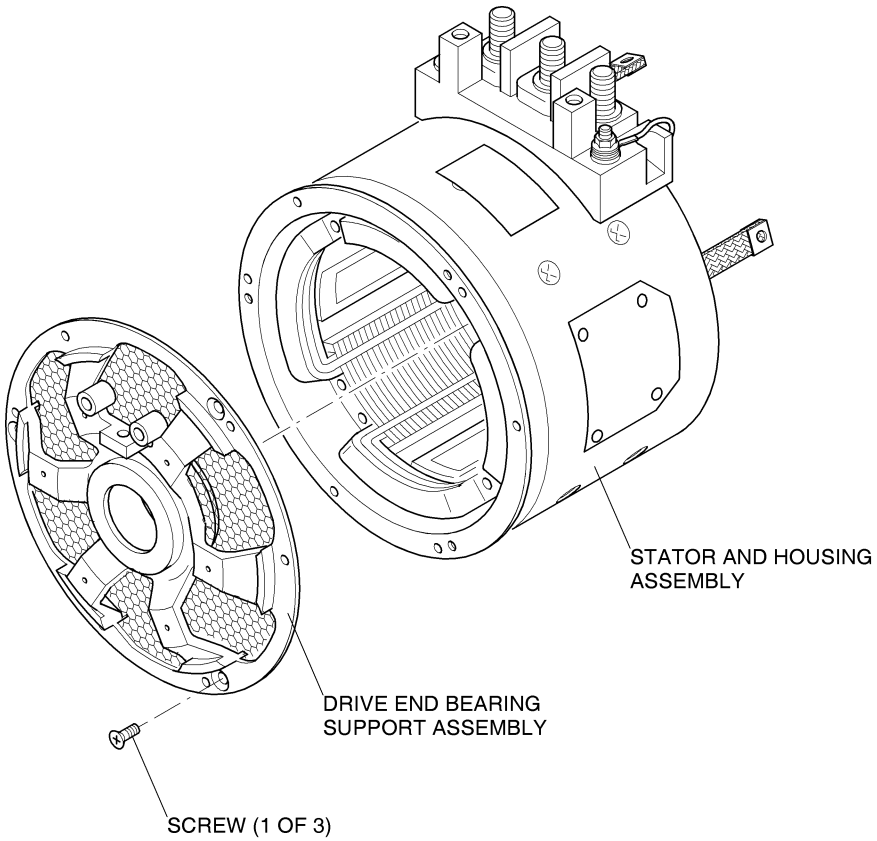


Figure 7011 - Installing Drive End Bearing Support Assembly

H. Determine shim(s) requirements. See Figure 7012**.**

(1) Measure and record the distance from the mounting surface of the bearing and brush support assembly (310) to inner race of bearing (440) on drive end of armature (430) shaft. Record as dimension ‘A’.

(2) Measure and record the distance from the mounting surface of the stator assembly (480) to the bottom of the bearing liner in drive end bearing support assembly (370). Record as dimension ‘B’.

(3) Subtract dimension ‘A’ from dimension ‘B’ and record difference. The difference is the gap without shims.

NOTE: The calculated difference between dimensions ‘A’ and ‘B’ is the gap for the spring wave washer (390). The desired gap for the compressed spring wave washer is 0.040 to 0.063 inch (1,02 to 1,60 mm).

(4) If required, make a shim pack with enough shims (400, 410, 420) to reduce the gap to between 0.040 to 0.063 inch (1,02 to 1,60 mm).

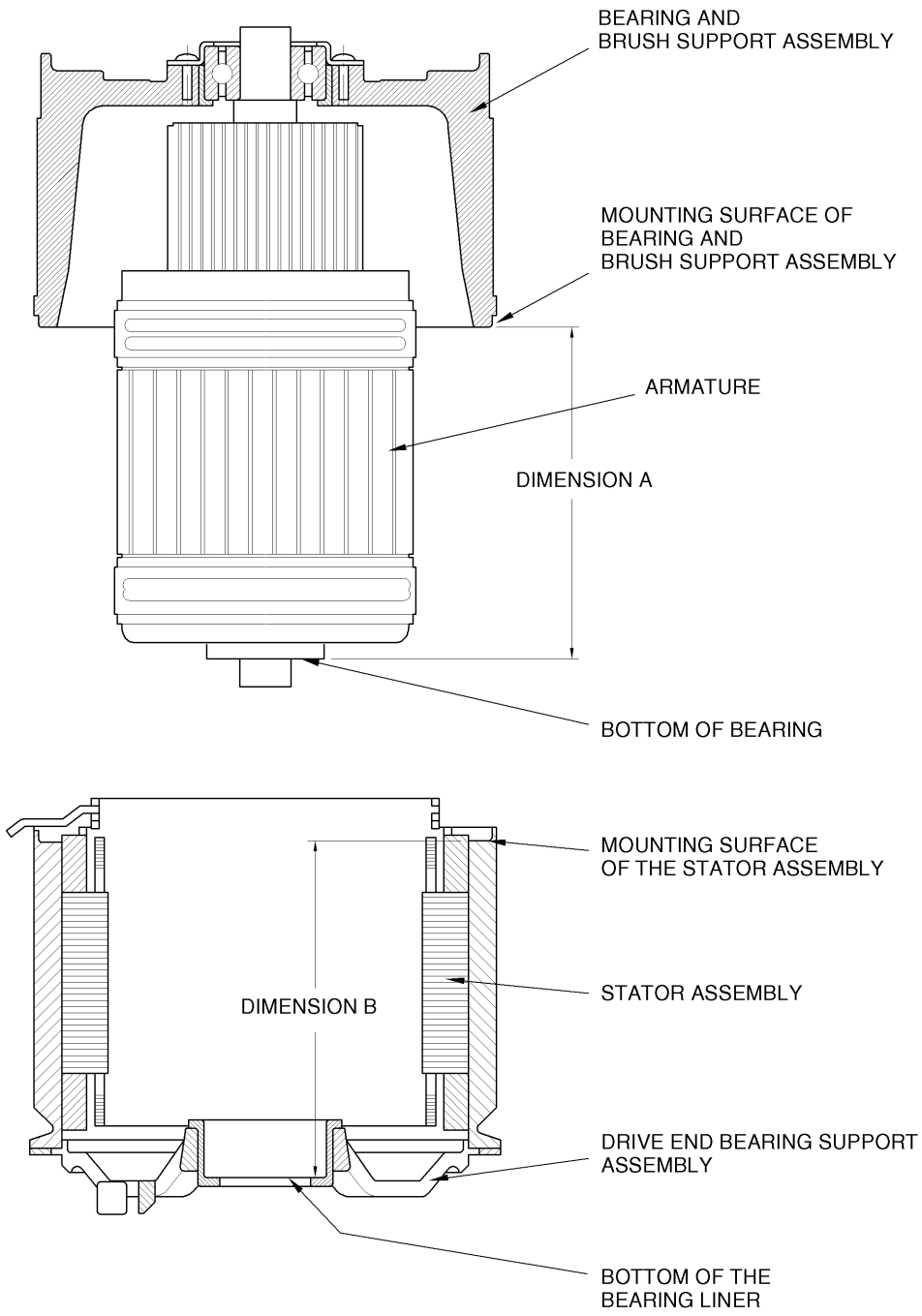


Figure 7012 - Determining Shim Requirements

I. Installing the shim(s) (400, 410, 420) (if required), and spring wave washer (390) into drive end bearing support assembly (370). See Figure 7013.

(1) If shim(s) (400, 410, 420) are required, put into the bottom of the bearing liner in the drive end bearing support assembly (370).

(2) Put the spring wave washer (390) in the bearing liner on top of the shim(s) (if present).

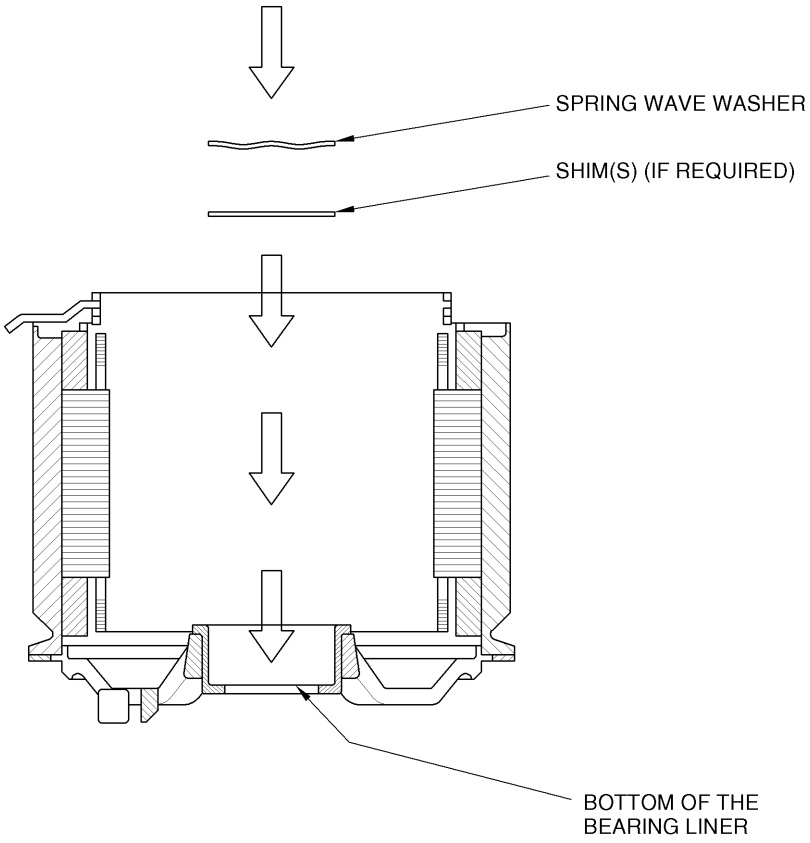


Figure 7013 - Installing Shim(s)

J. Assemble the bearing and brush support assembly (310), with attached armature (430), to the stator assembly (480). See Figure 7014.

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

WARNING: DO NOT LET PASTE TOUCH THE EYES OR SKIN. OBEY THE MANUFACTURER'S INSTRUCTIONS. REFER TO MSDS SHEET BEFORE PASTE IS USED.

(2) Apply a thin coat of lubricating and assembly paste to the inside diameter of the bearing liner of the drive end bearing support assembly (370).

(3) Set stator assembly (480) with attached drive end bearing support assembly (370) (drive end down) onto drive end hub support.

NOTE: Make sure the shim(s) and the spring wave washer are correctly located in the drive end bearing liner.

(4) Insert armature (430) with attached bearing and brush support assembly (310) into stator assembly (480) making sure bearing (440) on armature shaft is aligned with bearing liner of drive end bearing support assembly (370).

(5) Align four brush harness straps with brush holder assemblies. If necessary, use a probe to move brush harness straps to correct positions.

(6) Set inner race bearing driver onto anti-drive end ball bearing (440).

(7) Press drive end ball bearing (440) into bearing liner of drive end bearing support assembly (370).

(a) Make sure that screw holes in bearing and brush support assembly (310) are correctly aligned with mounting holes in stator assembly (480).

(b) Make sure that bearing and brush support assembly is properly installed against stator assembly (480).

(8) Put a lock washer (330) and a flat washer (340) onto each of the eight screws (320).

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.

(9) Apply thread sealing compound to threads of screws (320).

(10) Attach bearing and brush support assembly (310) to stator assembly (480) with eight attaching screws (320).

(11) Tighten screws (320) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m).

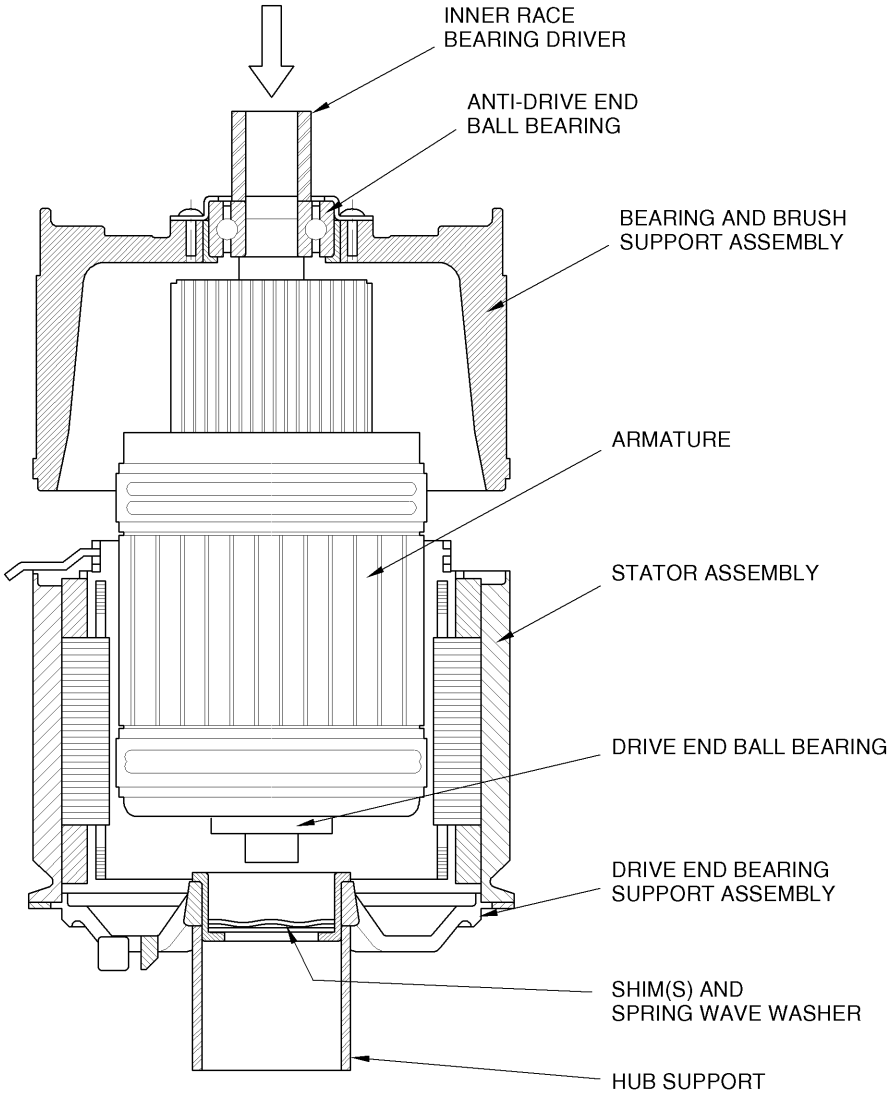


Figure 7014 - Pressing the Bearing and Brush Support Assembly with Attached Armature into the Stator Assembly

K. Installing dampener back plate (280) and friction ring (260) onto armature (430) shaft. Figure 7015**.**

(1) Set stator assembly (480) on horizontal stator support.

CAUTION: TAKE EXTRA CARE TO NOT DAMAGE THE BLUE XYLAN® COATING ON THE DAMPENER BACKPLATE.

(2) Twist dampener back plate (280) onto drive end of armature (430) shaft until fully seated.

(3) Put friction ring (260) into recess of dampener back plate.

NOTE: Friction ring (260) may not stay in place until drive shaft (220) with attached dampener plate (250) is installed.

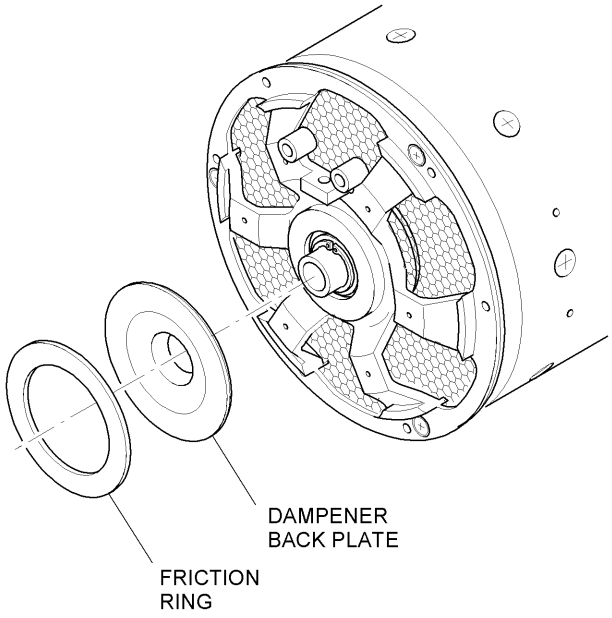


Figure 7015 - Installing Dampener Back Plate and Friction Ring

L. Assemble dampener hub (240) and dampener plate (250) on drive shaft (220). See Figure 7016.

CAUTION: DO NOT FORCE DAMPENER HUB ON DRIVE SHAFT MATING TAPER. TOO MUCH FORCE CAN CAUSE THE DAMPENER HUB TO FRACTURE.

CAUTION: TAKE EXTRA CARE TO NOT DAMAGE THE BLUE XYLAN® COATING ON THE DAMPENER HUB.

(1) If dampener hub (240) was removed from drive shaft (220), twist dampener hub onto drive shaft taper making sure dampener hub is fully seated.

(2) Put drive shaft (220) and dampener hub (240) through dampener plate (250) and dampener plate driver. Align splines.

(3) Using a leather or plastic mallet, lightly tap drive end of drive shaft (220) to install dampener plate (250) on dampener hub (240).

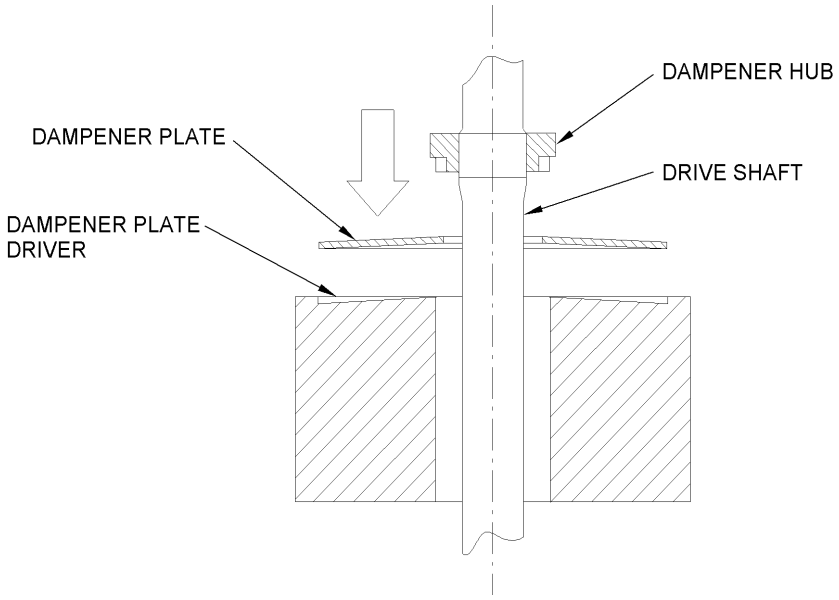


Figure 7016 - Assembling Dampener Plate and Hub

M. Insert drive shaft (220) in armature (430) shaft. See Figure 7017 and Figure 7018.

(1) Slide isolator (270) onto the drive shaft (220) square cross-section until the isolator is flush against the drive shaft square cross-section shoulder.

CAUTION: DO NOT USE HIGH FORCE TO ENGAGE THE DRIVE SHAFT AND ARMATURE SHAFT MATING CROSS-SECTION. FAILURE TO CORRECTLY ENGAGE THE SQUARE CROSS-SECTIONS CAN CAUSE DAMAGE TO THE DRIVE SHAFT AND ARMATURE SHAFT.

(2) Insert drive shaft (220) with isolator (270) in drive end of armature (430) shaft. Make sure that drive shaft square cross-section engages in armature shaft square cross-section.

(3) Push drive shaft (220) through armature (430) shaft until dampener plate (250) is fully installed against friction ring (260).

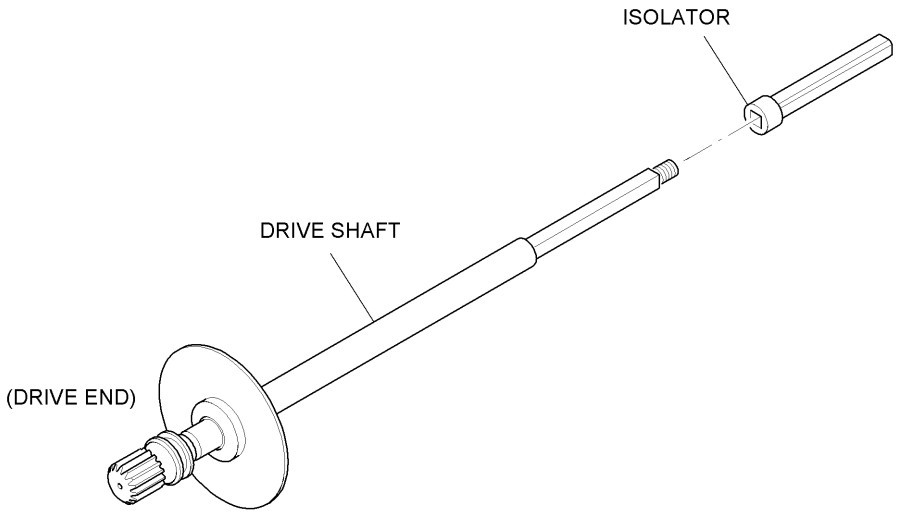


Figure 7017 - Installation of Isolator on the Drive Shaft

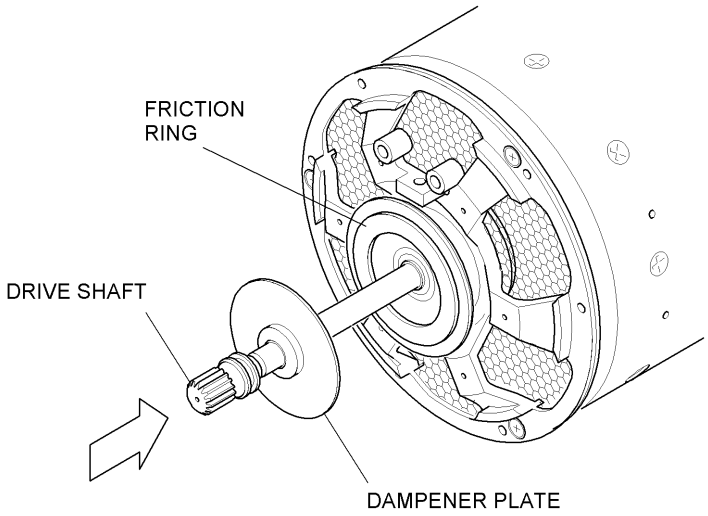


Figure 7018 - Inserting Drive Shaft into Armature Shaft

N. Attach anti-drive end bearing shield (160) and fan (100) to drive shaft (220). See Figure 7019.

(1) Slide anti-drive end bearing shield (160) on armature (430) shaft with part markings facing fan.

(2) Put fan (100) on armature (430) shaft and locate by installing the straight headless pin (150) in the armature shaft keyway.

(3) Assemble key washer (140) on armature (430) shaft. Locate the key washer inner tab in the armature shaft keyway.

NOTE: Make sure the rounded surface of the key washer (140) is against the fan (100).

(4) Attach the fan (100) and key washer (140) to the armature (430) shaft with spanner nut (130).

NOTE: Make sure the rounded surface of the spanner nut (130) is against the key washer (140).

(5) Put the spline wrench on the drive shaft (220) spline and torque the spanner nut (130) to 150 to 200 lbf.in (16,9 to 22,6 N·m) with a spanner wrench. Loosen the spanner nut to zero torque then finally torque to 80 to 100 lbf.in. (9,0 to 11,3 N·m).

(6) Lock one tab of the key washer (140) into a slot of the spanner nut (130).

(7) Put washer assembly (120) onto the drive shaft (220) with the largest washer facing the spanner nut (130). Attach the washer assembly (120) to the drive shaft (220) with self locking nut (110).

(8) Use the spline wrench to hold the drive shaft (220) in place. Tighten self-locking nut (110) to a torque of 80 to 100 lbf.in. (9,0 to 11,3 N·m).

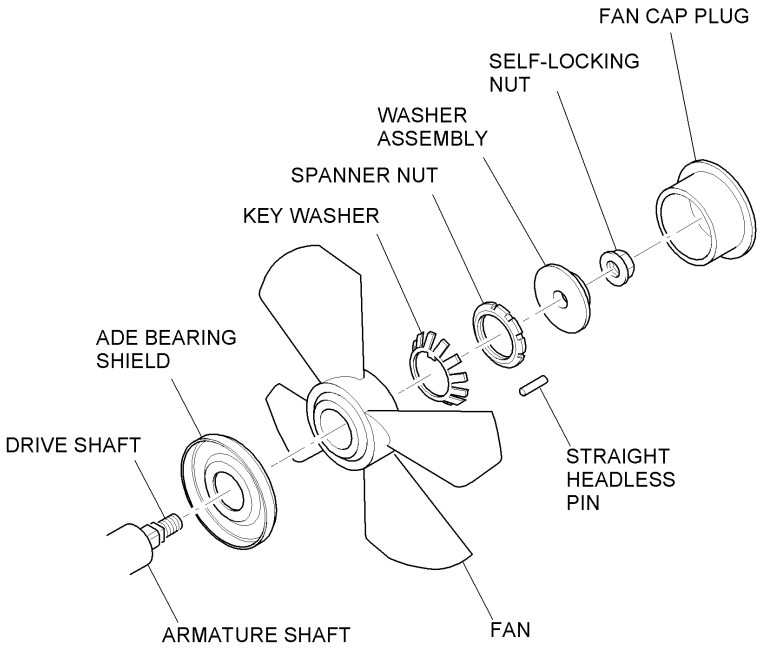


Figure 7019 - Installing the Fan

(9) Press or tap with a rubber mallet the fan cap plug (90) into the center of the fan (100).

(10) Before installing the fan cap plug (90) make sure that key washer (140) tab is locked into a slot of the spanner nut (130).

O. Install the brushes (200).

NOTE: If new brushes (200) are to be used, identify the brushes with the numbers 1 through 4.

CAUTION: RAISE AND LOWER BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO INSERT BRUSH SETS INTO BRUSH HOLDER ASSEMBLY.

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

(2) At each brush holder location, lift one brush spring at a time with a wire hook tool and insert brush set into a brush holder assembly.

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

(4) Install four electrical brushes (200) into the corresponding complete brush holders (10002-20).

(5) Secure the four brush (200) leads and four braided stator leads to complete brush holders (10002-20) with four screws (210) to a torque of 22.7 to 35.0 lbf.in. (2,6 to 4,0 N·m). Make sure leads are arranged over brush springs (10002-10) to prevent brushes (200) from hanging up.

P. Coarse seat the new brushes (200).

(1) Coarse seat the brushes (200) IAW SPD 1006.

NOTE: The sandpaper should first touch the leading edge (short side) of the brush (200) when the armature (430) is rotated in its normal direction.

(2) Remove sandpaper IAW SPD 1006 when the brushes are seated.

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

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

(3) Blow out the carbon residue from inside unit with clean, dry compressed air.

Q. Perform brush (200) run-in.

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

(1) Run-in the brushes (200) IAW SPD 1006.

NOTE: A correctly seated brush (200) has a smooth and semi-gloss contact surface.

R. Install air inlet (70) on models 23085-029 and 23085-030.

(1) Using a vertical stator support, place unit fan up, on a work bench.

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) Position air inlet (70) on bearing and brush support assembly (310) as shown in Figure 7020 and secure with four screws (80) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N.m).

NOTE: Do not attach lockwire to screws until after acceptance testing.

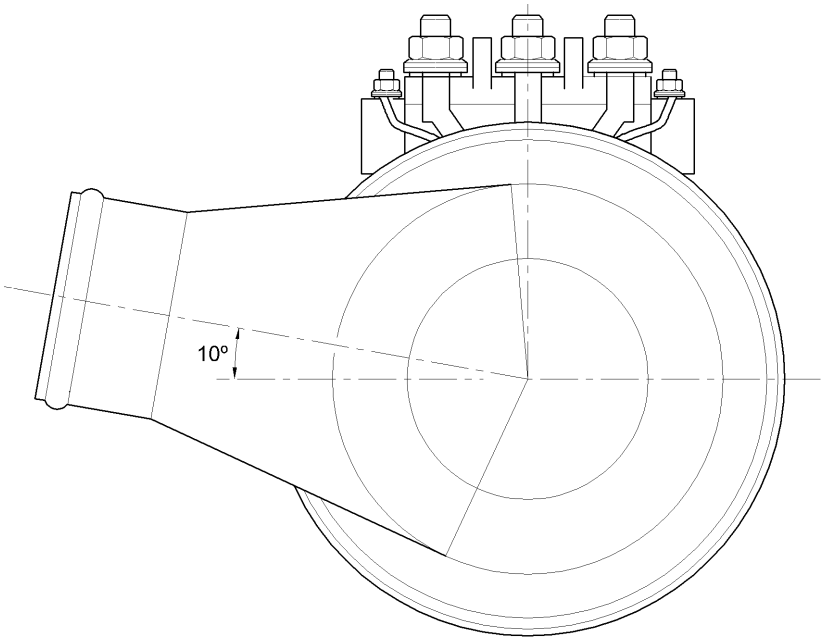


Figure 7020 - Angular Position of Air Inlet - Models 23085-029 and 23085-030

S. If returned with generator 23085-031, install air inlet (70).

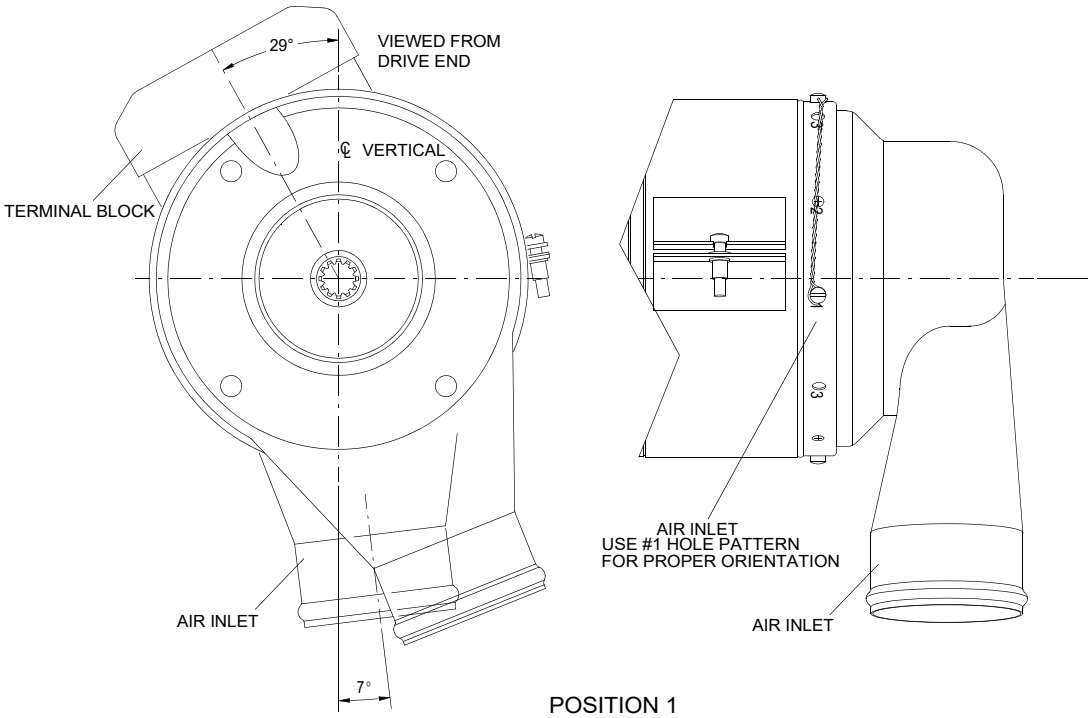
(1) Using a vertical stator support, place unit fan up, on a work bench.

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.

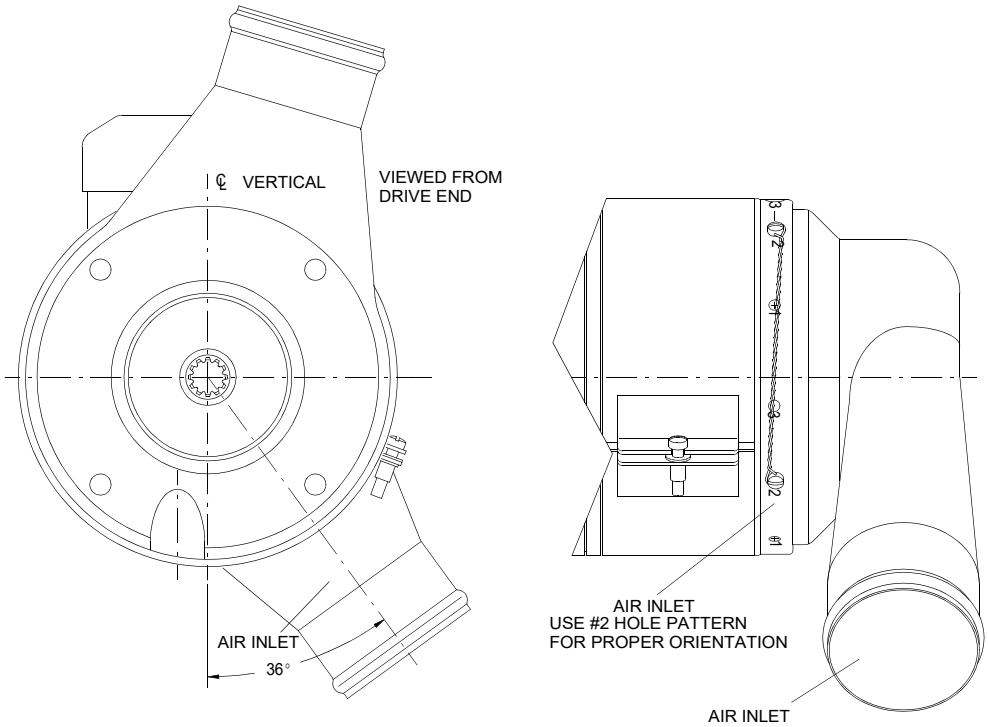
(2) Position air inlet (70) on bearing and brush support assembly (310) as shown in Figure 7021 and secure with four screws (80) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N.m).

NOTE: There are three different air inlet positions for this generator.

NOTE: Do not attach lockwire to screws until after acceptance testing.



POSITION 1



POSITION 2

Figure 7021 - Angular Position of Air Inlet - Model 23085-031

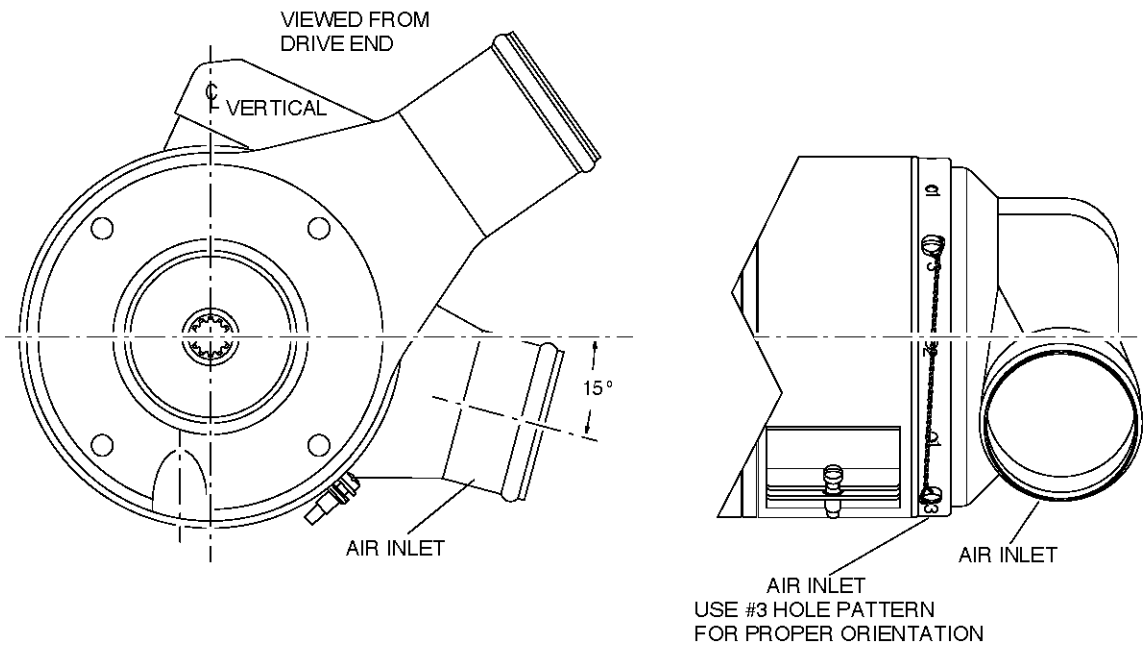


Figure 7022 - Angular Position of Air Inlet - Model 23085-031

T. Install patent notification label (30), if required.

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

(1) Clean stator assembly (480) surface adjacent to the identification plate (10), where label is to be applied, using isopropyl alcohol and a clean, lint-free cloth.

(2) Allow the isopropyl alcohol to dry.

(3) Remove the protective backing on the patent notification label (30) and Install label on stator assembly (480), oriented to read in the same direction as the identification plate (10).

U. Install caution decal (40) if required.

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

(1) Clean stator assembly (480) surface adjacent to the terminal block, where decal is to be applied, using isopropyl alcohol and a clean, lint-free cloth.

(2) Allow the isopropyl alcohol to dry.

(3) Remove the protective backing on the caution decal (40) and install decal on stator assembly (480) near the terminal block.

V. Install replacement identification plate (10), if required.

(1) Transfer information from old identification plate to replacement identification plate (10).

(2) Position replacement identification plate (10) on stator assembly (480) and secure with four drive screws (20).

WARNING: KEEP ACRYLIC COATING AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. ACRYLIC COATING IS FLAMMABLE.

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

(3) Coat the replacement identification plate (10) with acrylic coating and let the coating air dry.

8. Perform Acceptance Test on Starter-Generator

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

CAUTION: BEFORE ACCEPTANCE TESTING, ATTACH AN UNSERVICEABLE TERMINAL BLOCK (10004-50) TO THE STATOR ASSEMBLY (480).

CAUTION: MAKE SURE THE FILTER CAPACITOR LEADS ON THE BEARING AND BRUSH SUPPORT ASSEMBLY ARE DISCONNECTED AND TAPED BEFORE TESTING.

Perform acceptance test procedure on the assembled starter-generator as detailed in the TESTING AND FAULT ISOLATION section.

9. Final Assembly after Acceptance Testing

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

A. Attach serviceable terminal block (50) to housing if dummy terminal block was used.

(1) Remove unserviceable terminal block from housing. Refer to DISASSEMBLY section.

(2) Set unit on horizontal stator support.

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

CAUTION: AS TERMINAL BLOCK IS GENTLY PUSHED INTO PLACE, MAKE SURE THAT TERMINAL LEADS A AND D ARE NOT UNDERNEATH TERMINAL BLOCK.

(3) Set terminal block (50) on housing and gently push terminal block into position on large stator leads C, B and E.

(4) Put the small stator lead terminal lugs (90) on studs A and D.

(5) Put a lock spring washer (70) and flat washer (80) onto each of the two screws (60).

(6) Put the two screws (60) into the holes of the terminal block (50) and tighten two screws (60) to a torque of 20.0 to 25.0 lbf.in (2,3 to 2,8 N·m).

B. Install terminal block hardware.

(1) Secure stator lead to terminals A and D with self-locking nut (30) and plain washer (40) at each location.

(2) At terminals C, B and E install a plain washer (20) and self-locking nut (10).

NOTE: Do not tighten the nuts (10) and (30) on terminal block studs A, D, C, B and E. They will be tightened at the time of installation into the aircraft.

C. Attach terminal block cover (50) (if present).

NOTE: When a starter-generator is removed from aircraft for service, the terminal block cover usually stays on the aircraft.

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

Attach terminal block cover (50) to the terminal block (10004-50) with two screws (60). Tighten the screws (60) to a torque of 7.7 to 10.3 lbf.in (0,87 to 1,16 N·m).

D. Remove commutation viewing adapter.

Unthread the screw (180) from self-locking blind rivet nut that secures commutation viewing adapter to starter-generator. Remove the commutation viewing adapter.

E. Attach brush access cover (170).

(1) Position brush access cover (170) around bearing and brush support assembly (310).

CAUTION: THE JOINT FORMED BY THE BRUSH ACCESS COVER MUST NOT BE POSITIONED OVER AN ACCESS WINDOW IN THE HOUSING.

(2) Thread screw (180) into self-locking blind rivet nut. Tighten screw to a torque of 20.0 to 30.0 lbf.in. (2,2 to 3,4 N·m).

F. Attach filter assembly (10002-150) leads.

(1) Remove four screws (80) which attach air inlet to bearing and brush support assembly (310).

(2) Remove air inlet (70)

(3) Put a lock washer (360) on each of four screws (350).

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

(4) Apply thread sealing compound to threads of screws (350).

(5) Put a slotted terminal (10002-170) on each screw (350) and install the screws into the holes in the finned end of the bearing and brush support assembly (310) as shown in Figure 7023.

(6) Tighten the screws (350) to a torque of 7.7 to 10.3 lbf.in (0,87 to 1,16 N·m).

(7) Apply thread sealing compound to threads of four screws (80).

(8) Position air inlet (70) on bearing and brush support assembly (310) as shown in Figure 7019 and secure with four screws (80) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m).

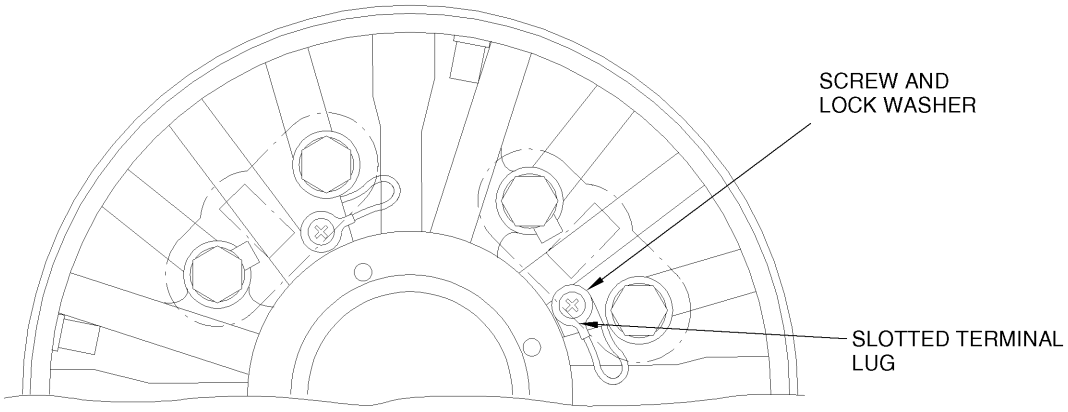


Figure 7023 - Attaching Filter Assembly Leads

G. Attach air inlet (70), if removed.

See Paragraph 7.R. and Paragraph 7.S.

H. Lockwire screws (80) that attach air inlet (70) to starter-generator.

Lockwire the four screws (80) that attach air inlet to starter-generator with Lockwire P/N NAS20995C32 IAW NASM 33540.

I. If present, attach QAD kit to starter-generator.

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

NOTE: Numbers in parentheses ( ) refer to item numbers given in Figure 10005 of the ILLUSTRATED PARTS LIST, unless otherwise specified.

(1) Put V-retainer coupling (10) over drive end bearing support assembly (10001-370).

(2) Put mounting adapter (40) in inner rim of V-retainer coupling (10) and engage QAD adapter's alignment pins (50) in mating holes in drive end bearing support assembly (10001-370).

(3) Torque self-locking nut (20) on T-bolt (30) to 70 lbf.in. (7,9 N·m).

10. Preparation for Shipment/Storage

Refer to STORAGE section for shipment/storage instructions.

11. Package the Starter-Generator for Shipment or Storage

Coat drive spline with synthetic aviation grease. Wrap the drive spline with protective paper according to MIL-B-121A, Grade A, Type II, Class 1.

Put a new o-ring (10001-230) into a suitable container and label container with instructions to user to lubricate and install o-ring on drive shaft prior to installation of the generator into the aircraft.

For shipment or storage, seal starter-generator unit in suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

FITS AND CLEARANCES

1. Introduction

A. The following paragraphs provide information for determining the acceptability of fits and clearances of the starter-generator and mounting adapters.

B. Examine the parts for damage. Refer to CHECK section, for details.

C. Repair the parts before assembly. Refer to REPAIR section, for details.

D. The acceptance limits for starter-generator components and subassemblies are listed in Paragraph 2.

E. The required torque values to be used during repair and assembly of starter-generator components and attaching parts are listed in Paragraph 3.

2. Component Acceptance Limits

Refer to Table 8001 for starter-generator component and subassembly acceptance limits. Paragraph designations in the CHECK column refer to the applicable inspection procedure found in the CHECK section.

NOTE: Numbers in parentheses ( ) refer to item numbers on the figure of ILLUSTRATED PARTS LIST, unless otherwise specified.

CHECK Para. Ref.	Nomenclature and IPL Number	Inspect for...	Acceptance Limits
8.B. See Table 6004	Mounting Adapter (10005-40)	Guide pin height (10005-50) 23085-029	0.14 to 0.16 inch (3,56 to 4,06 mm) (Adapter: 23085-1020)
		23085-030 23085-031	0.16 to 0.18 inch (4,06 to 4,57 mm) (Adapter: 23085-1830, -2090, -2091)
8.M.	Drive Shaft (10001-220)	Spline diameter	0.757 inch (19,23 mm) min. over two 0.1094 inch (2,779 mm) dia pins.
8.N.	Dampener Plate (10001-250)	Thickness	0.038 inch (0,97 mm) min.
		Internal spline diameter	Gage pin dia: 0.090 inch (2,29 mm) Distance between two pins: 0.655 inch (16,637 mm) max
8.O.	Friction Ring (10001-260)	Thickness	0.060 inch (1,52 mm) min.
8.Q. See Figure 6002	Bearing and Brush Support Assembly (10001-310)	Bearing liner diameter	1.5747 to 1.5750 inch (39,997 to 40,005 mm) See Figure 8002.

Table 8001 - Acceptance Limits

CHECK Para. Ref.	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
8.Q.(9)	Filter Assembly (10002-150)	Capacitance value	0.30 to 0.36 µFd checked at a frequency of 900 to 1100 Hz.
8.Q.(10)	Brush Spring (10002-10)	Force	Position “A” 2.7 lb (1,2 kg) min. Position “B” 3.5 lb (1,6 kg) max.
8.R. See Figure 6003	Drive End Bearing Support Assembly (10001-370)	Bearing liner diameter	1.5745 to 1.5748 inch (39,992 to 40,000 mm) See Figure 8002.
8.S. See Table 5002	Spring Wave Washer (10001-390)	Compression	27 to 35 lbs to compressed height (12,2 to 15,9 kg)
8.T.	Armature (10001-430)	Bearing Journal Diameter (A, C) See Figure 5017	0.6694 to 0.6691 inch (17,003 to 16,995 mm). See Figure 8001.
		Commutator Diameter (B) See Figure 5017	2.310 inch (58,674 mm) Min.
		Mica Undercut (Before recut)	Depth: 0.045 inch (1,14 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.040 inch (1,02 mm) to 0.050 inch (1,27 mm).
		Mica Undercut (After recut)	Depth: 0.050 inch (1,27 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.040 inch (1,02 mm) to 0.050 inch (1,27 mm).
		Commutator bar to bar acceptance test values	Bar-to-Bar: 0.0002 inch (0,005 mm) max. T.I.R: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar (Before refinishing)	Bar-to-Bar: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar and concentricity (After refinishing)	Bar-to-Bar: 0.0001 inch (0,0025 mm) max. T.I.R: 0.0005 inch (0,0127 mm) max.
		Balance	5 grain inch (8,2 gr mm) max. (each end).

Table 8001 - Acceptance Limits (Continued)

CHECK Para. Ref.	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
8.Y.	Terminal Block (10004-50)	Capacitance values: B to E and B to ground	1.8 to 2.2 µFd checked at 100 VDC/<1µA and frequency of 110 to 130 Hz.
	Capacitance measured at 77° F (25° C). Frequency at which capacitance is measured is 120 Hz ± 10 Hz.		

Table 8001 - Acceptance Limits (Continued)

3. Torque Values

NOTE: Numbers in parentheses ( ) refer to item numbers on the figure of ILLUSTRATED PARTS LIST, unless otherwise specified.

Table 8002 gives information necessary to tighten fasteners to specified torque. Values shown do not include frictional torque caused by self-locking devices or rundown resistance. Frictional torque values must be added to the specified torque.

Nuts, bolts, and screws not listed in Table 8002 are to be tightened in accordance with Safran Power methods and techniques or practices acceptable to your administration as specified in FAR PART 43.

Hardware Description	Torque Acceptance Limits
Screw (10001-60)	7.7 to 10.3 lbf.in. (0,87 to 1,16 N·m)
Fillister Head Screw (10001-80)	13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m)
Self-locking Nut (10001-110)	80 to 100 lbf.in. (9,0 to 11,3 N·m)
Spanner Nut (10001-130) Initial Final	 150 to 200 lbf.in. (16,9 to 22,6 N·m) 80 to 100 lbf.in. (9,0 to 11,3 N·m)
Fillister Head Screw (10001-180)	20.0 to 30.0 lbf.in. (2,3 to 3,4 N·m)
Screw (10001-210)	22.7 to 35.0 lbf.in. (2,6 to 4,0 N·m)
Socket Head Cap Screw (10001-320)	13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m)
Screw (10001-350)	7.7 to 10.3 lbf.in. (0,87 to 1,16 N·m)
Screw (10001-380)	13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m)
Screw (10001-460)	13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m)
Machine Bolt (10002-30)	25.0 to 30.0 lbf.in. (2,8 to 3,4 N·m)
Fillister Head Screw (10004-60)	20.0 to 25.0 lbf.in (2,3 to 2,8 N·m)
Self-locking Nut (10005-20)	70 lbf.in. (7,9 N·m)

Table 8002 - Torque Values

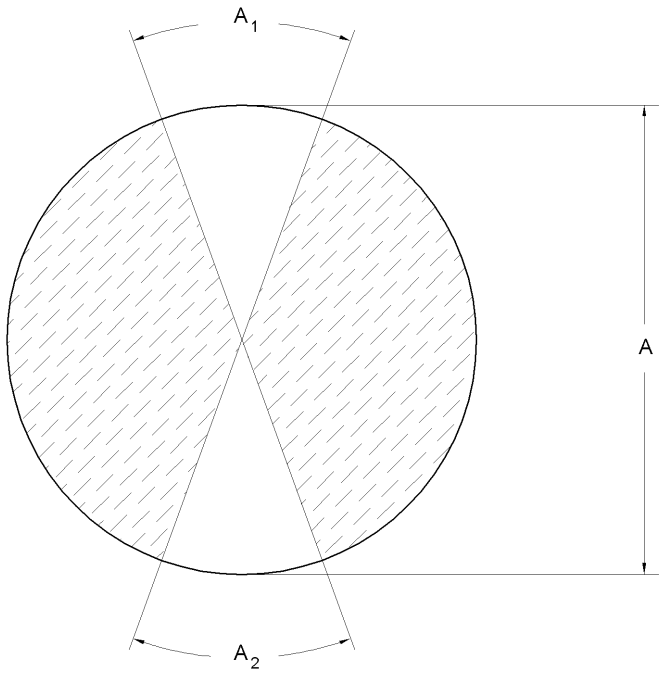


Figure 8001 - Measuring Armature Bearing Journal Diameters

NOTE: During overhaul/service inspection, diameter of bearing journal is considered to be acceptable if not more than 25% of circumference is below the minimum diameter limit (See Figure 8001). When the starter-generator is to be repaired and returned to service on a “continued time” basis, the minimum diameter limit of bearing journal diameter “A” is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) below minimum diameter limit.

NOTE: Acceptance criteria for used journals, not new or repaired journals.

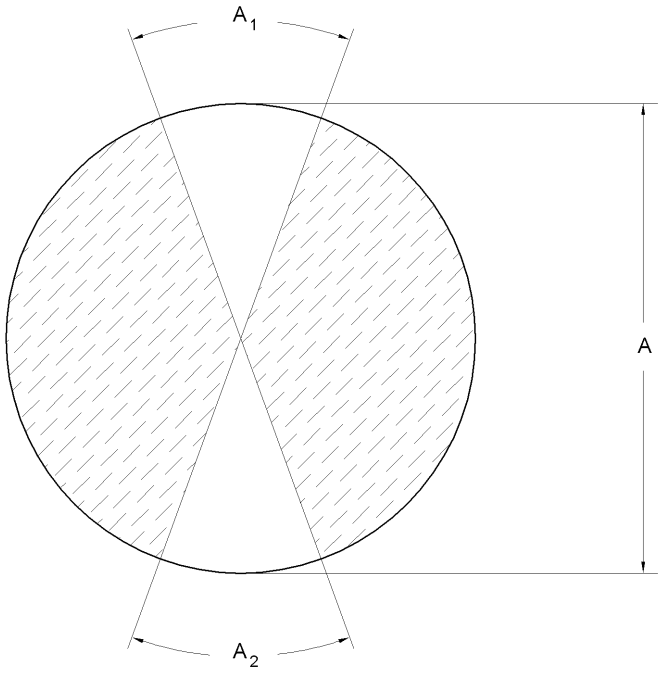


Figure 8002 - Measuring Bearing Liner Diameters

NOTE: During overhaul/service inspection, diameter of bearing liner is considered to be acceptable if not more than 25% of circumference is above the maximum diameter limit (See Figure 8002). When the starter-generator is to be repaired and returned to service on a “continued time” basis, the maximum diameter limit of bearing liner diameter “A” is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) above maximum diameter limit.

NOTE: Acceptance criteria for used liners, not new or repaired liners.

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SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. Introduction

Table 9001 lists the approved special tools, fixtures, and equipment necessary for starter-generator service.

Nomenclature	Figure
Adapters, Armature Shaft (Drive End, Anti-Drive End)	9001
Adapter, Commutation Viewing	9002
Drivers, Bearing (Inner Race and Outer Race)	9003
Fixture, Commutator Turning	9004
Fixture, Rivet Alignment and Press	9005
Support, Armature	9006
Support, Bearing and Brush Support Assembly	9007
Supports, Hub, (Drive End and Anti-Drive End)	9008
Support, Horizontal Stator	9009
Support, Vertical Stator	9010
Driver, Dampener Hub	9011
Driver, Dampener Plate	9012
Wrench, Spanner, Part No. TG-1277-1011	9016
Wrench, Spline	9013
PlusNut® Fastener Header	9014
Brush Holder Alignment Fixture	9015
Dampener Plate Gauge Tool, P/N 19-601076	9017

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 drawn cannot be procured from Safran Power. Equivalent tooling and fixture requirements meeting with Safran Power specifications can be used.

A. Armature shaft adapters (drive end, anti-drive end). See Figure 9001.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Materials: Brass.

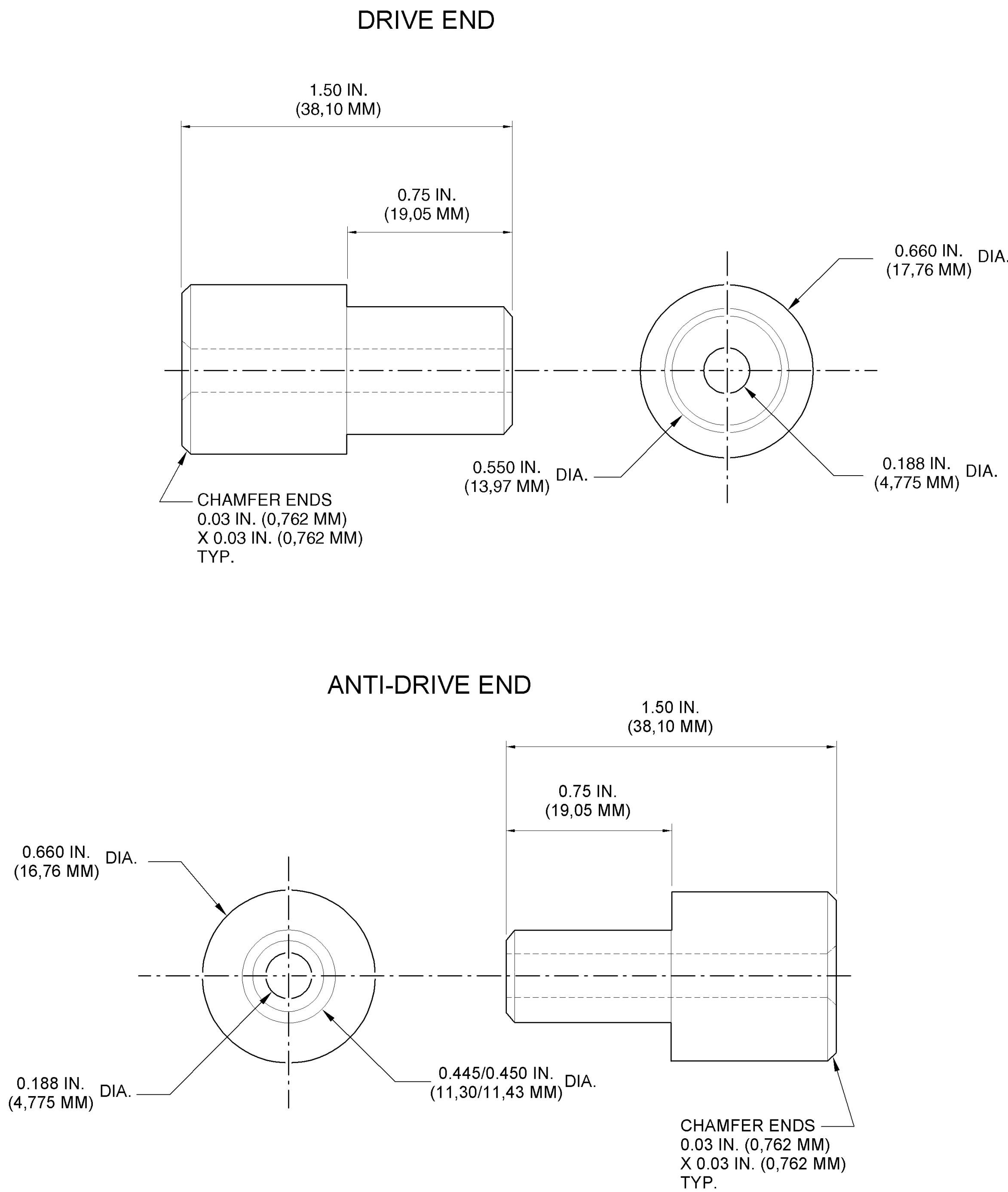


Figure 9001 - Armature Shaft Adapters

B. Commutation viewing adapters. See Figure 9002

This adapter is constructed using a used brush access cover. Two designs are shown. Design one uses four pieces of acrylic, 2.00 inch (50,8 mm) high by 1.75 inch (44,5 mm) wide by 0.063 inch (1,60 mm) thick. Design two uses one piece of acrylic, 18.18 inch (461,8 mm) long by 2.50 inch (63,5 mm) wide by 0.125 inch (3,18 mm) thick. Construction of these designs is as follows:

(1) Design One

(a) Cut four holes in a brush access cover. Each hole should be positioned above one of the four brush holder assemblies to allow for viewing the brushes as they make contact with the commutator during test.

(b) Cut four pieces of clear acrylic to be larger than the brush access holes in the stator and housing assembly.

(c) Apply adhesive on the inside surface of the viewing adapter to the frame of the cut out viewing windows.

(d) Attach the four pieces of acrylic to the viewing windows on the inner surface of the viewing adapter using four pop rivets.

(2) Design Two

(a) Remove the brackets from a used brush access cover.

(b) Attach the brackets to a piece of clear acrylic.

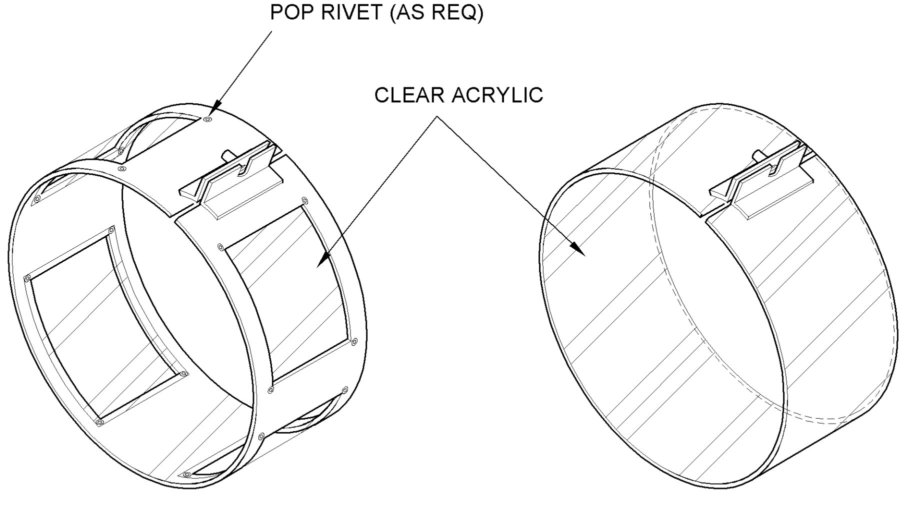


Figure 9002 - Commutation Viewing Adapter

C. Bearing drivers (inner race and outer race). See Figure 9003.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell Rc 55-60. Material: 1040 Steel, 2.00 inch (50,8 mm) diameter stock size.

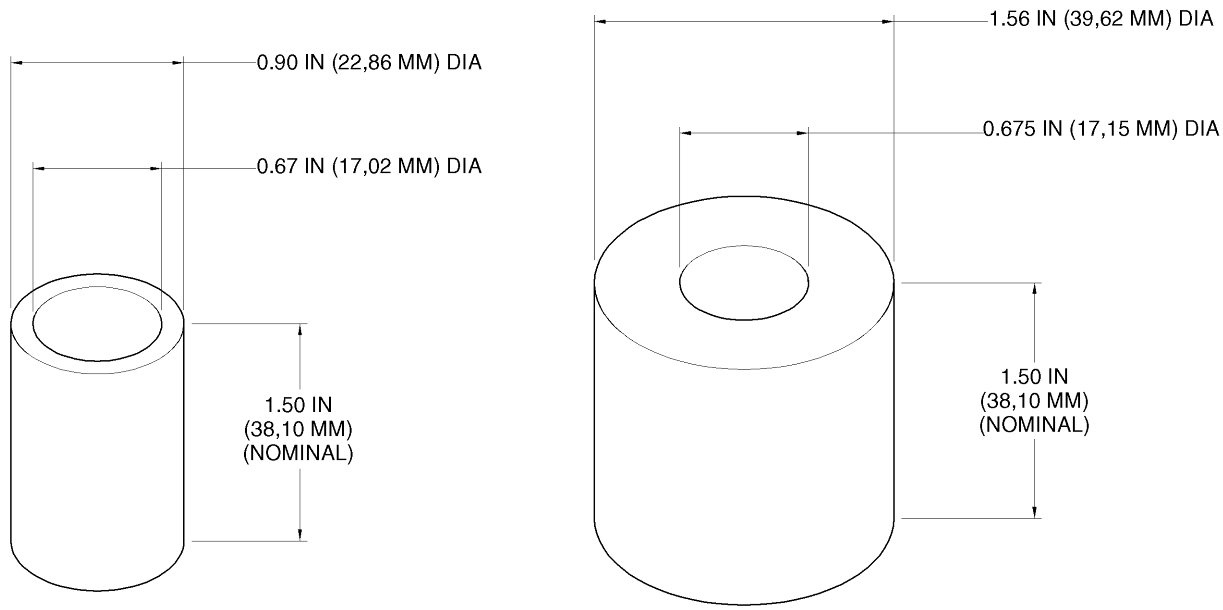


Figure 9003 - Bearing Drivers

D. Commutator turning fixture. See Figure 9004.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell Rc 35-40. Material: 1040 Steel, Stock size: 2.00 inch (50,8 mm) diameter.

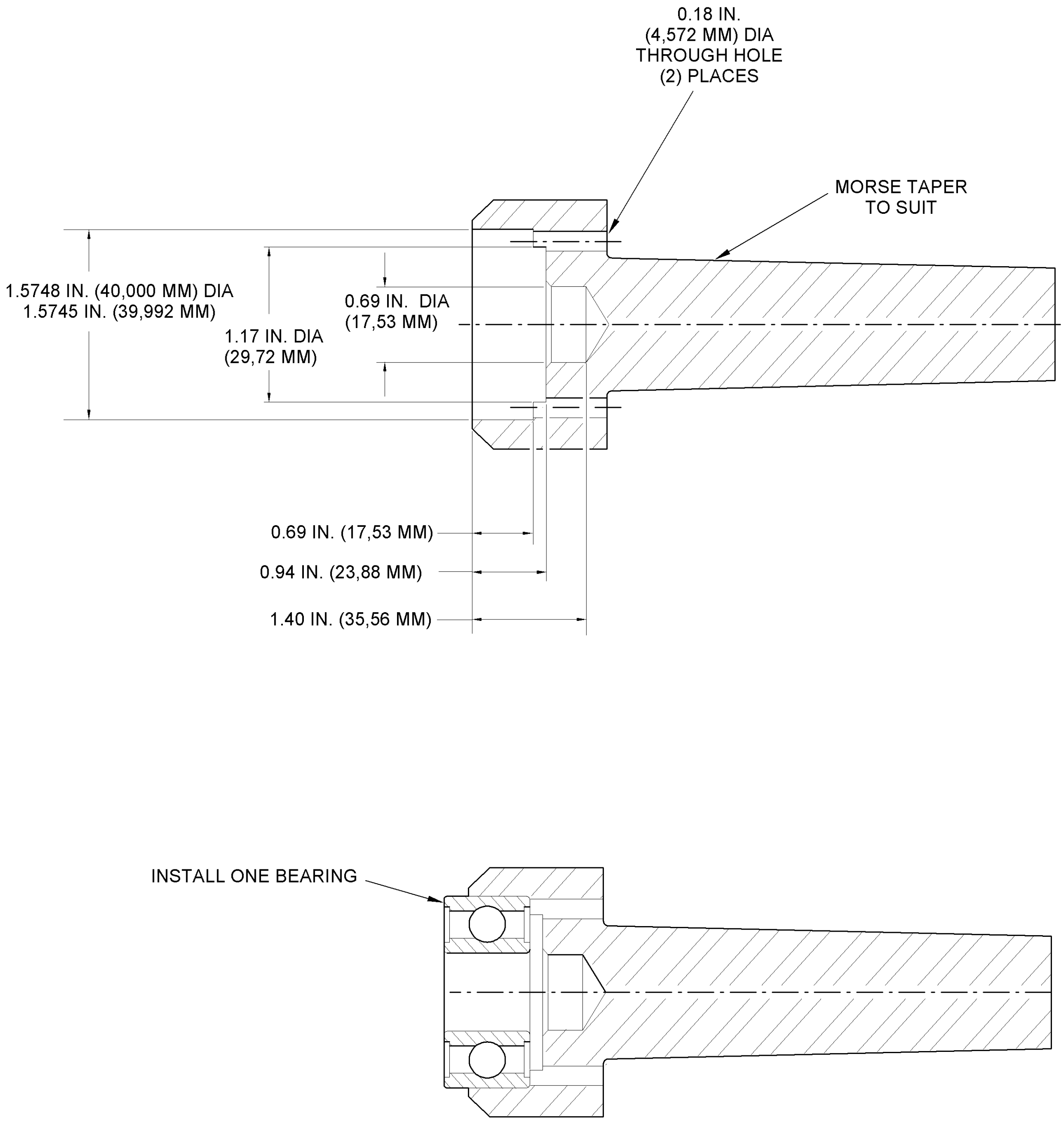


Figure 9004 - Commutator Turning Fixture

E. Rivet alignment and press fixture. See chart below and Figure 9005.

Tolerances on: Decimals 0.XX ± 0.01 inch (± 0,25 mm)
0.XXX ± 0.005 inch (± 0,127 mm)

Angles ± 5 Degrees

Materials:

Item	Qty	Dimensions	Description
1	1	0.50 inch (12,7 mm) x 5.00 inch (127,0 mm) x 5.00 inch (127,0 mm)	1010 Cold Roll Steel
2	1	0.75 inch (19,05 mm) x 3.00 inch (76,2 mm) x 3.00 inch (76,2 mm)	1010 Cold Roll Steel
3	1	0.50 inch (12,7 mm) x 2.50 inch (63,5 mm) x 2.50 inch (63,5 mm)	1010 Cold Roll Steel
4	1	0.188 inch (4,76 mm) Dia x 1.750 inch (44,45 mm) Long	O1 Tool Steel, Drill Rod
5	2	0.625 inch (15,88 mm) Dia x 1.750 inch (44,45 mm) Long	O1 Tool Steel, Drill Rod
6	2	0.190 inch (4,83 mm) -24	Screw, Cap, Socket Head
7	3	0.250 inch (6,35 mm) -20	Screw, Cap, Socket Head
8	1	1.50 inch (38,1 mm) Dia x 4.125 inch (104,78 mm) Long	A2 Tool Steel, Harden to Rockwell C 55-60

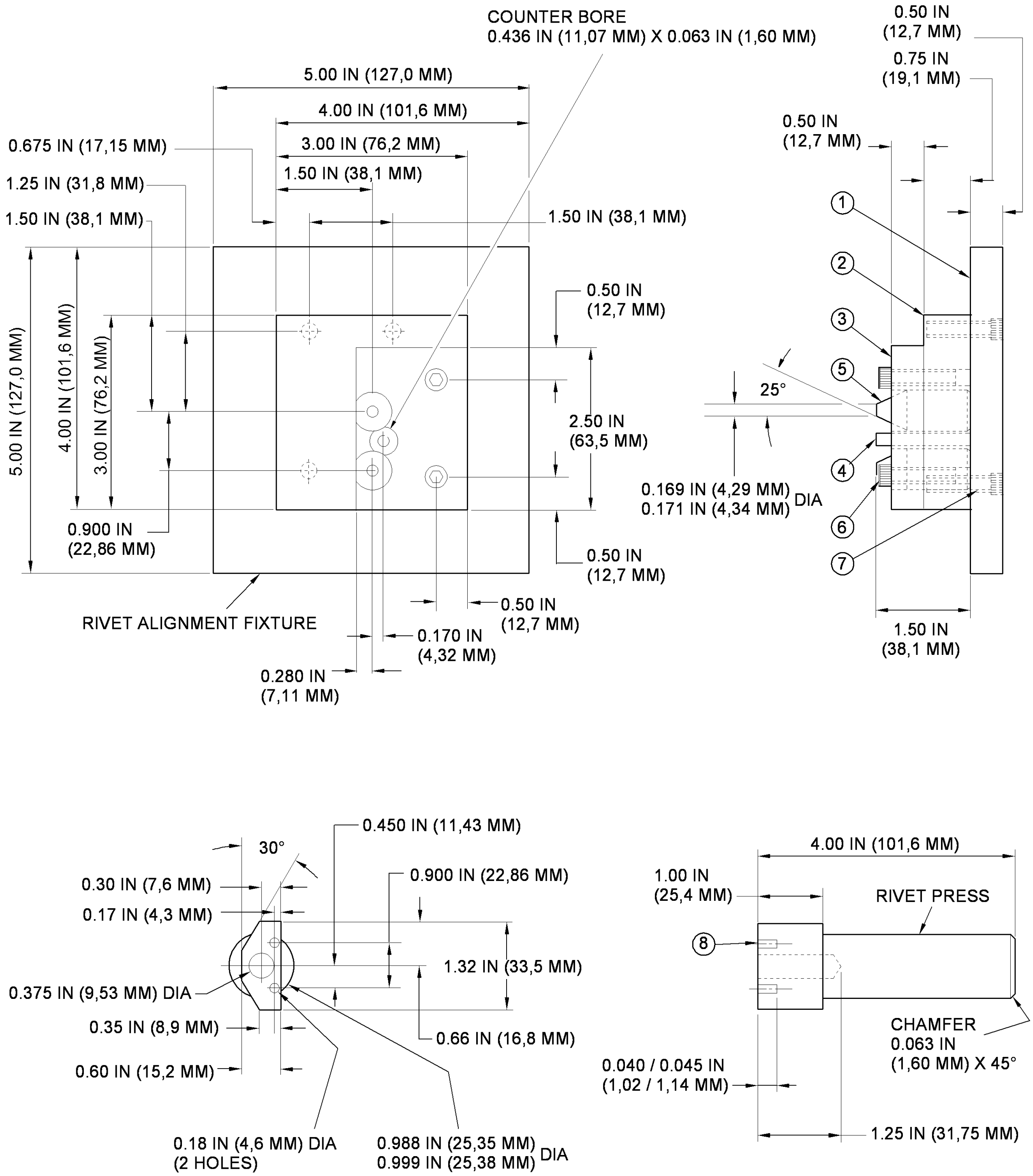


Figure 9005 - Rivet Alignment and Press Fixture

F. Armature support. See Figure 9006.

Material 0-1 tool steel, hardened to Rc 35-40. Tolerances on decimal 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm).

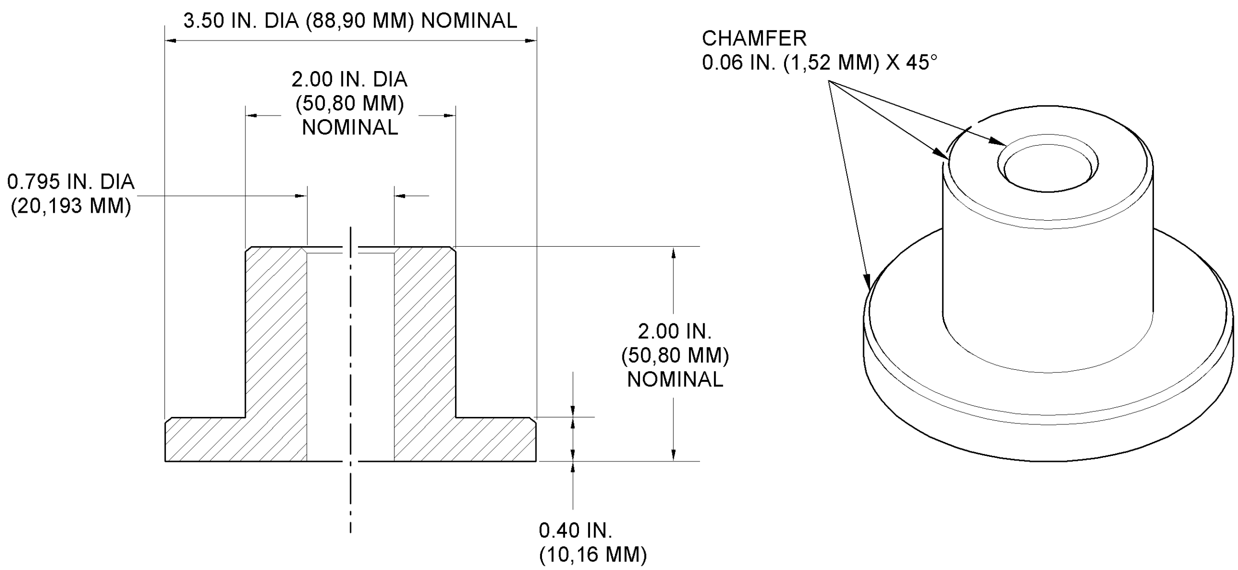


Figure 9006 - Armature Support

G. Bearing and brush support assembly support. See Figure 9007.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Angles ± 2°0'. Material is 01 Tool Steel or Equiv., Stock size: 6.00 inch (152,4 mm) diameter.

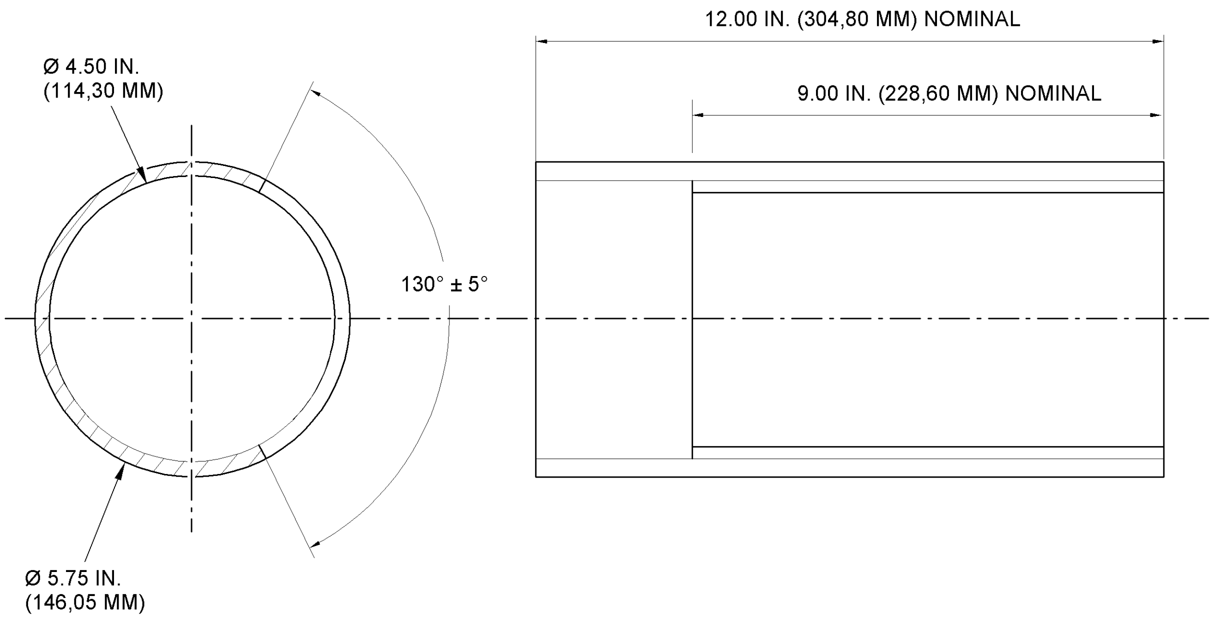


Figure 9007 - Bearing and Brush Support Assembly Support

H. Hub supports (drive end and anti-drive end). See Figure 9008.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Material is 1040 Steel hardened to Rc 35 - 40, Stock size: 2.00 inch (50,8 mm) diameter.

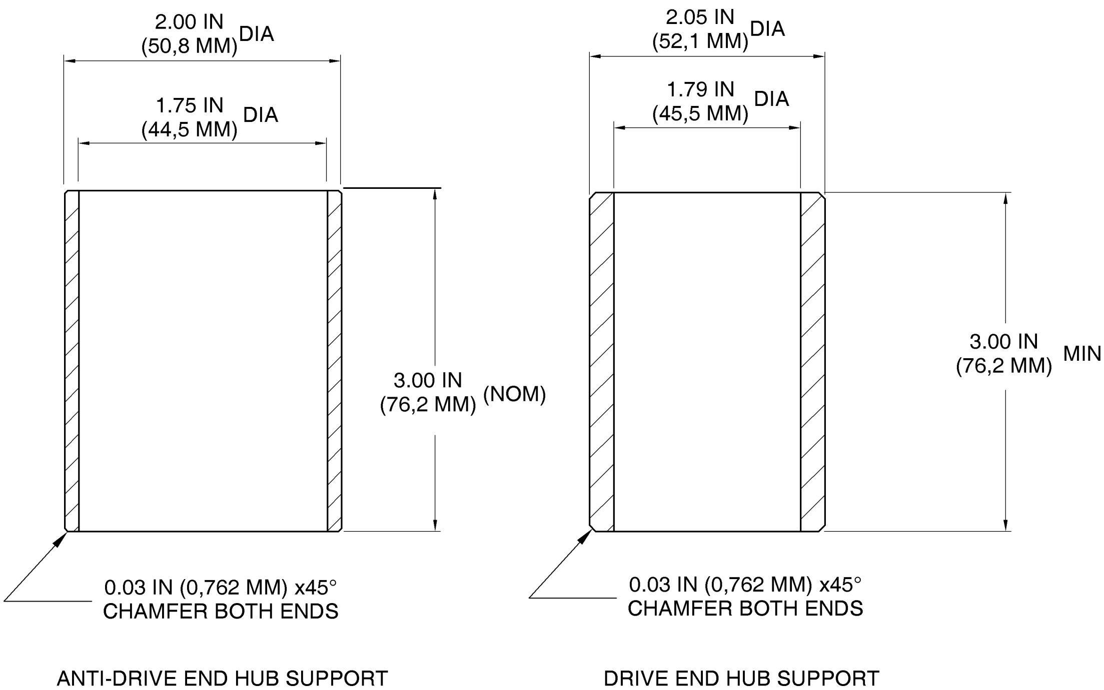


Figure 9008 - Drive End and Anti-Drive End Hub Support

I. **Horizontal stator support. See Figure 9009.**

All dimensions are nominal. The material is a suitable hardwood.

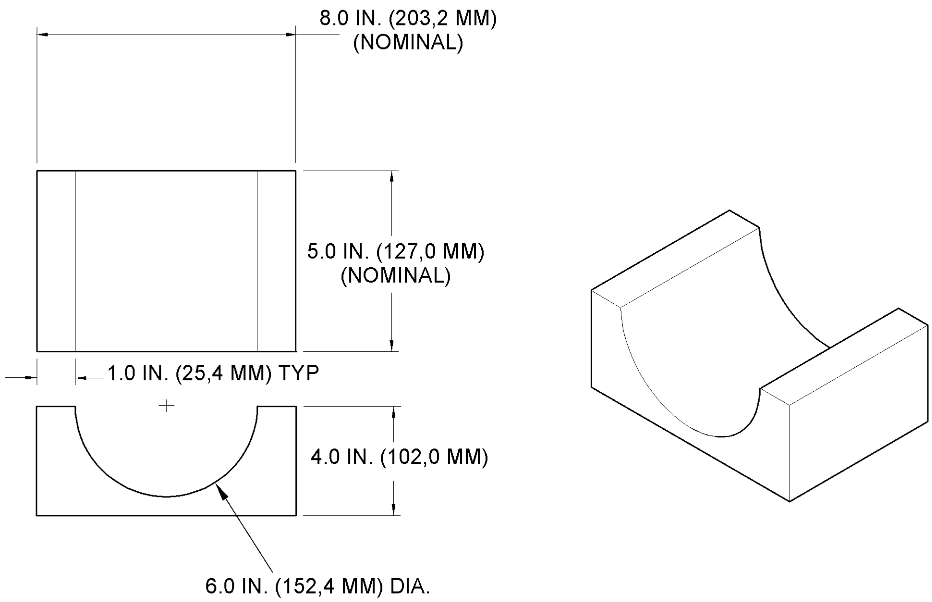


Figure 9009 - Horizontal Stator Support

J. Vertical stator support. See Figure 9010.

All dimensions are nominal. The material is a suitable hardwood.

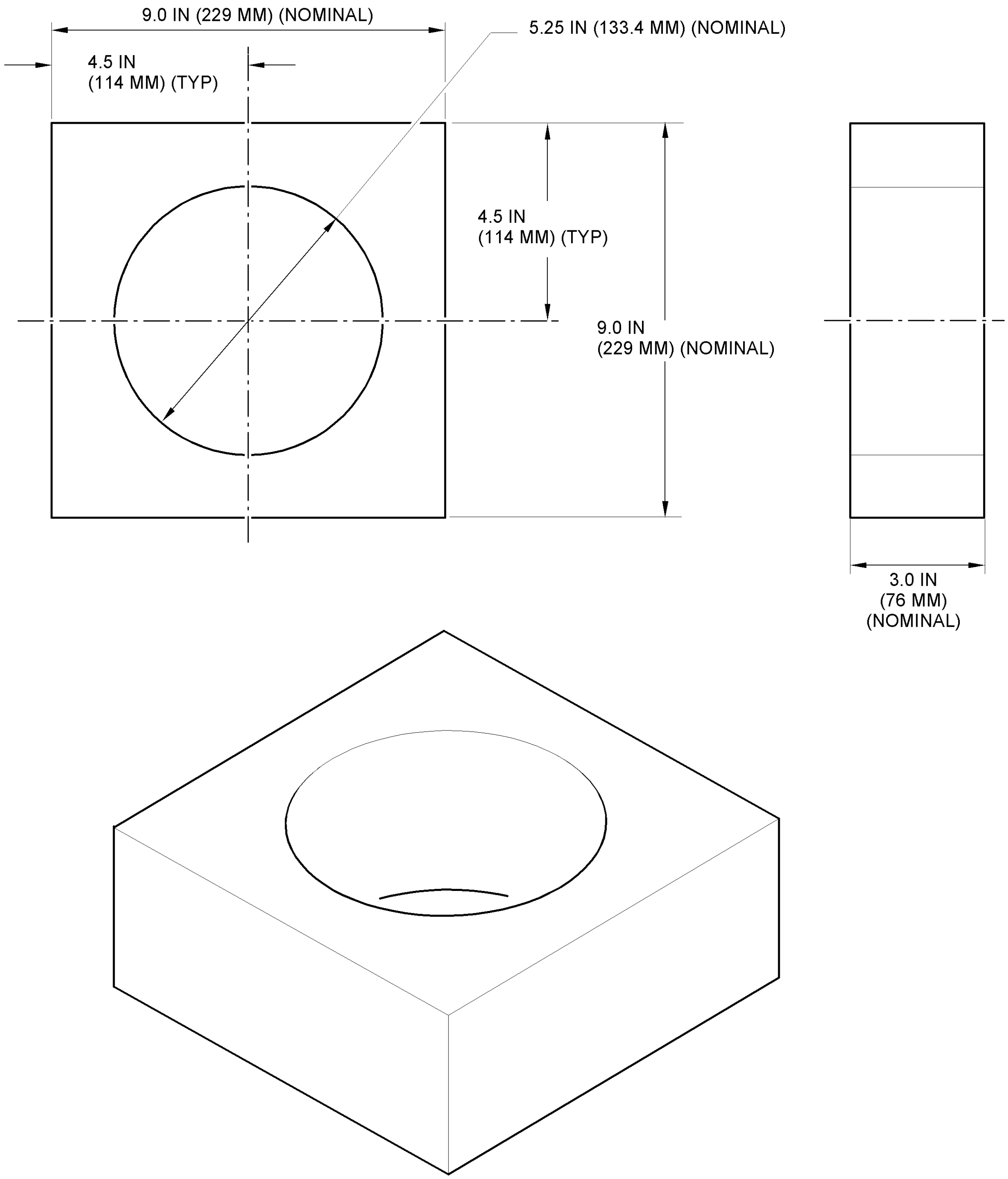


Figure 9010 - Vertical Stator Support

K. Dampener hub driver. See Figure 9011.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Material: 01 tool steel or equivalent.

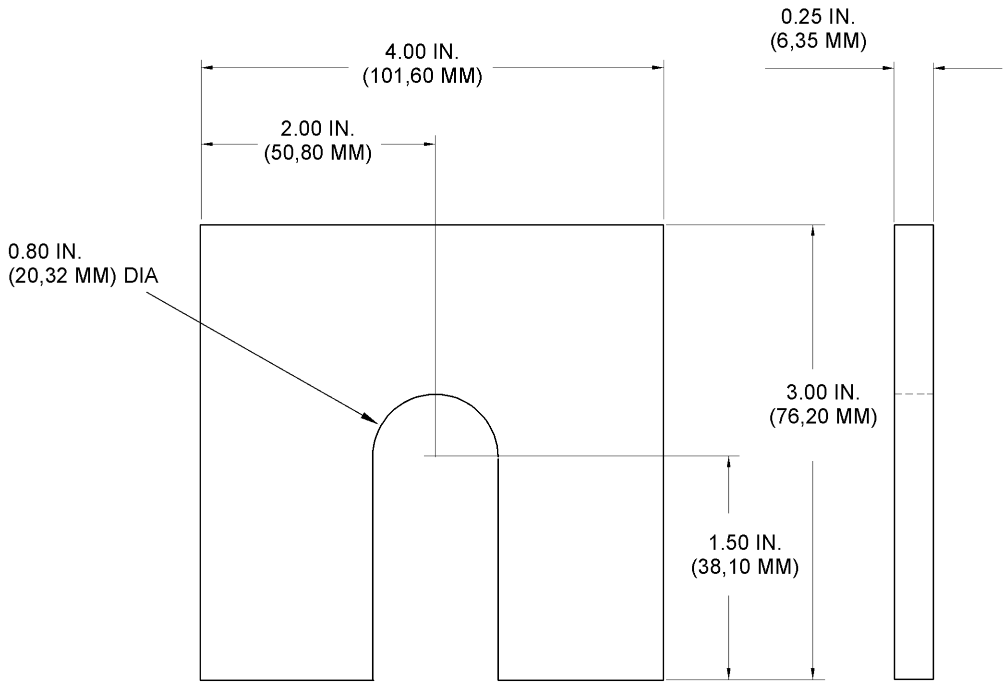


Figure 9011 - Dampener Hub Driver

L. Dampener plate driver. See Figure 9012.

Harden to Rockwell Rc 55-60.

Material:	01 tool steel or equivalent
Stock Size:	3.0 inch diameter (76,2 mm)
Tolerances on:	Decimals 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm)
Angles:	± 1 Degrees

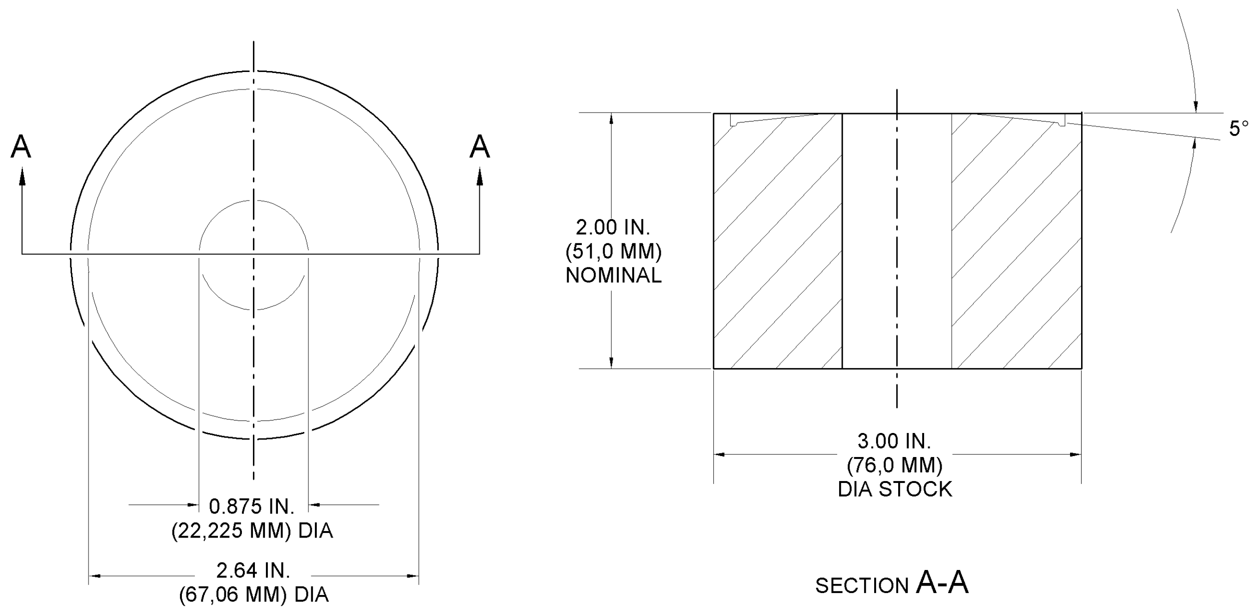
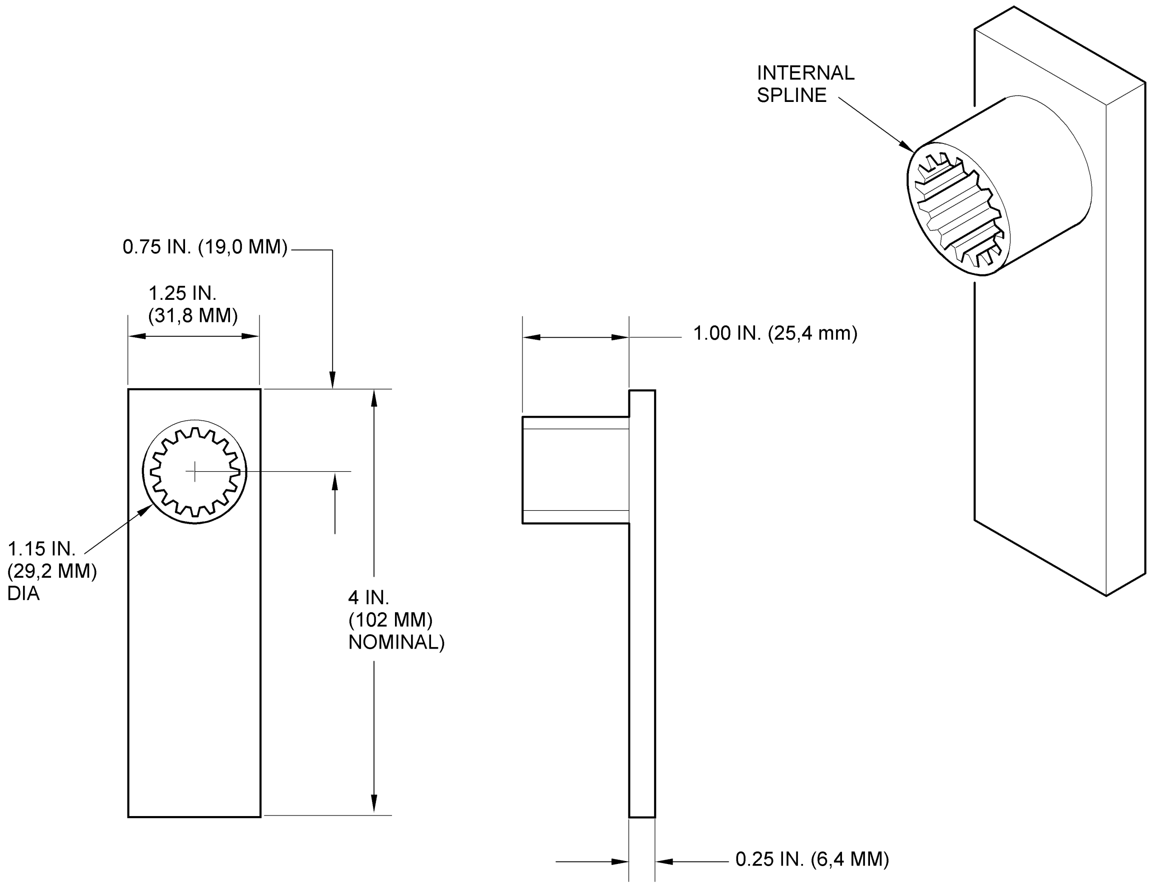


Figure 9012 - Dampener Plate Driver

M. Spline wrench. See Figure 9013.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Angles ±2°0’. Material is 1040 Steel, Stock size: 1.0 inch (25,4 mm) diameter, 4.00 inch (102,0 mm) long x 1.25 inch (31,75 mm) wide.



12 TOOTH SPLINE

INTERNAL INVOLUTE SPLINE DATA FILLET ROOT SIDE FIT	INCH	MM
NUMBER OF TEETH	12	
DIAMETRAL PITCH	20/40	
PRESSURE ANGLE	30°	
PITCH DIAMETER	0.6000	15,240
MINOR DIAMETER (MIN)	0.5550	14,097
MAJOR DIAMETER (MIN)	0.6500	16,510
CHORD SPACE (MIN)	0.0730	1,853
PIN DIAMETER	0.0720	1,829
BETWEEN THREE 0.0720 IN (1,829 MM) PINS (MIN)	0.5095	12,941

Figure 9013 - Spline Wrench

N. PlusNut® fastener header. See Figure 9014.

NOTE: For rivet nut replacement - Reference REPAIR section.

Part Number: C1000-832 (for NAS1329H08K120L in anti-drive end end bell).
Part Number: C1000-1032 (for NAS1329H3K130L in brush access cover).

Vendor Cage Code: V 0ZVN9

NOTE: Refer to ILLUSTRATED PARTS LIST section for Vendor CAGE Code name and address for tool procurement.

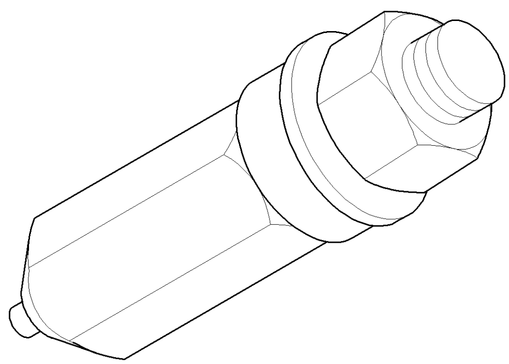


Figure 9014 - PlusNut® Fastener Header

O. Brush holder alignment fixture. See Figure 9015

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Angles ± 2°0'. Material is Tool Steel.

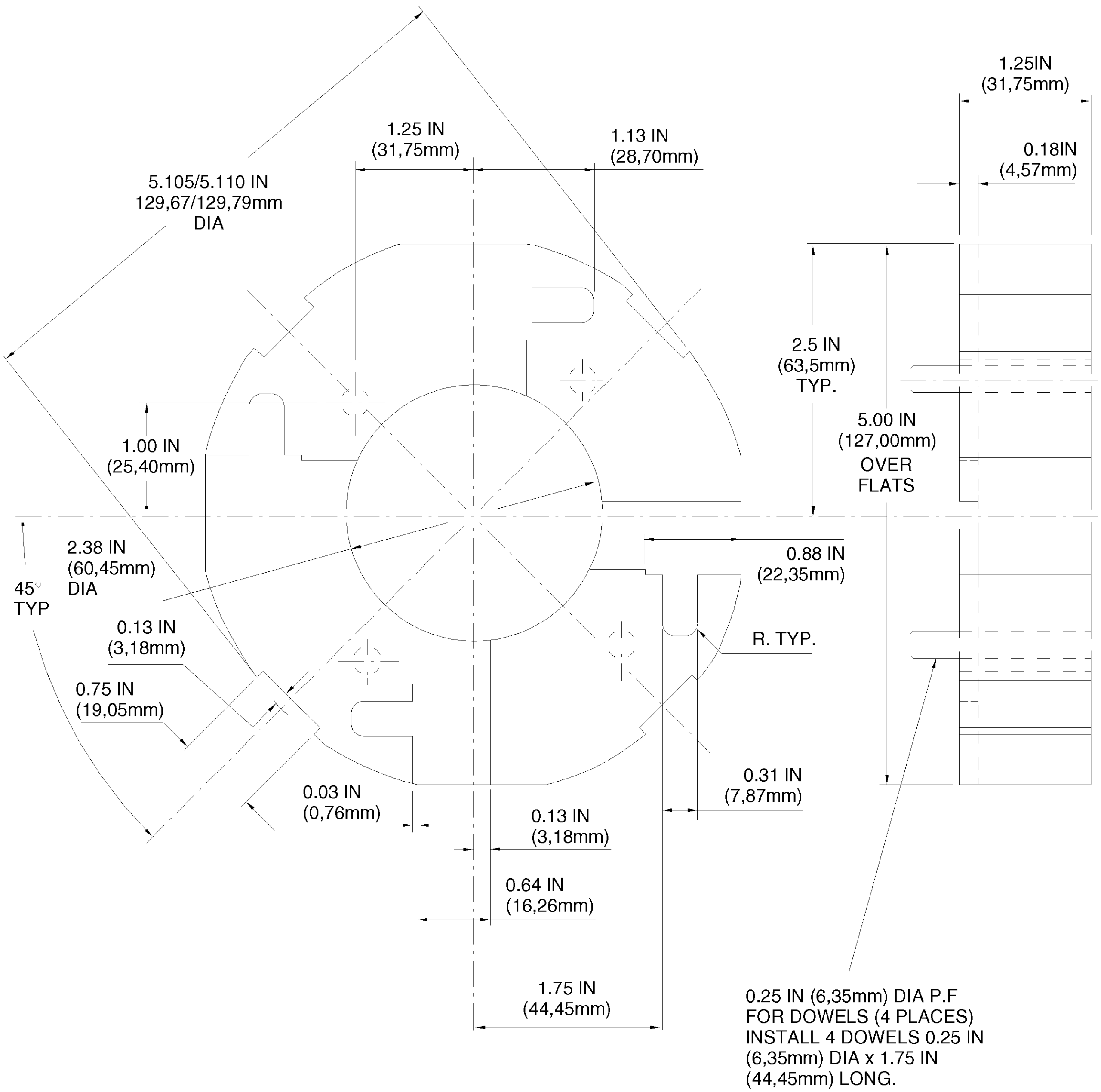


Figure 9015 - Brush Holder Alignment Fixture

P. Wrench, Spanner, Part No TG-1277-1011 to fit MS172239 Nut. See Figure 9016

Material is tool steel, hardened to Rc 56-58. Brazed to 0.813 in. (20.65 mm) deep socket. Tolerances on decimal 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm).

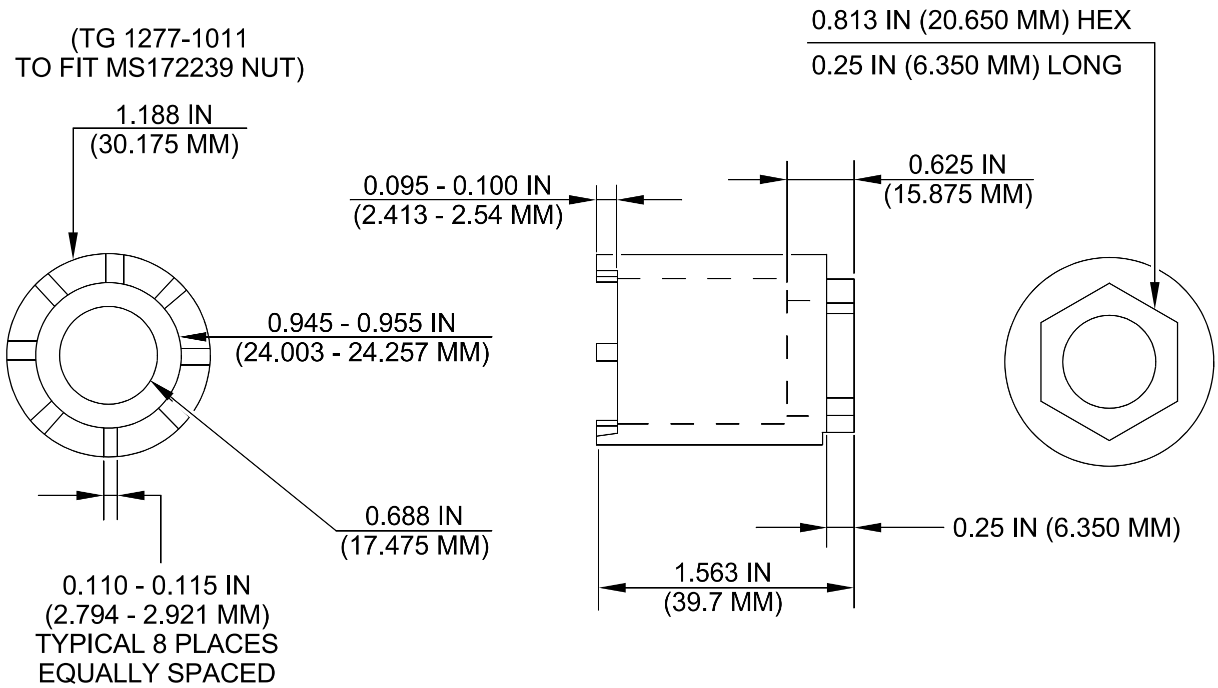
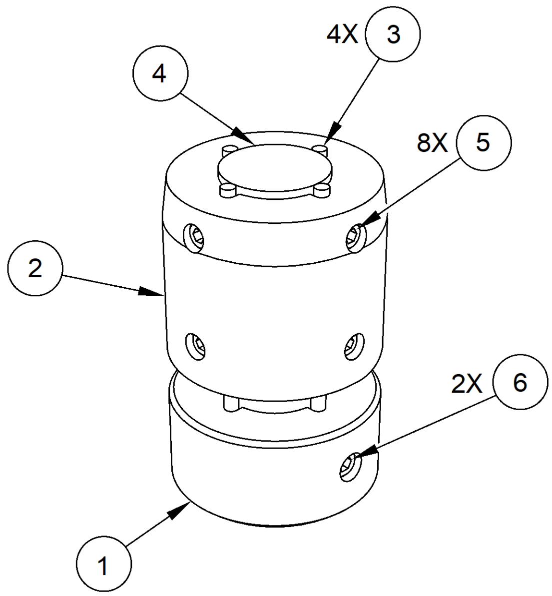


Figure 9016 - Wrench, Spanner, Part No TG-1277-1011

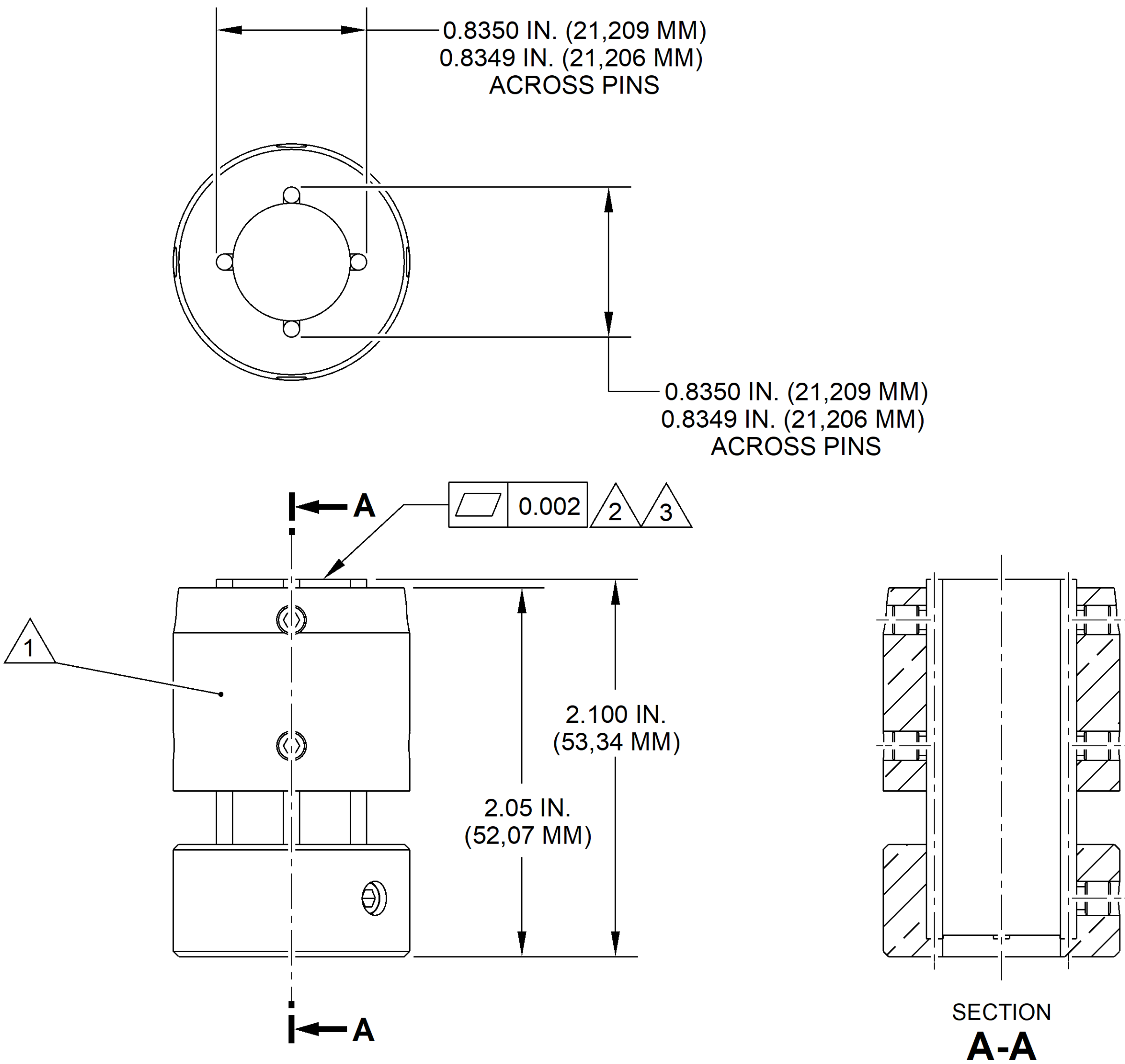
Q. Dampener Plate Gauge Tool. See Figure 9017

NOTE: To check the splines of the dampener plate - Reference CHECK section.



ITEM	PART	MATERIAL	QTY.
1	BOTTOM COLLAR, KNURLED	W1 TOOL STEEL OR O1 TOOL STEEL	1
2	TOP COLLAR	W1 TOOL STEEL OR O1 TOOL STEEL	1
3	CLASS X GAUGE PIN, Ø 0.0900 IN. (2,286 MM) X 2.00 IN. (50,8 MM) LENGTH	TOOL STEEL	4
4	CLASS X GAUGE PIN, Ø 0.6550 IN. (16,637 MM) X 2.00 IN. (50,8 MM) LENGTH	TOOL STEEL	1
5	#8-32 UNC-3A X 3/16 SET SCREW	STEEL	8
6	#10-24 UNC-3A X 3/16 SET SCREW	STEEL	2

Figure 9017 - Dampener Plate Gauge (P/N 19-601076) (Sheet 1 of 4)



NOTES:

1 MARK TOOL WITH PART NUMBER 19-601076 APPROXIMATELY WHERE SHOWN.

2 WHEN ASSEMBLED, FACES OF ITEMS 4 AND ITEM 3 SHALL MEET REQUIREMENT.

3 DIAMOND KNURL FINISH ITEM 1 ON SURFACE INDICATED.

Figure 9017 - Dampener Plate Gauge (P/N 19-601076) (Sheet 2 of 4)

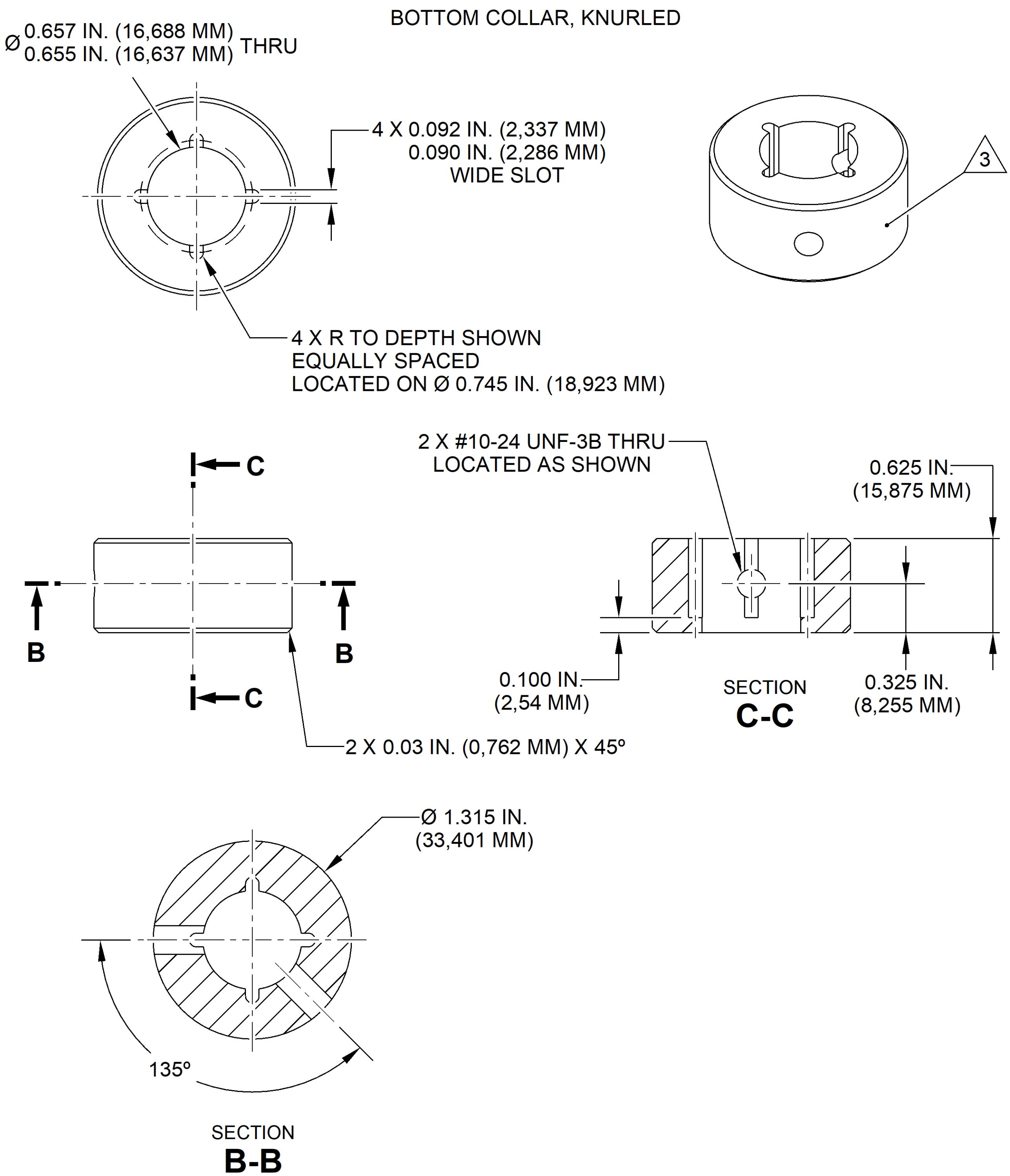


Figure 9017 - Dampener Plate Gauge (P/N 19-601076) (Sheet 3 of 4)

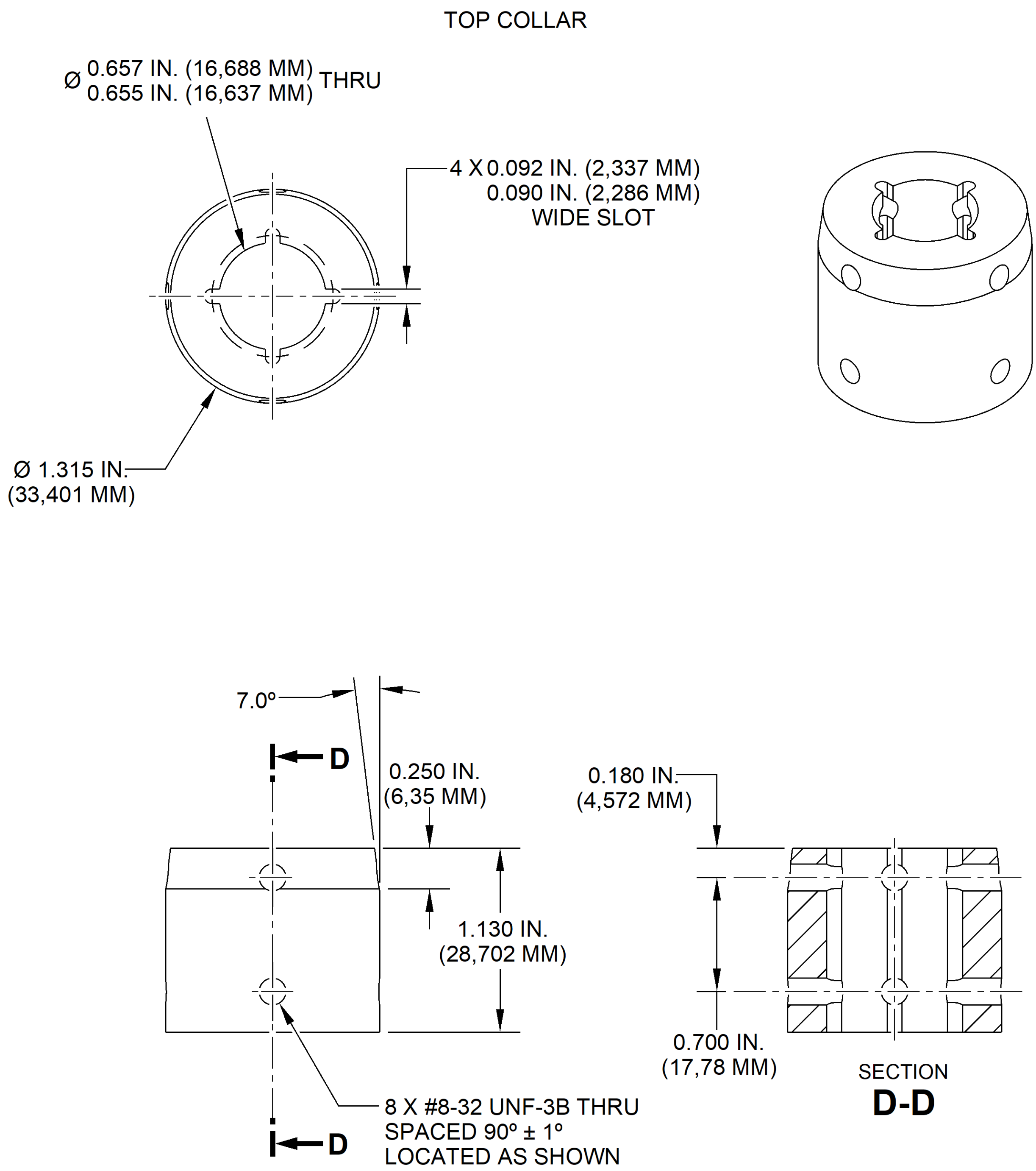


Figure 9017 - Dampener Plate Gauge (P/N 19-601076) (Sheet 4 of 4)

SPECIAL PROCEDURES

1. Introduction

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REMOVAL

1. Introduction

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INSTALLATION

1. Introduction

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SERVICING

1. Introduction

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STORAGE

1. Storage

Materials required to pack the generator for storage or shipment are listed in Table 15001.

Description	Specification	Quantity
Bag, small, plastic	Commercially available.	1
Bag, waterproof, vapor-proof	Commercially available. Bag must totally enclose instructions for installation and then be sealed.	1
Bag, waterproof, vapor-proof	Kraft-foil or suitable equivalent. Bag must totally enclose generator and then be sealed.	1
Box - domestic class, single wall, corrugated cardboard.	PPP-B-636 or suitable equivalent. Box must be large enough to totally enclose and restrain bagged and cushioned generator.	1
Box - WC5 overseas shipping container.	PPP-B-636 or suitable equivalent. Box must be large enough to completely enclose domestic class packaging.	1
Cardboard Tubing	Commercially available.	AR
Chemically Neutral Protective Paper	Commercially available.	AR
Desiccant	MIL-D-3464 Type I and II	1
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam. (Safran Power 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
Tag	Commercially available.	1 (Domestic) 2 (Internat'l)
Tape - waterproof, pressure sensitive.	Commercially available.	AR

Table 15001 - Packaging Material

A. General information.

CAUTION: IF MACHINE STORAGE TIME IS MORE THAN 24 MONTHS WITH NO USE, IT IS RECOMMENDED THAT ITS BEARINGS BE REPLACED. IT MUST THEN BE RE-TESTED ACCORDING TO TESTING AND FAULT ISOLATION SECTION BEFORE BEING PLACED INTO SERVICE.

(1) Unit must have successfully completed tests specified in TESTING AND FAULT ISOLATION section of this manual before preparing unit for shipment or storage.

(2) Verify that lockwire is in place.

(3) Record following information to tag(s):

- Model Number
- Serial Number
- Mod Status
- Test Date (PASSED)
- Packing date

(4) Use packaging materials as specified in Table 15001.

B. Documentation.

Include all applicable documentation with unit:

- Testing Records
- Repair Reports
- Final Inspection/Check Records
- Packing List and Certificate of Conformance

C. Domestic Packaging.

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

(1) Place O-ring (10001-230) into a small plastic bag and attach to machine.

(2) Place unit and desiccant into a waterproof and vapor-proof heat-seal bag and partially heat-seal it while forcing as much air as possible from bag.

(3) Insert vacuum tube into bag to draw remaining air out of bag.

(4) Withdraw vacuum tube quickly and complete heat-sealing of bag.

(5) Using machine's original shipping container if possible, place bagged machine into box surrounded with a minimum of 3 inch (76,2 mm) thick shock absorbing, cushioning material on all six sides.

(6) Securely and completely seal all flapped openings of box with tape.

(7) Tape tag to exterior surface of box. Make sure all information is visible.

D. Overseas Shipment On Surface Vessels.

(1) Accomplish domestic packaging of machine in accordance with Paragraph 1.C.

(2) Place domestically packaged starter-generator into WC5 shipping container.

(3) Securely and completely, seal all flapped openings of shipping container with tape.

(4) Tape tag to exterior surface of shipping container. Make sure all information is visible.

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REWORK

1. Introduction

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ILLUSTRATED PARTS LIST

1. Introduction

This section contains a listing of assemblies and detail parts for 23085 Series II DC Starter-Generators. All parts are listed, but for parts which lose their identities by being permanently fastened to other parts or are part of an assembly not subject to disassembly. Each list is arranged in disassembly sequence, but that attaching parts are listed immediately after the parts they attach, under the heading of (ATTACHING PARTS).

All replacement parts are manufactured or source-controlled by Safran Power with the exceptions listed in Paragraph 2.B.

CAUTION: DO NOT USE PARTS, MATERIALS OR PROCEDURES NOT APPROVED BY SAFRAN POWER. IF YOU DO, YOU WILL INVALIDATE THE CONTINUED FLIGHT WORTHINESS OR CERTIFICATION OF THE STARTER-GENERATOR.

To order authorized Safran Power parts, contact your regional Safran Power Spares Portal.

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. 10A). This indicates that the part has the same function and location as the base number (e.g. 10), but can be different in form and material. An item number that is preceded by a dash (e.g. -30) is not illustrated in the applicable figure.

B. Part Number

The part numbers listed in this column are the only authorized parts for replacement and overhaul of the starter-generator. Part numbers in this IPL consists mainly of Safran Power part numbers, and does include Military Standard (MS), Army Navy (AN), National Aerospace Standard (NAS) and industry standard (ANSI, ASME, ISO, etc.) part numbers unless a Commercial and Government Entity (CAGE) code appears in the Nomenclature column. Refer to Paragraph 3. for details.

C. Nomenclature

The proper name and type of each part is provided in this column. The description of each item is indented by columns to indicate the relationship to the next higher assembly. The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

(1) The description of each item is indented by columns to indicate the relationship to the next higher assembly (NHA). Each listed item is placed in the NOMENCLATURE column one indenture (one dot) to the right of the assembly to which it belongs. Items at equal indentures are all components of a single assembly or subassembly. The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

1 2 3 4 5
Assembly, level 1, no bullets
Detail Parts for Assembly, level 2, 1 bullet
Sub-Assembly, level 3, 2 bullets
Attaching Parts for Sub-Assembly, level 4, 3 bullets
Detail Parts for Sub-Assembly, level 5, 4 bullets

The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. The abbreviations used to show this are as follows:

ALT	One of the two part numbers can be used. If the part number in the Nomenclature column is NOT specified as 'ALT', it can not be used as an alternative. The information is for reference only or as a way to help identify the part.
OPT	Optional. The part is fully interchangeable in form, fit and function with the subject part number. This gives an alternative part for procurement and support functions.
PRFD	Preferred. The part is the preferred part to the other optional parts shown.
REPLD BY	Replaced by. The part is replaced by and interchangeable with the item number shown.
REPLS	Replaces. The part replaces and is interchangeable with the item number shown.
SUPSD BY	Superseded by. The part is replaced by and is not interchangeable with the item number shown.
SUPSDS	Supersedes. The part replaces and is not interchangeable with the item number shown.

D. Effect Code

This column establishes part relationships with starter-generator models, which are essentially the same, but have minor variations. These starter-generator models are the end items on the detailed parts list and are assigned reference letters such as A, B, C, D, etc. Subassemblies or detail parts, which are not common to all configurations, but are associated with one or more of the coded end items, carry the letter or letters assigned to the end item(s) with which they are associated. When parts are used on all models, the column is left blank. Effectivity codes are redefined for each major subassembly figure.

E. Units Per Assembly

The numbers listed in this column indicate the quantity of parts used per assembly at the location shown and are not necessarily the total quantity per unit. For bulk items, the abbreviation AR is used to indicate the part quantity is "as required". The abbreviation NP indicates non-procurable and refers to items which are not procurable and can not be ordered. The abbreviation RF indicates that the item is listed for reference only.

3. Vendors

In the case of an item supplied by a vendor and not listed under the prime manufacturer's part number, a vendor CAGE code is prefixed by the capital letter V appearing in the nomenclature column. This CAGE code number designates the original manufacturer of non-Safran Power components, and is in accordance with Cataloging Hand Books H4-1, H4-2, and H4-3. CAGE codes are listed in the NOMENCLATURE column, but for the government codes below, which are not listed.

V80205	National Aircraft Standard (prefix NAS)
V81349	Military Specifications (prefix M)
V88044	Army/Navy Standard (prefix AN)
V96906	Military Standard (prefix MS)

The Customer Support division in your region is to be contacted for parts dispatch.

VENDOR CODE	NAME AND ADDRESS
0LAX1	National Paper and Packaging Co. Cleveland, OH 44103 www.nationalpaper.com
OPYJ1	Ellsworth Adhesives P.O. Box 1002, W129 N10825 Washington Dr. Germantown, WI 53022-8202 Ph: 800-888-0698 Fax: 262-253-8619 www.ellsworth.com
OSR97	Chase Corporation Woodside, NY 11377 Ph: 718-932-0800 Fax: 718-932-4345 www.humiseal.com
0ZVN9	Omni Fasteners Inc 909 Towpath Road Broadview Heights OH 44147-3676 Ph: 440-838-1800 Fax: 440-838-6200
1DS07	Saint Gobain New Haven CT Ph: 203-777-3631 www.saint-gobain.com/us

VENDOR CODE	NAME AND ADDRESS
1N6B3	Henkel Surface Technology Madison Heights MI 48071-0000 www.hstna.com
3EZL6	Klueber Lubrication Londonderry, NH Ph: 603-647-4104 Fax: 603-647-4105 www.klueber.com
3CPE0	Safran Power Technical Services 8380 Darrow Road Twinsburg, OH 44087 Ph: 330-487-2000 Fax: 330-487-1902
60076	Titan Tool Company Inc 7410 West Ridge Road Fairview, PA 16415-1170 Ph: (814) 474-1583 Fax: (814) 474-5337
7V827	Loctite Corporation Aurora, IL Ph: 860-571-5100 www.loctite.com
94058	The Brulin Corporation 2920 Dr. Andrew J. Brown Ave. Indianapolis, IN 46205-4066 Ph: 317-923-3211 Fax: 317-925-4596 www.brulin.com
97785	Federal Process Co. 3737 Park East Drive Beechwood, OH 44122-4307
NC01	GSA Supply on-line Ph: 800-846-7325 www.gsasupplyco.com

4. NOTES:

NOTE 1: Starter-generators Part No. 23085-029 and 23085-030 are not supplied with a QAD kit. QAD kit must be ordered separately.

NOTE 2: Starter-generator Part No. 23085-031 is not supplied with a QAD kit or air inlet. QAD kit and air inlet must be ordered separately.

NOTE 3: Bearing and Brush support P/N 23085-359 has been replaced by P/N 23085-355. Bearing and Brush Support Assemblies are identical except P/N 23085-359 is obsolete due to configuration changes.

NOTE 4: Anti-Drive End End Bell P/N 23085-1810 must conform to the latest machining standards. See Paragraph 6.A. in the ASSEMBLY section for identification of the latest configuration.

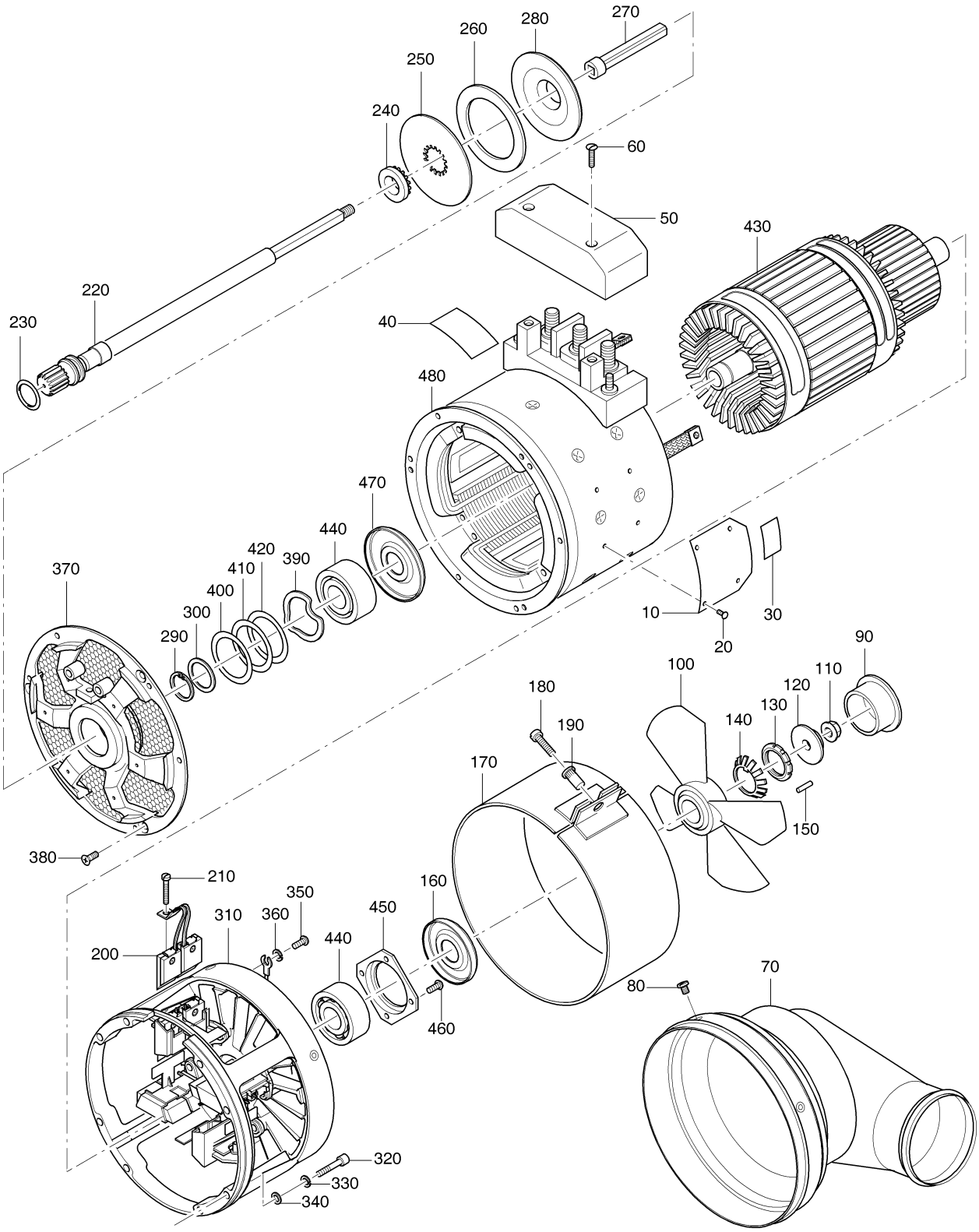

Figure 10001 - DC Starter-Generator

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
	23085-029	DC STARTER-GENERATOR. . . . . . (QAD KIT SOLD SEPARATELY, SEE Figure 10005 FOR DETAILS.)	A	RF
	23085-030	DC STARTER-GENERATOR. . . . . . (QAD KIT SOLD SEPARATELY, SEE Figure 10005 FOR DETAILS.)	B	RF
	23085-031	DC STARTER-GENERATOR. . . . . . (QAD KIT SOLD SEPARATELY, SEE Figure 10005 FOR DETAILS)	C	RF
10	06-209285	• PLATE, Replacement Identification . . . . (ATTACHING PARTS)		1
20	MS21318-13	• SCREW, Drive . . . . . . ---------- * ----------		4
30	06-200001	• LABEL, Patent Notification		1
40	06-201020	• DECAL, Caution		1
50	23079-1060	• COVER, Terminal Block . . . . . . (ATTACHING PARTS)		1
60	NAS1189-06P12L	• SCREW . . . . . . ALT: 01-200346 ---------- * ----------		2
70	23085-1743	• INLET, Air . . . . . . ALT: 23085-1740	A,B	1
-70A	23085-1746	• INLET, Air . . . . . . ALT: 23085-1745 (AIR INLET SOLD SEPARATELY) (ATTACHING PARTS)	C	1
80	MS35265-45	• SCREW, Drilled Fillister Head, Slotted. . ---------- * ----------		4
90	23078-1860	• PLUG, Fan Cap		1
100	23078-1851	• FAN . . . . . . (ATTACHING PARTS)		1
110	MS21042-4	• NUT, Self-Locking.		1
120	23078-1873	• WASHER ASSEMBLY		1
130	MS172239	• NUT, Spanner.		1
140	MS172204	• WASHER, Key		1
150	MS16555-301	• PIN, Straight, Headless		1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		---------- * ----------		
160	23088-1342	• SHIELD, Bearing, ADE		1
170	23048-1127	• COVER, Brush Access		1
		(ATTACHING PARTS)		
180	AN502-10-18	• • SCREW, Fillister Head		1
190	NAS1329H3K130L	• • NUT, Blind Rivet, Self-Locking . . . . . ALT: 01-200376		1
		---------- * ----------		
200	30300-1413	• BRUSH, Electrical Contact . . . . . SUPSD BY 23093-1301		RF
	23093-1301	• BRUSH, Electrical Contact . . . . . MOD A SUPSDS 30300-1413 SB 23085-0XX-24-07		4
		(ATTACHING PARTS)		
210	05-340209	• SCREW, Pan Head		4
		---------- * ----------		
220	23078-1840	• SHAFT, Drive	A	1
	23078-1844	• SHAFT, Drive	B,C	1
230	M83248/1-113	• O-RING		1
240	23032-1916	• HUB, Dampener		1
250	23032-1910	• PLATE, Dampener		1
260	02-5600-17	• RING, Friction		1
270	23078-1802	• ISOLATOR		1
280	23032-2716	• BACK PLATE, Dampener		1
290	MS16624-1066	• RING, Retaining		1
300	23032-1144	• SPACER		1
310	23085-359	• BEARING AND BRUSH SUPPORT . . . . ASSEMBLY, Anti-Drive End (SEE Figure 10002 FOR DETAILS) REPLD BY 23085-355 See NOTE 3 in Paragraph 4.		1
	23085-355	• BEARING AND BRUSH SUPPORT . . . . ASSEMBLY, Anti-Drive End (SEE Figure 10002 FOR DETAILS) REPLS 23085-359 See NOTE 3 in Paragraph 4.		1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		(ATTACHING PARTS)		
320	NAS1352-08-14P	• SCREW Cap, Socket Head . . . . . ALT: 01-200892		8
330	MS35338-42	• WASHER, Lock Spring.		8
340	05-370232	• WASHER, Flat		8
		---------- * ----------		
350	MS35206-227	• SCREW, Pan Head		4
360	MS35338-41	• WASHER, Lock		4
370	23088-1072	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY (SEE Figure 10003 FOR DETAILS) Refer to SB 23088-107X-24-01		1
		(ATTACHING PARTS)		
380	MS24693-S47	• SCREW, Flat Head.		3
		---------- * ----------		
390	02-4231-03	• WASHER, Spring Wave		1
400	02-4250-15	• SHIM, Steel, 0.010 inch (0,25 mm)		AR
410	02-4250-14	• SHIM, Steel, 0.005 inch (0,13 mm)		AR
420	02-4250-13	• SHIM, Steel, 0.002 inch (0,05 mm)		AR
430	23085-1507	• ARMATURE		1
440	03-6009-25	• BEARING, Ceramic Hybrid Ball		2
450	23081-1080	• RETAINER, Bearing		1
		(ATTACHING PARTS)		
460	02-4022-02	• SCREW		4
		---------- * ----------		
470	23088-1340	• SHIELD, Drive End Bearing		1
480	23085-1382	• STATOR ASSEMBLY . . . . . (SEE Figure 10004 FOR DETAILS)		1

- ITEM NOT ILLUSTRATED

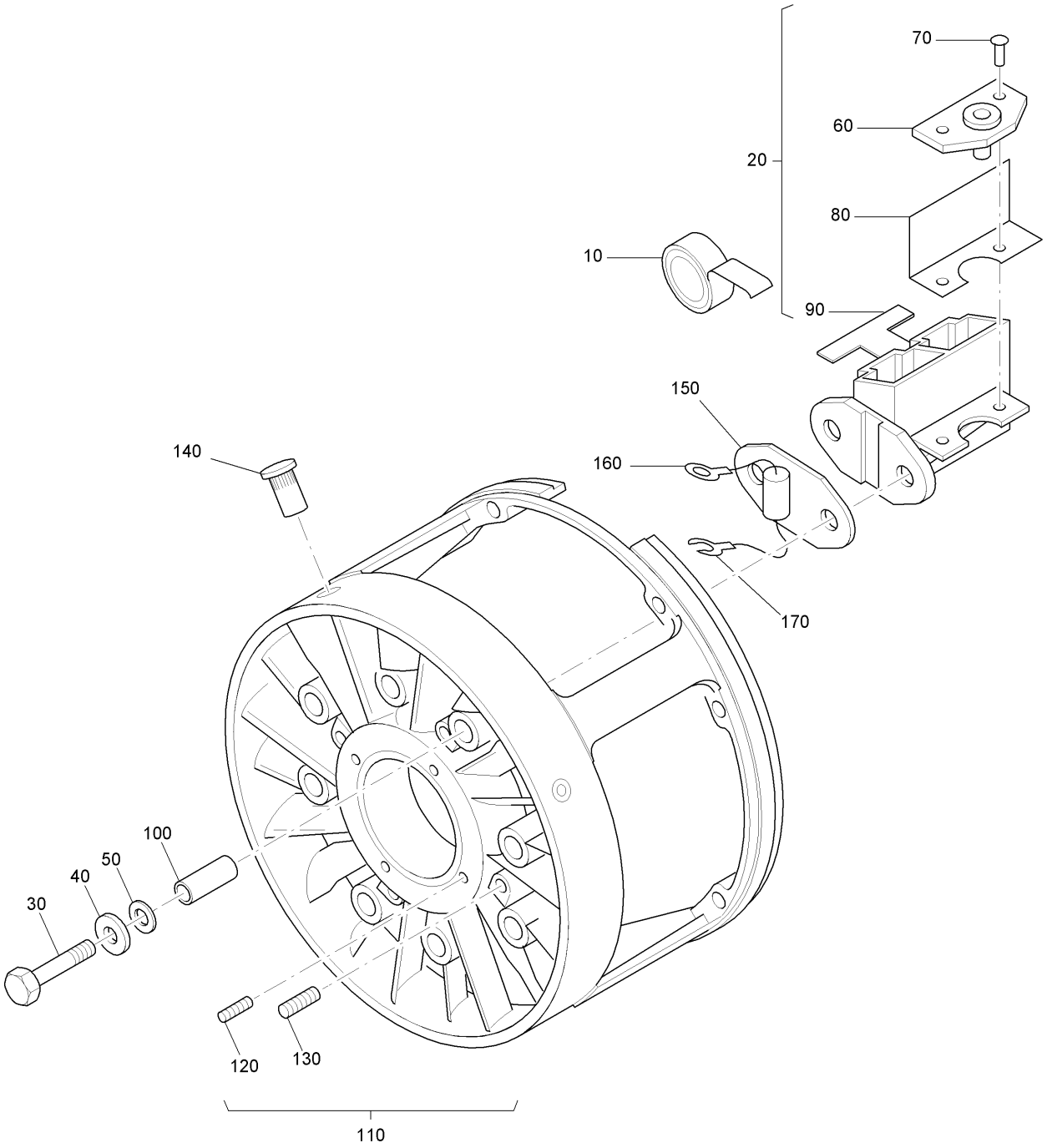

Figure 10002 - Bearing and Brush Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10002-				
	23085-359	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY (SEE Figure 10001 FOR NHA) REPLD BY 23085-355 See NOTE 3 in Paragraph 4.		RF
	23085-355	BEARING AND BRUSH SUPPORT . . . . . ASSEMBLY (SEE Figure 10001 FOR NHA) REPLS 23085-359 See NOTE 3 in Paragraph 4.		RF
10	23033-2840	• SPRING, Brush		8
20	23075-1203	• BRUSH HOLDER, Complete		4
		(ATTACHING PARTS)		
30	AN3-7A	• BOLT, Machine, Hex Head		8
40	NAS1149F0332P	• WASHER, Flat		8
50	05-374095	• WASHER, Non-Metallic		8
		---------- * ----------		
60	23075-1400	• • BOARD, Brush Lead Terminal		1
		(ATTACHING PARTS)		
70	MS20426AD3-5	• • RIVET		2
		---------- * ----------		
80	23075-1230	• • SHEET, Insulation		1
90	23075-1193	• • BRUSH HOLDER		1
100	02-2001-27	• SLEEVING, Insulation		8
110	23085-1810	• END BELL, Anti-Drive End . . . . . See NOTE 4 in Paragraph 4.		1
120	NAS1130-08L15D	• • INSERT, Helical Coil . . . . . ALT: MS21209C0815		4
130	NAS1130-06-15	• • INSERT, Helical Coil		4
140	NAS1329H08K120L	• • NUT, Blind Rivet . . . . . ALT: 01-200796		4
150	23085-366	• FILTER ASSEMBLY		4
160	MS35431-7	• • TERMINAL LUG, Flat Solder . . . . . ALT: 02-2377-02		1
170	02-2370-18	• • TERMINAL LUG, Slotted Tongue		1

- ITEM NOT ILLUSTRATED

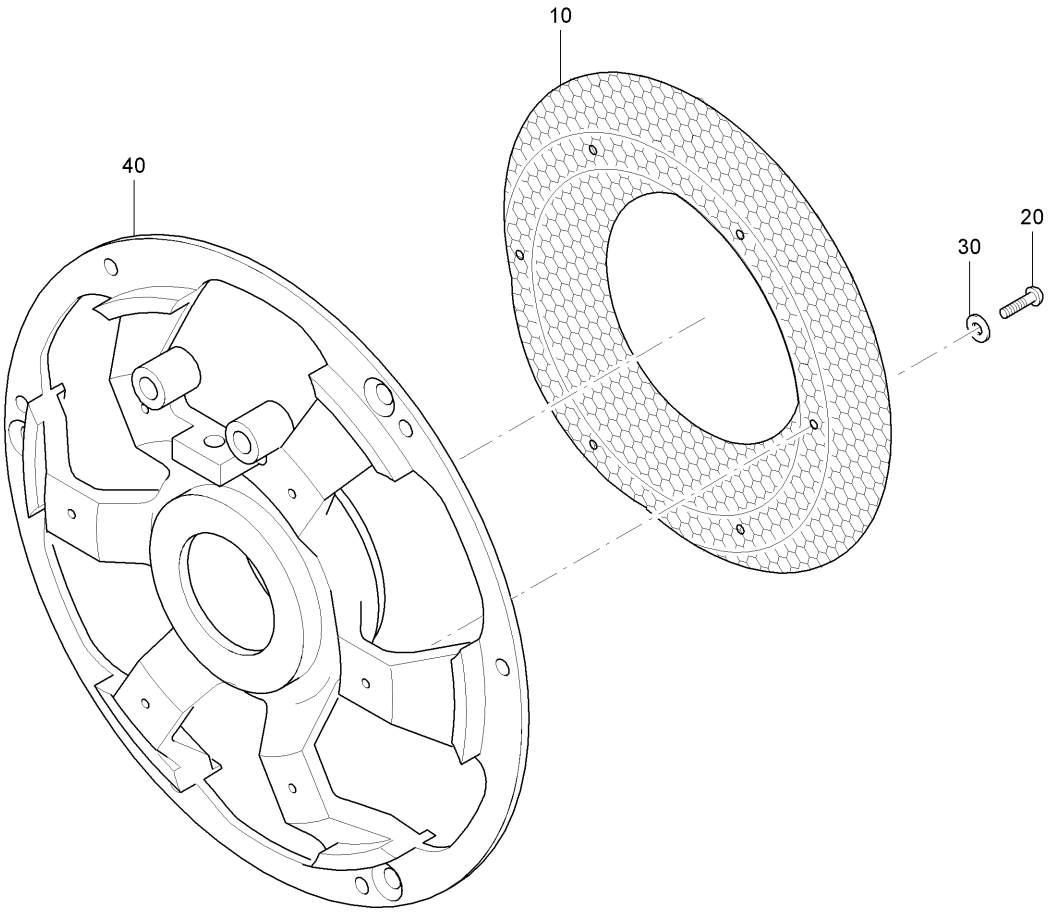

Figure 10003 - Drive End Bearing Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10003-				
	23088-1072	DRIVE END BEARING SUPPORT . . . . . ASSEMBLY (SEE Figure 10001 FOR NHA)		RF
10	23088-1140	• SCREEN, Guard		1
		(ATTACHING PARTS)		
20	MS21318-15	• SCREW, Drive		6
30	AN960-4L	• WASHER, Flat		6
		---------- * ----------		
40	23088-1022	• END BELL, Drive End		1

- ITEM NOT ILLUSTRATED

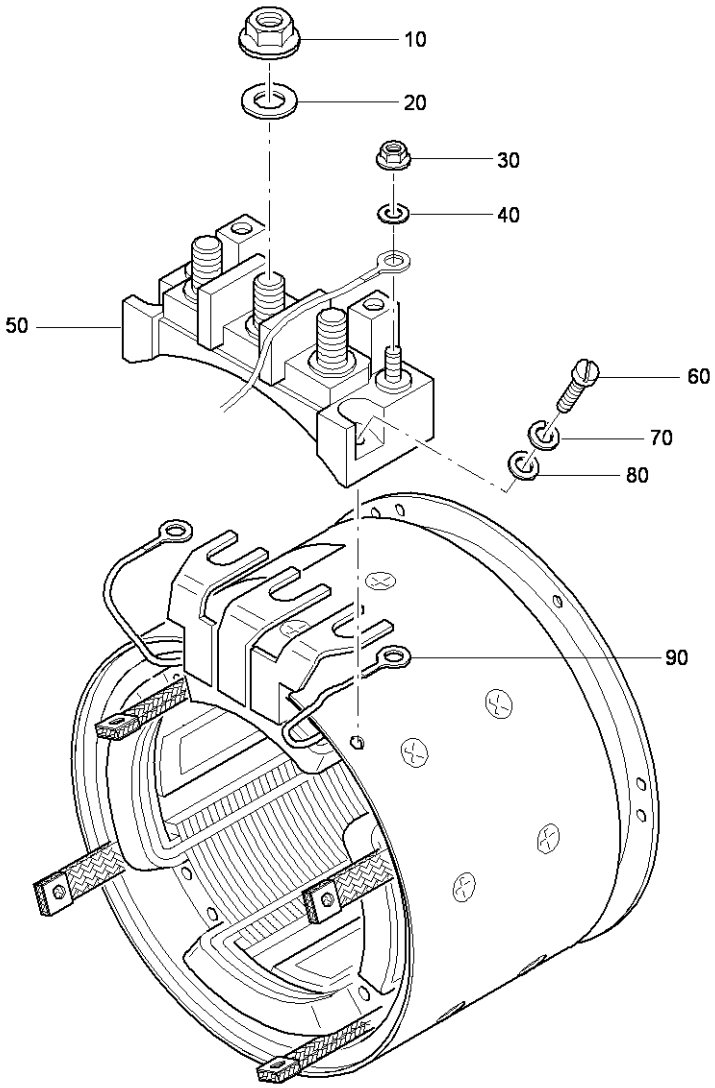

Figure 10004 - Stator Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10004-				
	23085-1382	STATOR ASSEMBLY . . . . . (SEE Figure 10001 FOR NHA)		RF
10	MS21042-6	• NUT, Self Locking		3
20	AN960C616	• WASHER, Plain		3
30	MS21042-3	• NUT, Self Locking		2
40	AN960C10	• WASHER, Plain		2
50	23085-1370	• TERMINAL BLOCK AND FILTER . . . . . ASSEMBLY		1
		(ATTACHING PARTS)		
60	MS35266-64	• SCREW, Machine Fillister Head		2
70	MS35338-43	• WASHER, Lock Spring		2
80	AN960C10L	• WASHER, Flat		2
		---------- * ----------		
90	05-652015	• TERMINAL, Lug		2

- ITEM NOT ILLUSTRATED

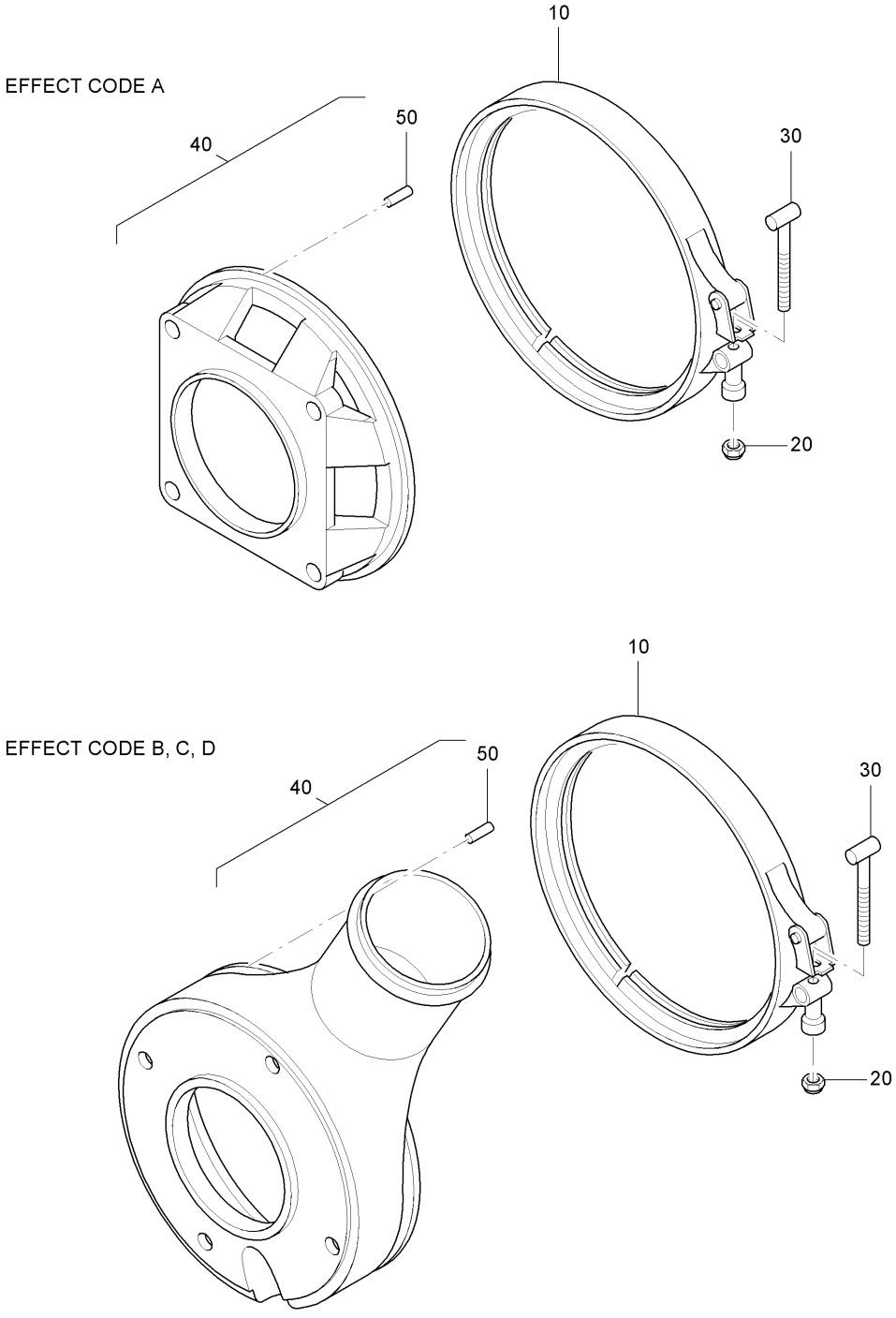

Figure 10005 - QAD Mounting Kit

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10005-				
	23085-500	KIT, QAD (Quick-Attach-Detach) . . . . . . Mounting Can be used on 23085-029	A	RF
	23085-507	KIT, QAD (Quick-Attach-Detach) . . . . . . Mounting Can be used on 23085-030 and -031	B	RF
	23085-524	KIT, QAD (Quick-Attach-Detach) . . . . . . Mounting Can be used on 23085-031	C	RF
	23085-525	KIT, QAD (Quick-Attach-Detach) . . . . . . Mounting Can be used on 23085-031	D	RF
		(ATTACHING PARTS)		
10	23072-1128	• COUPLING, V-Retainer		1
20	MS21045-4	• • NUT, Self-Locking, Hex.		1
30	23032-2802	• • T-BOLT		1
		---------- * ----------		
40	23085-1020	• ADAPTER, Mounting	A	1
	23085-1830	• ADAPTER, Mounting	B	1
	23085-2090	• ADAPTER, Mounting	C	1
	23085-2091	• ADAPTER, Mounting	D	1
50	02-4412-06	• • PIN, Grooved, Headless	A,C,D	3
	05-180108	• • PIN, Spring, Coiled, Heavy Duty.	B	3

- ITEM NOT ILLUSTRATED

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