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COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

DC Starter-Generator 23046 SERIES I

List of Part Numbers

23046-001	**23046-007**
23046-007M	**23046-009**
23046-017	**23046-019**
23046-020	**23046-028**

TITLE PAGE

EXCLUSIVE DISTRIBUTORS

1. Contact Information

A. Customer Portal

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HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator, 23046 Series I.

Attached to this transmittal letter is Revision No. 11 of the Component Maintenance Manual with IPL (original issue dated Feb 01, 1965).

REVISION 11, DATED JUNE 15, 2020

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 revised per standards set by the Air Transport Association of America Specifications ATA-100 and ATA-2200 to include the latest engineering information and also to include Temporary Revision(s) and Service Information Letter(s) as listed below.

Key items included in this revision:

- Changes in Fits and Clearances section:
  - References in the “Table 8002 - Acceptance Limits” are updated to match with the CHECK section.
- The technical changes in this revision are individually identified with revision bars.

RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	Feb 01/65	Feb 01/65	SP
1	Jan 12/68	Jan 12/68	SP
2	Mar 30/70	Mar 30/70	SP
3	Feb 01/74	Feb 01/74	SP
4	Jun 15/75	Jun 15/75	SP
5	Dec 01/76	Dec 01/76	SP
6	Jun 27/01	Jun 27/01	SP
7	Mar 23/10	Mar 23/10	SP
8	Apr 09/13	Apr 09/13	SP
9	Sep 29/14	Sep 29/14	SP
10	Jan 17/20	Jan 17/20	Safran
11	Jun 15/20	Jun 15/20	Safran

Revision Number	Date Issued	Date Inserted into CMM	Initials

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.

RECORD OF TEMPORARY REVISIONS

Temp Rev Number	Temp Rev Status	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials
23046-0XX-05		2	Jan 25/00	Jan 25/00	SP	Jun 27/01	SP
23046-0XX-06		1	Jan 25/00	Jan 25/00	SP	Jun 27/01	SP
23046-0XX-07		2	Feb 03/00	Feb 03/00	SP	Jun 27/01	SP
24-08		6	Feb 13/09	Feb 13/09	SP	Mar 23/10	SP
24-09		1	Jun 18/10	Jun 18/10	SP	Apr 09/13	SP
24-10		1	Jul 02/13	Jul 02/13	SP	Sep 29/14	SP
24-11		1	Jul 02/13	Jul 02/13	SP	Sep 29/14	SP
24-12		7002	Apr 05/16	Apr 05/16	SP	Jan 17/20	Safran
24-13		7023	Apr 05/16	Apr 05/16	SP	Jan 17/20	Safran
24-14	Cancelled	1012	Aug 10/18	Aug 10/18	Safran	Jan 17/20	Safran
24-15	Cancelled	1028	Aug 10/18	Aug 10/18	Safran	Jan 17/20	Safran
24-16		10010	Aug 12/19	Aug 12/19	Safran	Jan 17/20	Safran
24-17		6003	Sep 09/19	Sep 09/19	Safran	Jan 17/20	Safran

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SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
114	Incorporated	-	Nov 1/65				
137-1	Incorporated	1	May 1/68				
161	Incorporated	-	Feb 1/70				
169-1	Incorporated	1	Jun 1/73				
197	Incorporated	-	Nov 15/73				
198	Incorporated	-	Nov 15/73				
203	Incorporated	-	Feb 15/74				
23046-0XX-24-01	Superseded	1	Apr 29/94				
23046-0XX-24-02	Superseded	1	Apr 29/94				
23046-0XX-24-03	Incorporated	1	Apr 29/94				
23046-0XX-24-04	Incorporated	-	Apr 12/94				
23046-0XX-24-05	Incorporated	1	Jan 5/06				
23046-0XX-24-06	Incorporated	-	Oct 11/04				
23046-0XX-24-07	Incorporated	1	Feb 19/10				
23046-028-24-01	Incorporated	-	Aug 29/12				
23064-1180-24-01	Incorporated	-	Oct 26/12				

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	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 2006-01	Incorporated	-	Sep 26/06				
GSIL 2006-02	Incorporated	1	Feb 10/09				
GSIL 2009-01	Valid	2	Feb 03/17				
02-5600	Incorporated	4	Jul 07/15				
03-6010-XX-01	Valid	-	May 2/95				
23701	Valid	1	Jun 19/00				
23703	Incorporated	-	Jan 24/97				
GSIL 2011-01	Incorporated	-	Dec 16/11				

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for overhaul and service repair of the Safran Power USA 23046 Series I DC Starter-Generators. Line maintenance is supported by Maintenance Manual (MM) 23700. A DC Starter-Generator overhaul includes:

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

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

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

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

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

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

All weights and measures used in this manual are in English units, followed by the Système Internationale (SI) equivalent in parentheses.

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

Publications can be obtained by going to the Technical Publications web portal. Go to https://techpubsdistribution.labinal-power.com.

2. **User Qualification and Certification Requirements**

The information contained in this CMM is intended for use by persons trained and certified in the repair and overhaul of aircraft electrical accessories. Eligibility and certification of overhaul technicians shall be in accordance with the guidelines established by the U.S. Federal Aviation Administration or an equivalent regulatory authority. Refer to U.S. Code of Federal Regulations 14 CFR, parts 65.101 through 65.103 and part 145.39.

Where special processes are included by reference to military or commercial standards, the qualifications and certification of personnel performing the process shall be the same as indicated in the cited standard. Make sure to follow the detailed requirements of all cited military or commercial standards used in the repair of this equipment.

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 shall also be responsible for maintaining all necessary test, inspection, and maintenance records for each unit received for service.

All instrumentation and inspection equipment shall 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 shall 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 shall be examined 100% to determine serviceability.

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

4. **Safety Advisory**

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

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

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

CAUTION: Alerts operating and maintenance personnel to conditions that could result in equipment damage.

5. **Materials List**

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

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

Material	Used in
Acrylic Coating	ASSEMBLY, REPAIR
Anti-seize Compound	ASSEMBLY
Chemical Film Dichromate	REPAIR
Corrosion Preventative	CLEANING
Detergent	CLEANING
Enamel Paint	REPAIR
Epoxy Primer	REPAIR
Insulating Enamel	REPAIR
Isopropyl Alcohol	DISASSEMBLY, CLEANING, CHECK, REPAIR, ASSEMBLY, REPAIR
Loctite Grade D and Grade N	ASSEMBLY
Zinc Chromate Primer	REPAIR
Zinc Phosphate Coating	REPAIR

Table i Hazardous Materials

6. **Non-Safran Power USA Authorized Components and Processes Policy**

Safran Power USA authorizes the use of genuine Safran Power USA spare parts which meet stringent engineering design specifications and quality standards, and have traceability to having been procured and certified to these specifications by the Safran Power USA Quality Assurance incoming and in-process inspection systems. The Safran Power Spares Portal is the only authorized distributor of genuine Safran Power USA replacement parts and complete units.

The use of any non-Safran Power USA parts, or any parts not having been submitted to the Safran Power USA Quality Assurance inspection system will invalidate any and all factory warranties. All Safran Power USA warranties are automatically voided on any

Safran Power USA designed unit that has been modified by the installation of any unauthorized parts, materials or unapproved processes supplied by other outside services. The repair station's quality assurance activity shall assume product liability for all units that have been modified in this fashion.

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

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

7. Symbols and Definitions

These symbols and definitions are used in this manual.

A	Ampere
cm	Centimeter
©	Copyright
° C	Degree Celsius
F	Farads
° F	Degree Fahrenheit
g	Gram
Hz	Hertz
kg	Kilogram
kPa	Kilopascals
lbs	Pounds
lbf in.	Pound Force Inch
lbf ft	Pound Force Foot
m	Milli
mm	Millimeter
ms	Millisecond
Nm	Newton Meter
V	Volt or Voltage
-	Minus
+	Plus
±	Plus or Minus
%	Percent
µ	Micro
µF	MicroFarad
™	Trademark
Ω	Ohm

8. Abbreviations

This manual contains these abbreviations.

AC	Alternating Current
ADE	Anti-drive End
AR	As Required
ASD	Aerospace and Defense
Assy	Assembly
ATA	Air Transport Association of America
CMM	Component Maintenance Manual
DC	Direct Current
DE	Drive End
FAA	Federal Aviation Administration
GCU	Generator Control Unit
IPL	Illustrated Parts List
ISO	International Standardization Organization
MM	Maintenance Manual
MIL	Military Specification
NDT	Non-Destructive Testing
No.	Number
OSHA	Occupational Safety and Health Act
PSIG	Pounds per Square Inch Gauge
Q.A.D.	Quick Attach Detach
REF	Reference
RPM	Revolutions Per Minute
SB	Service Bulletin
SIL	Service Information Letter
SPD	Standard Practice Document
SI	System International
SP	Safran Power
TIR	Total Indicated Runout

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DESCRIPTION AND OPERATION

1. Purpose

The 23046 Series I DC Starter-Generators are designed to operate as a motor providing torque for engine starting and (after engine start-up) generating DC electrical power.

Some models feature a quick attach/detach (QAD) kit easing starter-generator removal/installation 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.

The 23046 Series I Starter-Generators consist of eight models, -001, -007, -007M, -009, -017, -019, -020 and -028. Examples of inter-relations between models: Model 23046-019 is a Model 23046-020 with a 23046-516 QAD kit installed.

The starter-generators consist 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 bearing and brush support assembly. The drive shaft is installed into the hollow armature shaft. 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 backplate.

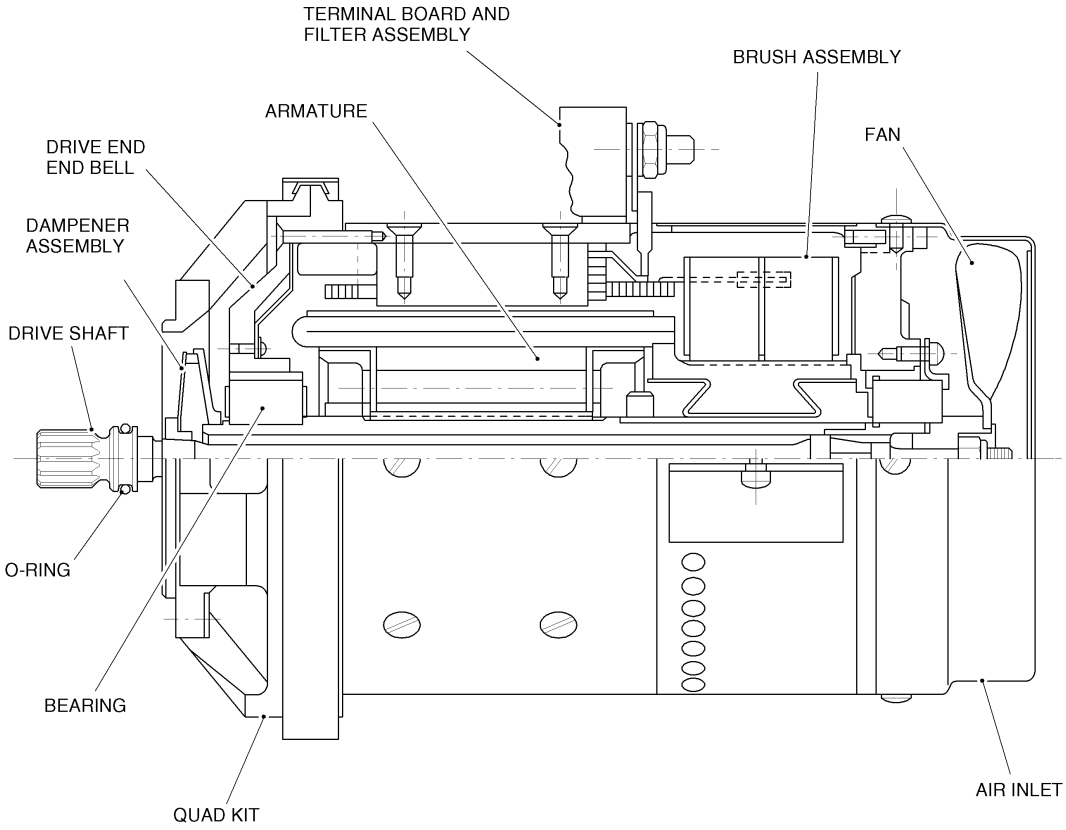

Figure 1 - Parts of the 23046 Series I DC Starter-Generator

This Starter-Generator is a self-excited machine incorporating four main poles and four interpoles. During 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 duct system. The fan is protected by a screened cover. Electrical and mechanical characteristics are given in Table 1.

Outline drawings for all models are shown in Figure 2 through Figure 7.

2. Operation

As an engine starter, the machine can be energized either by batteries or by ground-power units. The Starter-Generator utilizes a series-starting field and should be started with shunt field de-energized.

CAUTION: THE START SWITCH MUST NOT BE HELD CLOSED FOR MORE THAN THE FEW SECONDS NEEDED FOR A NORMAL ENGINE START; OTHERWISE, THE MACHINE MAY BE DAMAGED BY EXCESSIVE TEMPERATURES CAUSED BY THE LARGE STARTING CURRENTS.

As a generator, the machine provides rated DC output when driven at speeds within the rated speed range. The power supply for starter operation should first be disconnected, and the generator should then be connected to the load bus. The generator will operate satisfactorily with either a carbon-pile or static type regulator conforming to BuWep Drawing E-1597-1 and MIL-R-6809. A reverse-current relay is normally used for automatically disconnecting the generator from the load bus, if generator voltage drops below a pre-determined minimum.

Characteristic	Value
Rating	6 kW
Continuous load within speed range	200 A
Voltage (gen. output)	30 V
Speed range (rated load)	
23046-001, -007, -007M, -009, -017	7,200 to 12,000 rpm
23046-019, -020	6,700 to 12,000 rpm
23046-028	7,900 to 12,000 rpm
Minimum speed for regulation	7,800 rpm
23046-001, -007, -007M, -009, -017, -028	7,200
23046-019, -020	6,700
Direction of rotation (viewing drive end)	CCW
Cooling	Self-Cooled
Terminal Designations	
Positive	B+
Negative	E–
Positive field	A+
Equalizer	D
Starting	C+
External start power	28 V max.
See Table 2 for starting current	

Table 1 - Leading Particulars

Model No.	Weight lbs. (kg)	Spline and Mounting Flange Specification	Spline No. of Teeth	Spline Pitch Dia. inch (mm)	Cooling Opening	Starting Current (A)
23046-001	25(No QAD) (11,34)	AND 10261, Type XI-B	12	0.600 (15,24)	Screened Cover	800
23046-007	27.8* (12,61)	AND 10262, Type XII-A	16	0.800 (20,32)	Screened Cover	800
23046-007M	27.8* (12,61)	AND 10262, Type XII-A	16	0.800 (20,32)	Screened Cover	800
23046-009	28.6* (12,97)	AND 10261, Type XI-B	12	0.600 (15,24)	Screened Cover	800
23046-017	28.4* (12,88)	AS972A spline, MS3326-2	12	0.600 (15,24)	Screened Cover	800
23046-019	30* (13,61)	AS972 spline, MS3326-2	12	0.600 (15,24)	Equivalent to 3 inch (76,2mm) Cover	800
23046-020	30* (13,61)	AS972 spline, MS3326-2	12	0.600 (15,24)	Equivalent to 3 inch (76,2 mm) Cover	800
23046-028	28.3* (12,84)	AND 10262, Type XII-A	16	0.800 (20,32)	Screened Cover	800
* with QAD kit						

Table 2 - Model Particulars

Model No	Overhung Moment lbf.in. (Nm)	Shaft Shear Section Torque lbf.in. (Nm) Max.
23046-001	105 (11,86)	1500 (169,5)
23046-007	120 (13,56)	1500 (169,5)
23046-007M	120 (13,56)	1500 (169,5)
23046-009	116 (13,11)	1500 (169,5)
23046-017	125 (14,12)	1100 (124,3)
23046-019	135 (15,25)	1600 (180,8)
23046-020	135 (15,25)	1600 (180,8)
23046-028	122 (13,78)	1500 (169,5)

Table 3 - Overhung Moment and Shaft Shear Torque

3. MOD Status

See Table 4 below for the latest MOD level of each Starter-Generator model.

23046-								Description
001	007	007M	009	017	019	020	028	
A	A	A	A	-	A	A	A	03-6010-15 Bearings
B	B	B	B	A	B	B	B	03-6010-18 Bearings (SB 23046-0XX-24-03 or SB 23046-0XX-24-04)
-	-	-	-	-	C	C	-	23088-1324 Brushes (SB 23046-0XX-24-05)
-	-	-	-	-	D	D	-	23080-3111/-3112 Shields and 23048-1486 Fan (SB 23046-0XX-24-06)
-	-	-	-	-	E	E	-	23093-1300 Brushes (SB 23046-0XX-24-07)
-	-	-	-	-			C	23093-1307 Brushes (SB 23046-028-24-01)

Table 4 - MOD Status

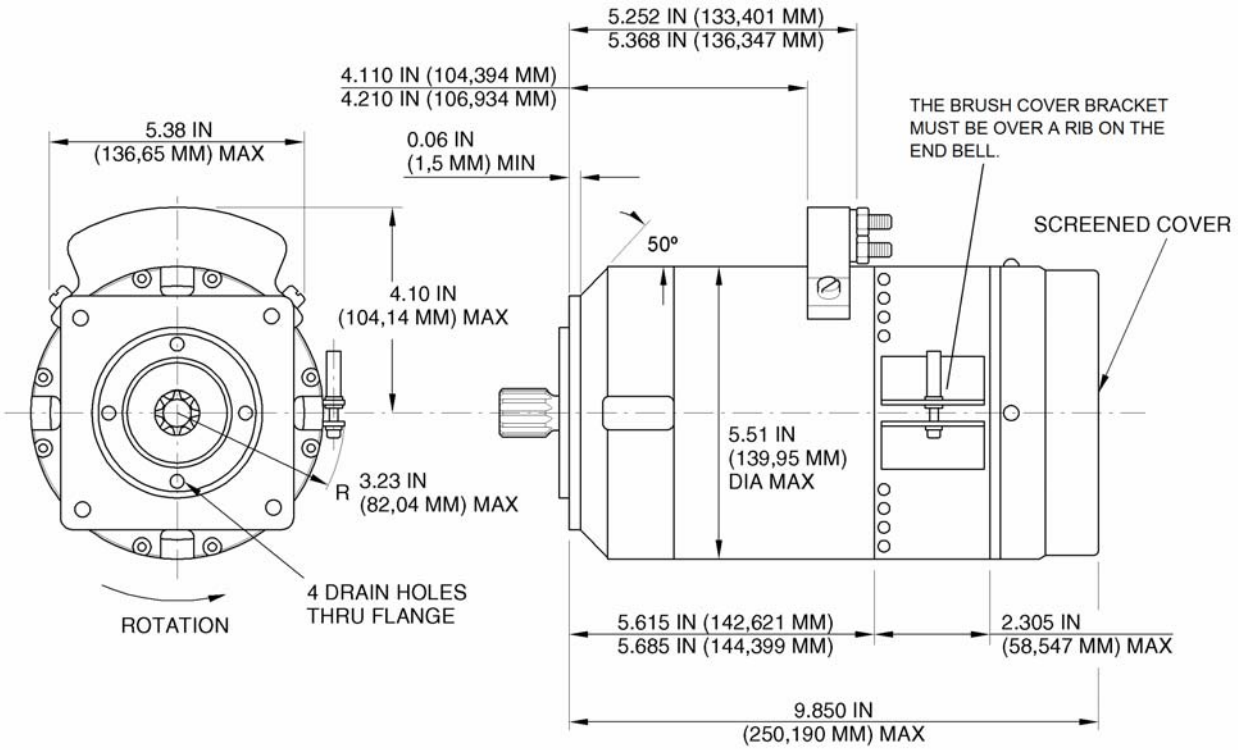

Figure 2 - Outline Drawing of Model 23046-001

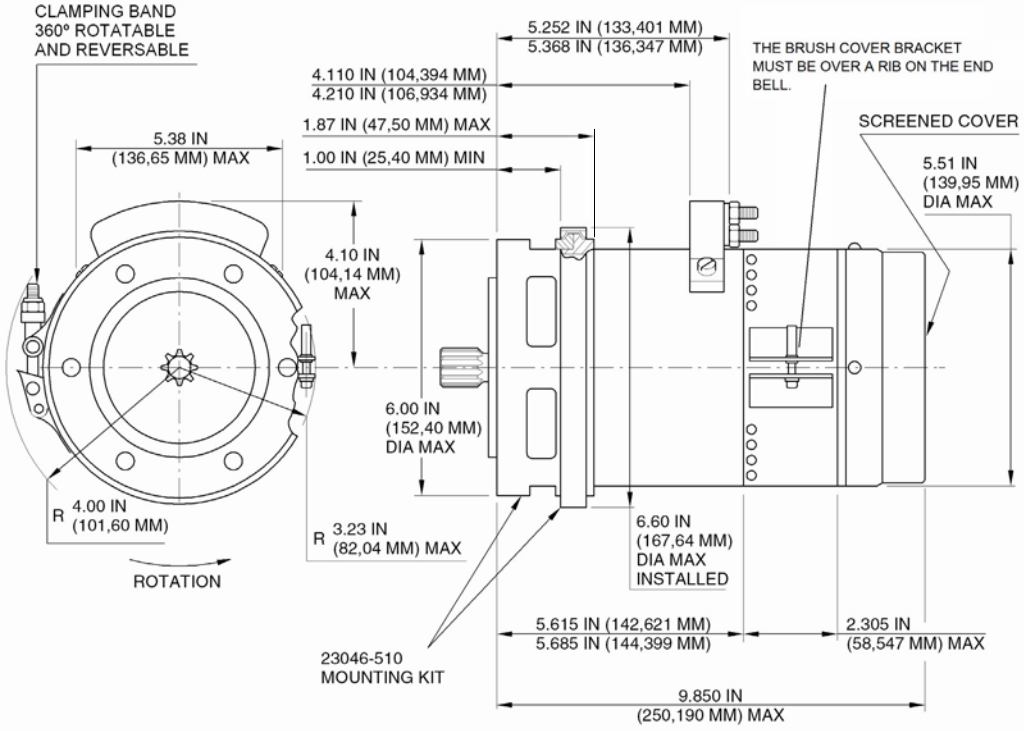

Figure 3 - Outline Drawing of Models 23046-007 and -007M

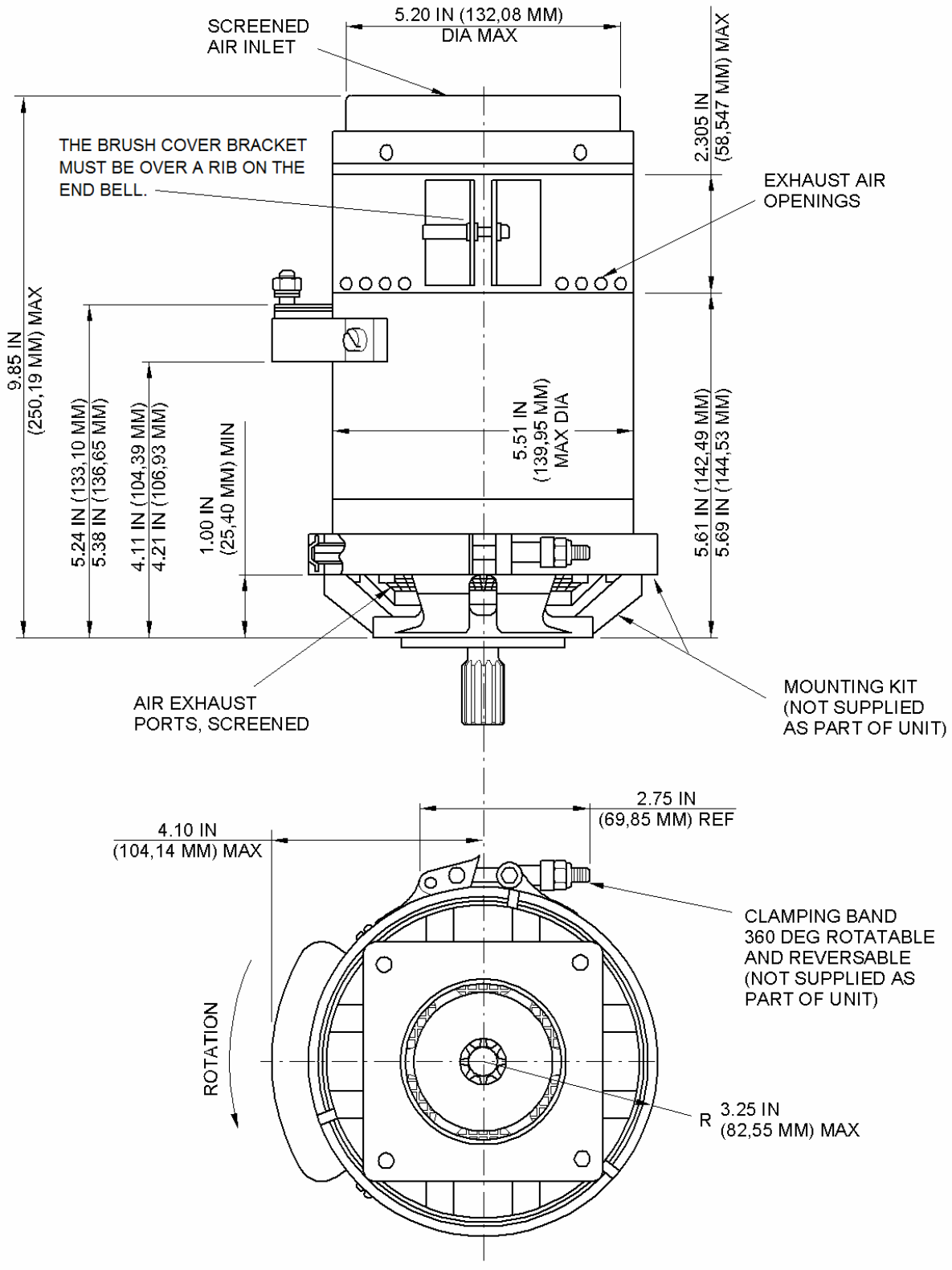

Figure 4 - Outline Drawing of Model 23046-009

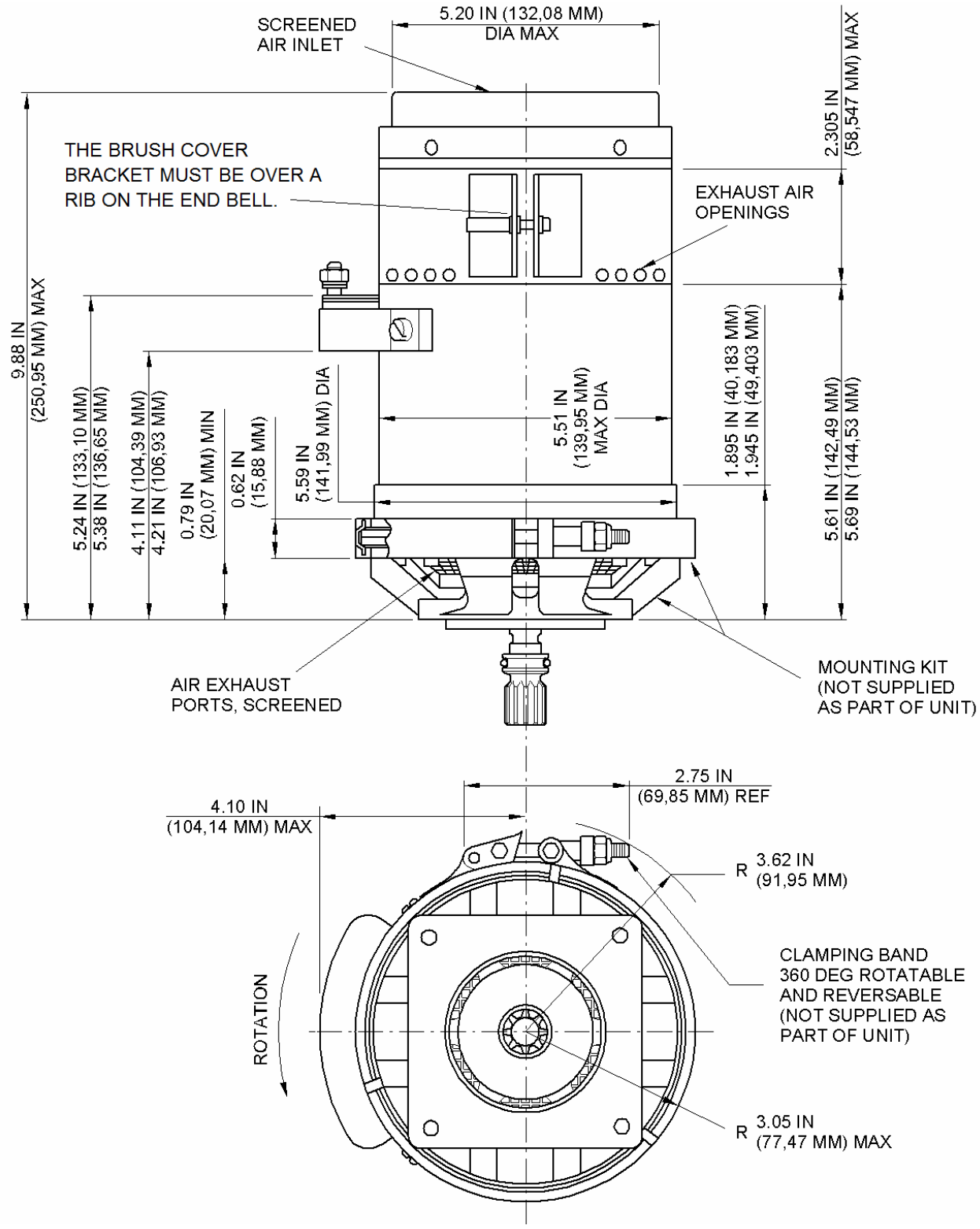

Figure 5 - Outline Drawing of Model 23046-017

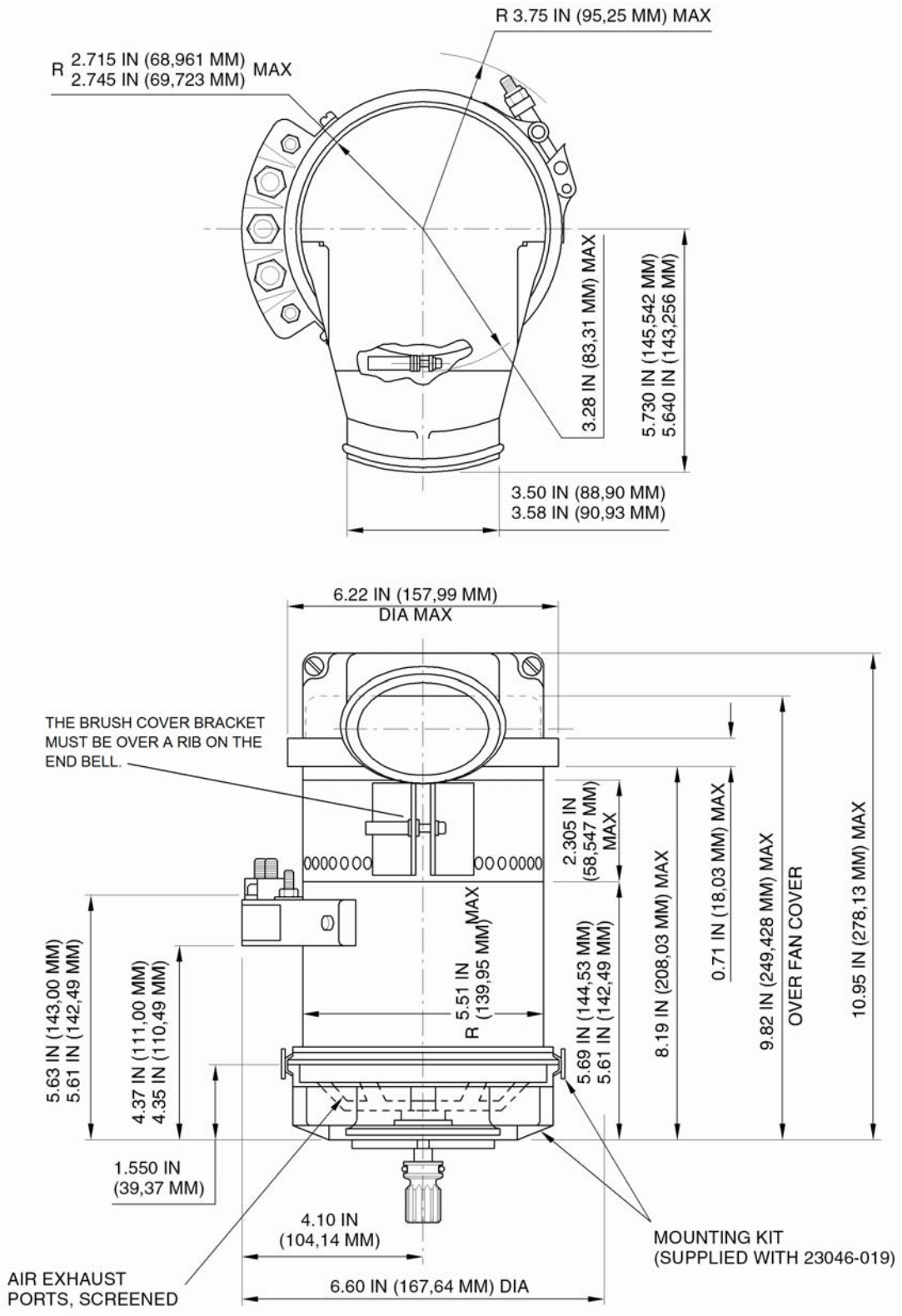

Figure 6 - Outline Drawing of Models 23046-019 and -020

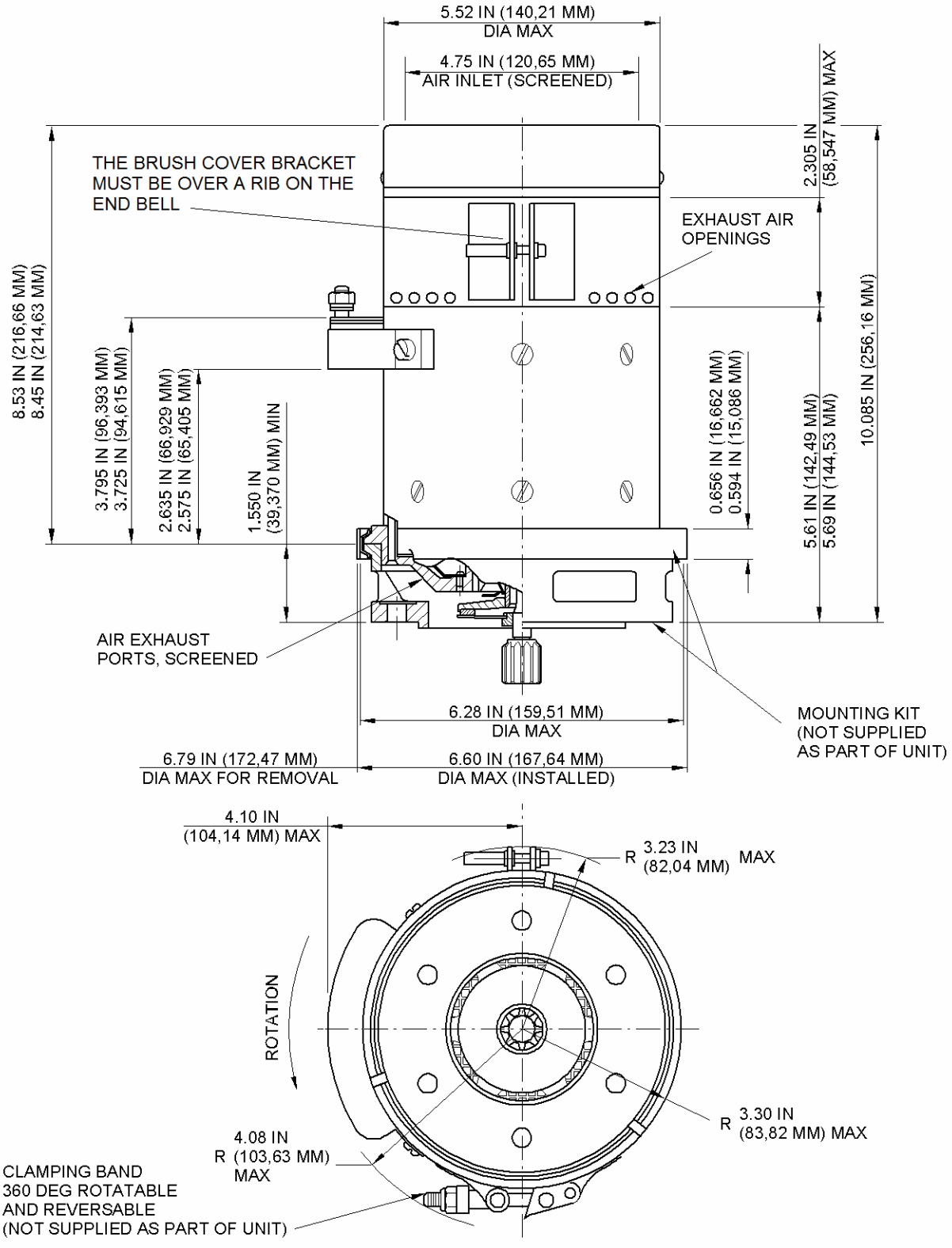

Figure 7 - Outline Drawing of Model 23046-028

TESTING AND FAULT ISOLATION

1. Introduction

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

Prior to performing testing, confirm that starter-generator is clean (refer to CLEANING section). Inspect for good mechanical condition (refer to CHECK section).

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

Verification Testing – A starter-generator must be examined for removal or have a test done for qualification for continued service. The inspection is found in the CHECK section before testing can start. A starter-generator that passes the initial inspection can have a verification test done which is an acceptance test not including dielectric tests. A verification test can be used to pass the performance tests or isolate a fault. When a fault is identified during a test, refer to the fault isolation tables in this section to find the possible cause.

Acceptance Testing – A unit that is overhauled or repaired must have a test done before you send the unit back to service. The tests must be in accordance with this section to make sure the minimum performance standards are in specification. When an acceptance test is done, zero operating hours time since overhaul (TSO) is given to an overhauled unit. Repaired units are continued time.

Refer to Figure 1001 for proper electrical connections, and Figure 1002 and Figure 1003 for typical test set-ups.

2. Test Conditions

Parameter	Operating Condition
Ambient Temperature	50° to 104° F (10° to 40° C)
Barometric Pressure	27 to 33 inch (914 to 1118 millibar) of mercury
Mounting	Drive shaft (rotational axis) horizontal
Load Current Tolerance	± 5 Amps DC
Speed Tolerance	± 50 rpm
Cooling	Self-cooling

Table 1001 - Performance Test Conditions

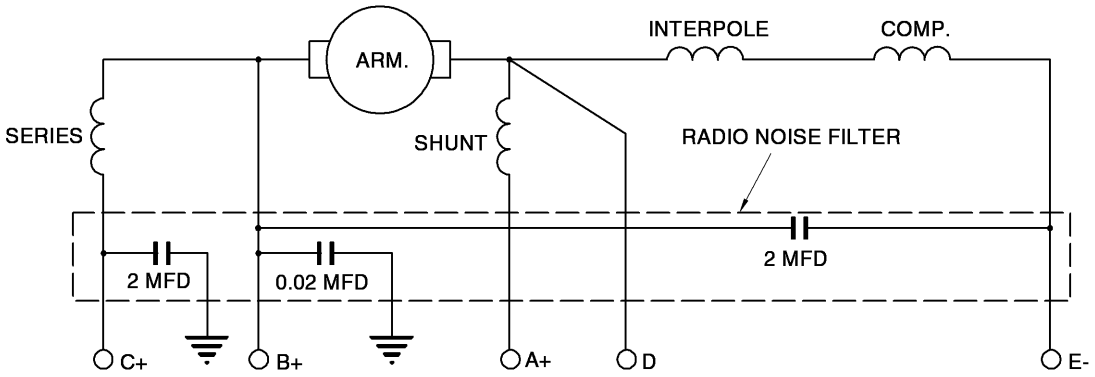

Figure 1001 - `Electrical Connections

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

3. Required Test Equipment

Use instruments with accuracy and calibration in compliance with ISO-10012-1.

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Setup Reference
Commutation Viewing Adapter	-	Figure 9003
Drive Test Stand	Capable of driving starter-generator 6500 to 14,000 rpm	Not Illustrated
Dial Indicator with ball or mushroom indicator tip. Optional: Magnetic Base to fit dial indicator	Accuracy: 0.0001 inch (0.0025 mm)	Not illustrated
Dummy Terminal Block (1) (Non-serviceable)	Use dummy terminal block during testing to avoid damage to filter capacitors.	--
High Potential Tester	250 VAC rms, 50 to 60 Hz	Not Illustrated
Ohmmeter	-	Not Illustrated

Table 1002 - Test Equipment Requirements and Specifications

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Setup Reference
QAD Mounting Kit (See IPL)	-	Not Illustrated
Starter Test Stand	Capable of measuring a locked rotor torque of 20 lbf.ft (27,1 Nm) and having a power supply capacity of 1000 ADC at 22 V.	Not Illustrated
Thermometers or equivalent temperature measuring devices	Range: 50 to 300° F (10 to 150° C) Accuracy: ± 1° F (± 0.5° C)	Not Illustrated
Ammeter, DC	0 to 800 A	A_1
Ammeter, DC	0 to 15 A	A_2
Load Bank, Variable	30 V, 0 to 200 A	Variable Load Bank
Resilient Cradle (wooden v-block with foam rubber cushion and restraining strap)	-	Not illustrated
Shunt, Precision	800 A, 500 mV DC	SH_1
Strobe Light	-	Not Illustrated
Vibration Meter	Metrix vibration meter with probe magnet or equivalent	Not Illustrated
Voltmeter, DC	Range: 0 to 30 V DC Accuracy: ± 1% of reading	V_1
Voltmeter, DC	Range: 0 to 3 V DC Accuracy: ± 1% of reading	V_2
Voltage Regulator, DC	0 to 30 V DC	Voltage Regulator

Table 1002 - Test Equipment Requirements and Specifications (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 V DC
DC Current	± 2.5 A
Cooling Air Pressure	± 0.2 inch (5,1 mm) - water
Torque	± 1.0 lb-ft

Table 1003 - Setpoint Tolerances

6. Test Preparation

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

A. Perform an initial inspection

Perform an initial inspection of the starter-generator in a brightly lit work area to determine its overall condition. Parameters for this initial inspection are given in the CHECK section.

B. Cleaning and Brush Seating

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

(1) Reference CLEANING section.

(2) Perform brush seating procedures per SPD 1006.

C. Install commutation viewing adapter.

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.

(1) Remove air inlet.

(2) Remove brush access cover (130).

(3) Install commutation viewing adapter.

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

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

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

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

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

E. Install starter-generator onto drive stand

(1) Install appropriate QAD kit end bell drive end pad onto drive stand. Refer to ILLUSTRATED PARTS LIST.

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

(2) While supporting anti-drive end of starter-generator, align and install drive end to end bell drive end pad.

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

(4) Install rim-clenching clamp and tighten self-locking hex nut to the value stamped on the clamp.

(5) Assemble terminal block hardware to terminal block.

(a) Torque the self-locking nut (10001-740) to a torque of 22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm).

(b) Torque the self-locking nut (10001-760) to a torque of 220 to 235 lbf.in. (24,86 to 26,55 Nm).

(6) Turn OFF all power to drive stand.

(7) Connect starter-generator to test circuit as shown in Figure 1002.

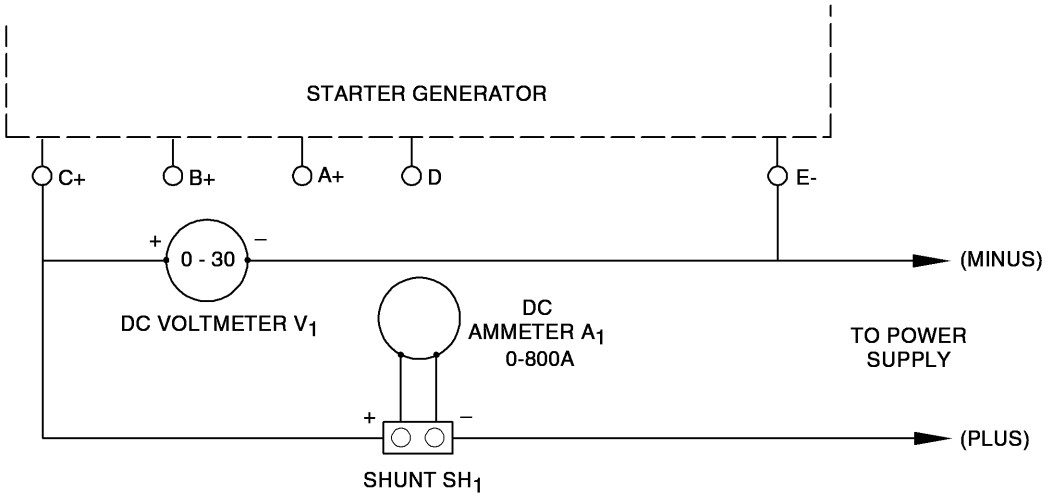

Figure 1002 - Test Set-Up for Starter Test

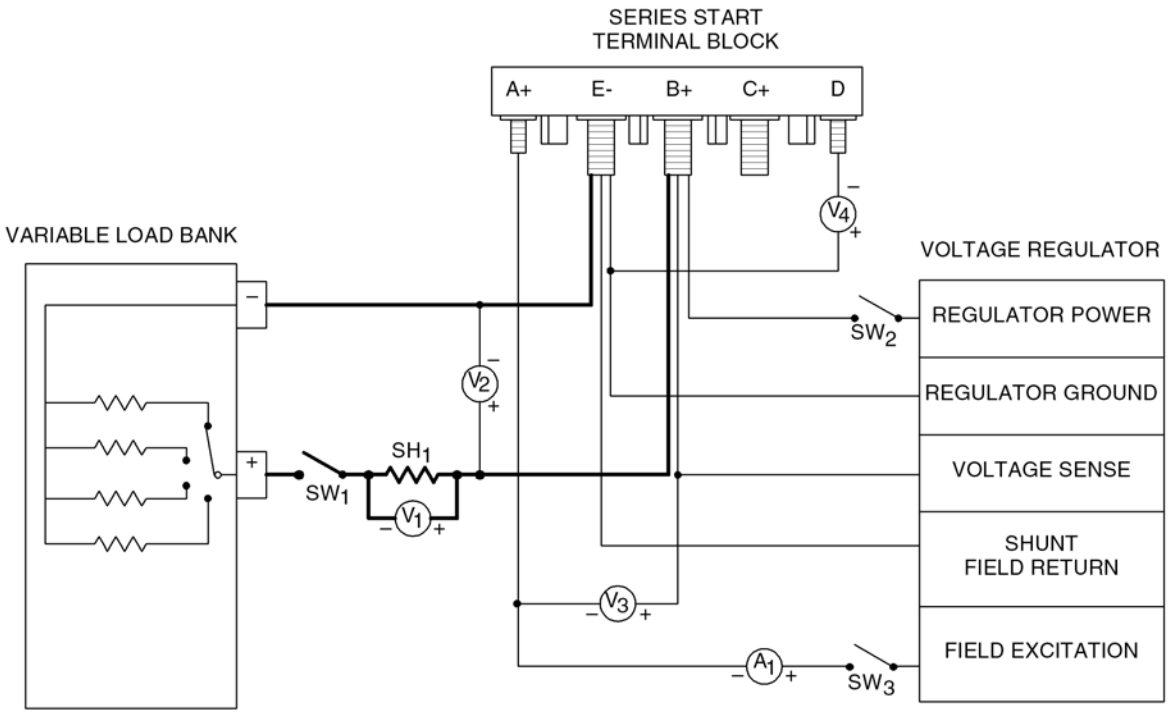

Figure 1003 - Test Set-Up for Generator Test

7. Acceptance Tests

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.**

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

A. Maximum Speed for Regulation

(1) Procedure

Without operational warm-up and regulator connected to the Starter-Generator, operate Starter-Generator self-excited at 12,000 rpm for Models 23046-019 and -020, 13,000 rpm for all other models, 30 V DC, and no-load. Record field current, commutation, and frame temperature.

(2) Acceptance Limits

(a) Shunt field current shall not be less than 0.81 A.

(b) Commutation must be black.

B. Continuous Operating Speed and Equalizing Voltage

(1) Operate Starter-Generator at 12,000 rpm, 30 V DC and 200 A until stabilized.

NOTE: Stabilization is defined in Paragraph 4.

(2) Measure and record the voltage between terminals D and E, air inlet temperature and winding or frame temperature.

(3) Acceptance Limits.

(a) The voltage between terminals D and E must be within the limits shown in Figure 1004, Figure 1005 or Figure 1006. Refer to Table 1004 for figure applicability.

(b) For models 23046-001, -007, -007M, -009, -017 the winding or frame temperature must not be more than 175° F (97° C) higher than the air inlet temperature.

Model	D to E Voltage Range
23046-001, 23046-007, 23046-007M, 23046-009, 23046-017	Figure 1004
23046-019, 23046-020	Figure 1005
23046-028	Figure 1006

Table 1004 - Equalizing Voltage Graphs

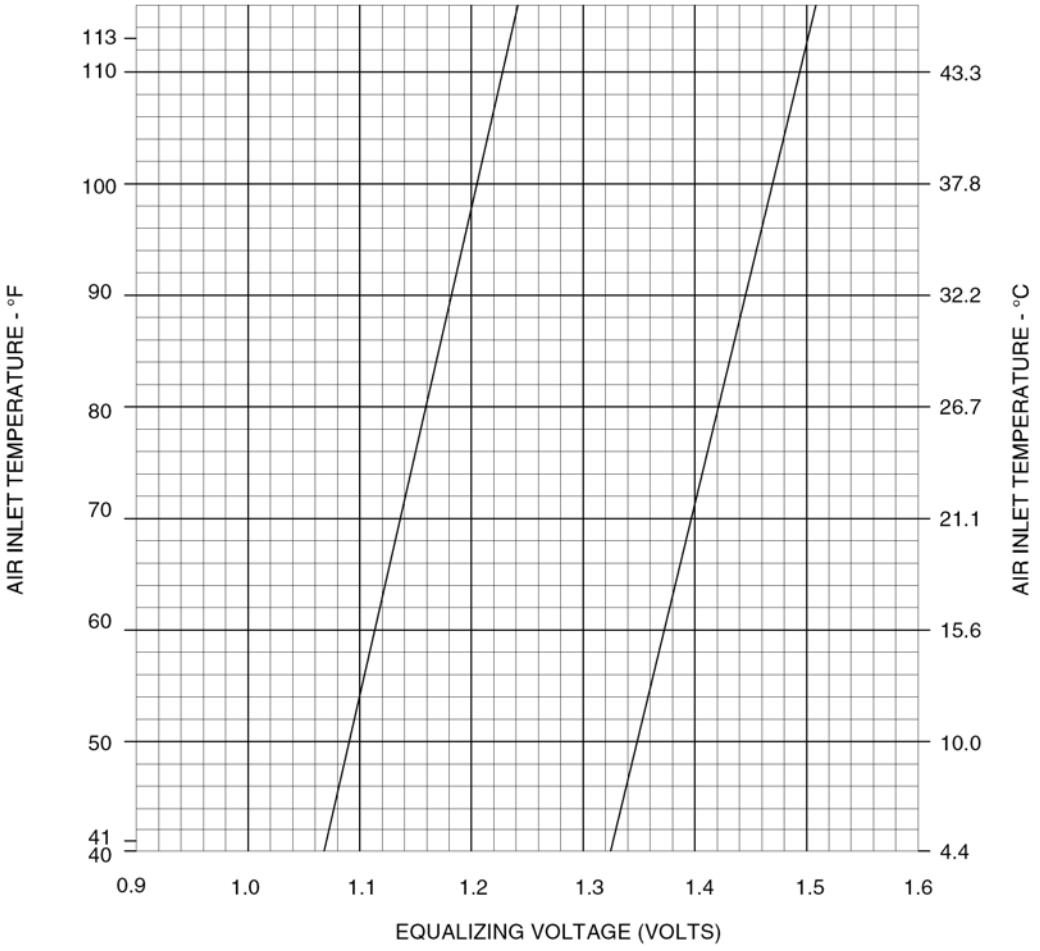

Figure 1004 - Equalizing Voltage Acceptance Limits, 23046-001, -007, -007M, -009 and -017

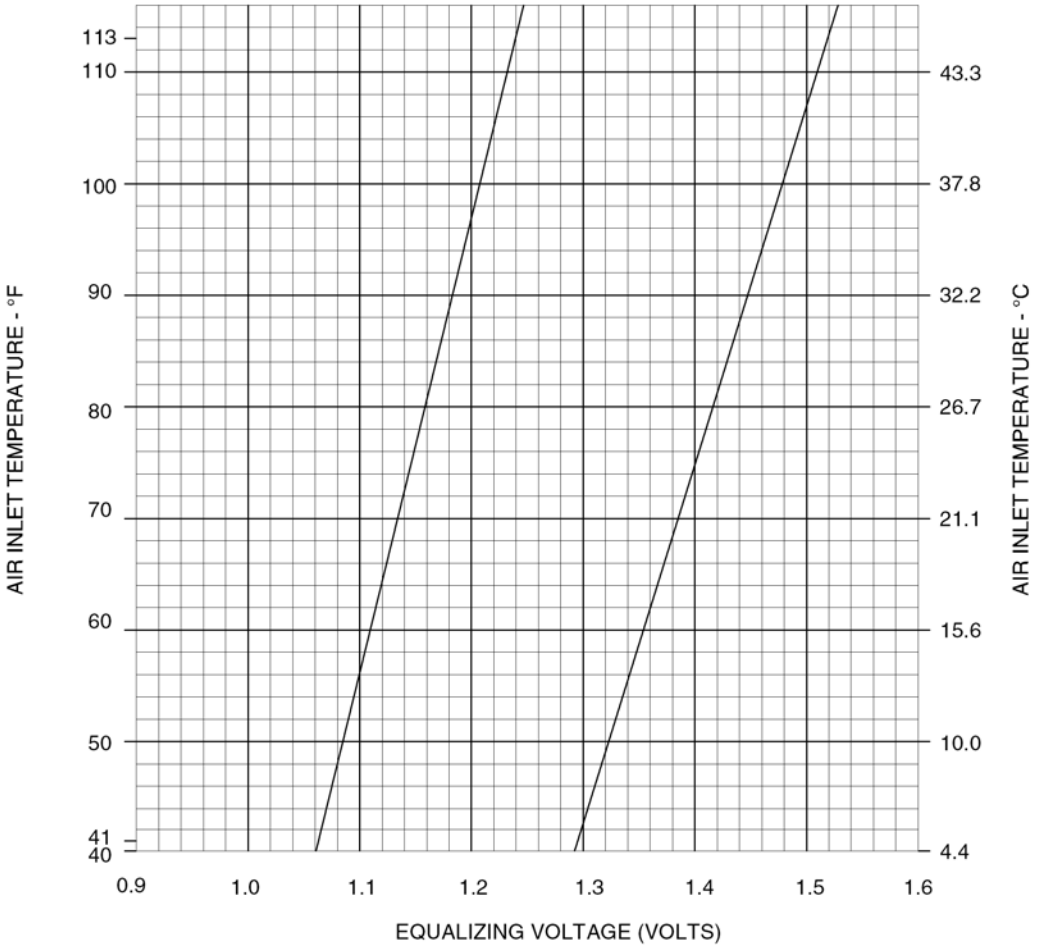

Figure 1005 - Equalizing Voltage Acceptance Limits, 23046-019 and -020

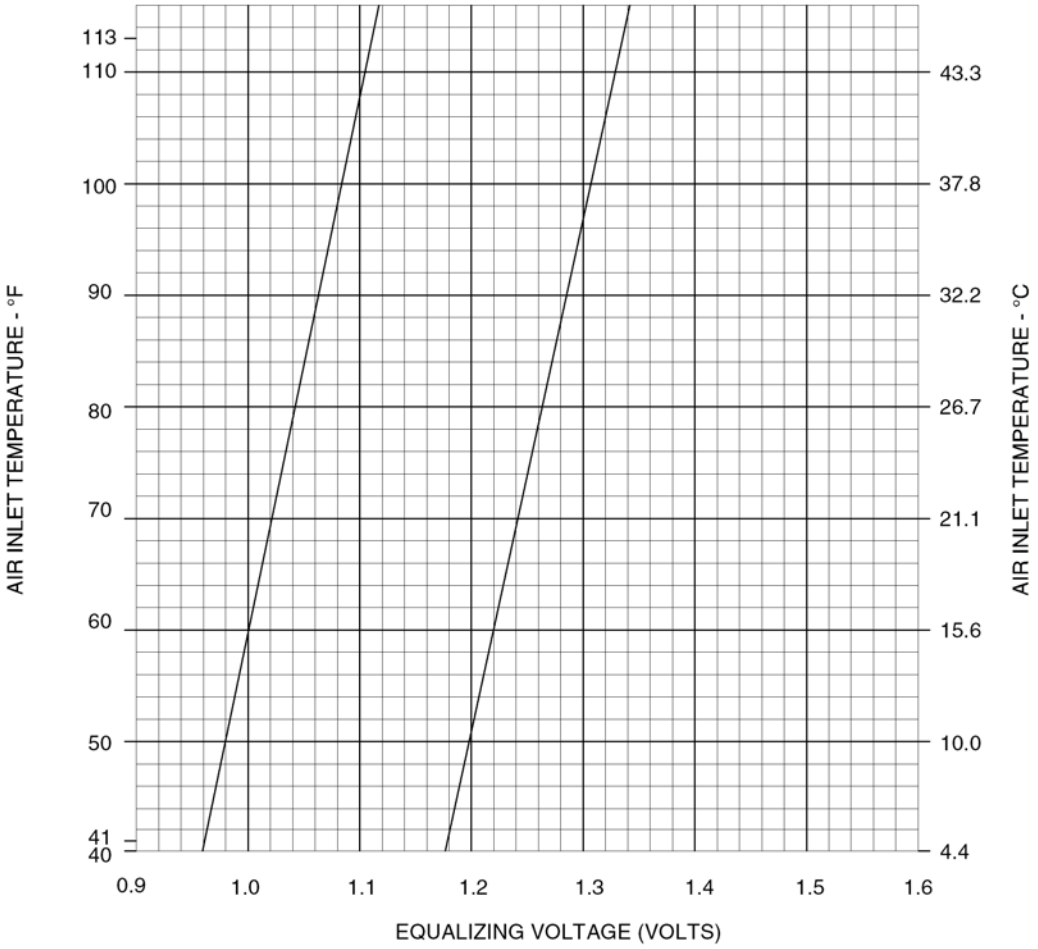

Figure 1006 - Equalizing Voltage Acceptance Limits, 23046-028

(4) For models 23046-001, -007, -007M, -009, -017, reduce the load to 100 A and check the commutation.

(5) 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 sparking or “arcing” beyond 0.25 inch (6,4 mm).

C. Minimum Speed for Regulation

(1) Procedure

Operate as a generator at 7,800 rpm for Models 23046-019 and -020, 7,900 rpm for all other models, 30 V DC, with load of 200 A applied. Check external resistance and shunt field current.

(2) Acceptance Limits

(a) Shunt field current shall not exceed 8.0 A.

(b) External resistance (B to A volts divided by field current) shall not be less than 1.25 Ω.

(c) For models 23046-001, -007, -007M, -009, -017:

- 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.
- Unacceptable commutation is considered to be sparking or “arcing” beyond 0.25 inch (6,4 mm).

D. Minimum Speed

(1) Procedure

Operate as a generator at 7,000 rpm for Models 23046-019 and -020, 7,200 rpm for all other models, 26 V DC, with load of 200 A applied. Check external resistance and shunt field current.

(2) Acceptance Limits

(a) Shunt field current shall not exceed 8.0 A.

(b) External resistance shall not be less than 1.25 Ω.

E. Overspeed

(1) Procedure

Operate starter-generator at no-load for five minutes at 14,000 rpm with field circuit open.

(2) Acceptance Limits

No mechanical failure shall occur as a result of this test.

F. Compounding

(1) Procedure

Operate at 12,000 rpm, 30 V DC. Check for compounding at 0, 50, 100, 150 and 200 A. Record shunt field current.

(2) Acceptance Limits

Shunt field current shall increase with load.

G. Commutation

(1) Procedure

(a) Operate starter-generator at 12,000 rpm, 30 V DC, with load of 200 A.

(b) Visually examine the condition of commutation.

NOTE: The proper angle for viewing commutation is approximately 30 to 45 degrees from the brush box as shown in Figure 1007

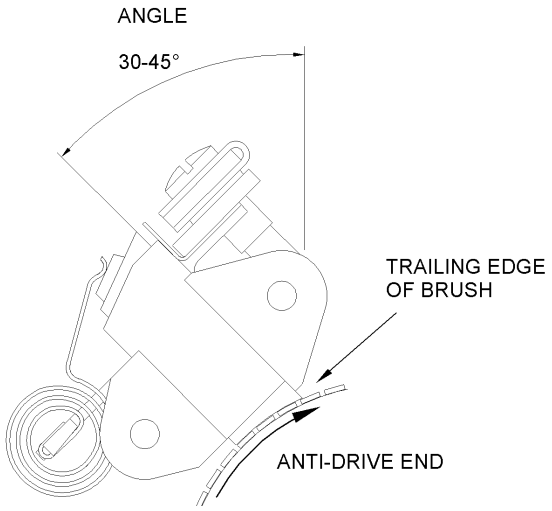

Figure 1007 - Correct Viewing Angle

(2) Acceptance Limits

(a) Acceptable (pin point) commutation must be interpreted to permit sparking that extends approximately 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.

H. Starter-Generator Dielectric Test

WARNING: **BEFORE USING HIGH VOLTAGE TESTER, MAKE CERTAIN THAT TESTER HAS BEEN TURNED "OFF" AND THAT NO ONE IS TOUCHING ANY PORTION OF CONNECTION POINTS OR PROBE LEADWIRES. FAILURE TO COMPLY WITH THIS WARNING CAN RESULT IN SEVERE ELECTRICAL SHOCK TO THE OPERATOR OR ASSISTANTS.**

CAUTION: DO NOT DO A DIELECTRIC TEST DURING MAINTENANCE INSPECTION OR TROUBLESHOOTING OF THE UNIT AS IT CAN CAUSE CUMULATIVE DEGRADATION OF THE ELECTRICAL CIRCUIT INSULATION. THIS TEST IS TO BE DONE ONLY FOR ACCEPTANCE TESTING OF AN OVERHAULED GENERATOR THAT HAS BEEN THOROUGHLY CLEANED.

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

(1) Operating Instructions

(a) Attach a dummy terminal block, refer to DISASSEMBLY section and ASSEMBLY section for details.

NOTE: Alternatively, remove the screw that secures the terminal block to the housing that is adjacent to terminal D. Cover the terminal lug attached to the terminal block with electrical tape before doing a dielectric test.

(b) Attach positive (red) lead of high pot tester to terminal B.

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

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

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

(d) Apply dielectric test voltage of 250 V RMS for one minute, or 300 V RMS for one second (commercial frequency) between the terminal and machine frame.

(e) Slowly decrease voltage to zero.

(f) Turn the power supply OFF.

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

(2) Acceptance Limits

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

I. No Load Speed Test

(1) Procedure

(a) Operate as a starter with shunt field circuit open (terminal A and B) for models 23046-019/-020, at no load with voltage applied between terminal C and E.

For all other models, connect 1.25 Ω between terminal A and B.

(b) Increase voltage until speed reaches 4,300 rpm for Models -019 and -020.

(c) Record voltage for Models -019 and -020.

(d) For all other models, apply 24 V from C to E.

(e) Record speed for all other models.

(2) Acceptance Limits

Voltage shall be less than 28 V for Models 23046-019 and -020. Speed shall be greater than 3,500 rpm for all other models.

J. Locked Rotor Test

CAUTION: DAMAGE TO THE EQUIPMENT MAY RESULT IF THE SHUNT FIELD WINDING IS NOT OPENED BEFORE ACCOMPLISHING THIS TEST. DO NOT ENERGIZE THE UNIT FOR MORE THAN 4 SECONDS.

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

(2) Procedure

(a) For all models except 23046-019 and -020, connect 1.25 Ω between terminals A and B.

(b) With shunt field open and the rotor locked, apply a variable DC voltage between terminals C(+) and E(-). Increase voltage until output torque measures 15 lbf.ft (20,3 Nm) for Models 23046-019 and -020, and 13 lbf.ft (17,6 Nm) for all other models. Record current and voltage.

(3) Acceptance Limits

(a) Current shall not exceed 800 A for Models 23046-019 and -020, and 500 A for all other models.

(b) Voltage shall not exceed 16 V for Models 23046-019 and -020, and 13 V for all other models.

K. Radial Vibration Test (for Models 23046-019 and -020 only)

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

(1) Mount starter-generator in a resilient cradle (foam rubber cushioned V-block) with the drive shaft supported (centered). Ref Figure 9010.

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

(3) Mount the probe of the vibration measuring tool to the generator housing.

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

(5) With no load, gradually increase starter voltage between terminals C and E until speed is 4300 rpm. The speed can be measured by pointing the strobe light at the fan.

(6) Measure and record total frame vibration amplitude.

(7) Acceptance Limits

(a) Total vibration amplitude shall not exceed 0.001 inch (0,025 mm).

L. Commutator Run-Out Check

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) Remove the commutation viewing adapter from the starter-generator.

(2) Put the starter-generator in a V-block or cradle support.

(3) Make sure there is sufficient access for the dial indicator to touch the commutator surface.

NOTE: You can get access to the commutator by removing one of the brushes from the brush holder or by finding an access area between the brush holders to do the measurement.

(4) Put the tip of the dial indicator on the brush wear path on the commutator surface.

NOTE: Make sure the dial indicator is perpendicular to the commutator surface.

(5) Install a spline wrench on the drive shaft.

(6) Turn the drive shaft by applying constant turning force in the direction of rotation of the starter-generator.

(7) Measure bar-to-bar and total indicator reading (TIR) runout in the full circumference of the commutator.

(8) Acceptance Limits:

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

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

8. Final Assembly After Acceptance Testing

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

9. Fault Isolation Tables

The following tables list faults that may occur during acceptance testing, performance testing, or when 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 the corrective action is accomplished.

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
A. Maximum Speed for Regulation Test		
Shunt Field Current Low	Low voltage power source.	Check power source to make certain that full voltage is being applied to starter-generator terminals.
	Defective switch in power supply line.	Replace switch.
	Damaged armature.	Replace armature.
	Short circuited or open stator windings.	Replace stator and housing assembly.
	Improperly seated brushes.	Check brush seats and accomplish brush seating. See REPAIR section.
Excessive sparking at brushes	Short circuited or grounded field windings.	Replace stator and housing assembly.
	Excessive clearance in bearings or rough bearing races.	Replace bearings.
	Damaged or eccentric commutator.	Refinish commutator. See REPAIR section.
	Armature out of balance.	Balance or replace armature. See REPAIR section.
	Short circuit in armature windings.	Replace armature.
	Brushes incorrectly installed with top bevel reversed.	Reverse and reseat brushes. See SPD 1006.
	Severe overload or short circuit in electrical system.	Locate and correct fault.
	Brushes sticking in holders.	Free-up brushes. See SPD 1006.
	Weak brush springs.	Replace brush springs.

Table 1005 - Fault Isolation Table

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
B. Continuous Operating Speed and Equalizing Voltage		
D to E voltage exceeds limits or Winding or frame maximum temperature exceeded	Brushes are incorrectly seated or installed.	Refer to SPD 1006 for brush installation, seating, and run-in procedures.
	One or more brush leads are loose.	Remove brush access cover. Inspect all brush leads for open circuit. If open circuit exists, overhaul or repair as necessary
	Armature is shorted or grounded.	Disassemble starter-generator. Clean Armature. Dielectric test according to procedure in CHECK section. Replace armature if shorted or grounded.
	Stator windings shorted or grounded.	Disassemble starter-generator. Clean stator and housing assembly. Dielectric test stator and housing assembly according to procedure in CHECK section. Replace stator and housing assembly if shorted or grounded.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive sparking at brushes	Short circuited or grounded field windings.	Replace stator and housing assembly.
	Excessive clearance in bearings or rough bearing races.	Replace bearings.
	Damaged or eccentric commutator.	Refinish commutator. See REPAIR section.
	Armature out of balance.	Balance or replace armature. See REPAIR section.
	Short circuit in armature windings.	Replace armature.
	Brushes incorrectly installed with top bevel reversed.	Reverse and reseat brushes. See SPD 1006.
	Severe overload or short circuit in electrical system.	Locate and correct fault.
	Brushes sticking in holders	Free-up brushes. See SPD 1006
	Weak brush springs.	Replace brush springs.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
C. Minimum Speed for Regulation Test		
Field Current Limit is exceeded	An excessive load was applied during test.	Check and adjust applied load at load bank as necessary.
Low external field resistance	Brushes are not fully seated.	Refer to SPD 1006 for brush installation, seating and run-in procedures.
	Brushes hung up in brush holder assemblies.	DISASSEMBLE brush access cover from starter-generator. Inspect brush holder assemblies and brush leads for proper positioning. CLEAN and REPAIR starter-generator as necessary. Perform brush run-in procedure. Refer to SPD 1006 for brush installation, seating and run-in procedures.
	Surface of commutator incorrectly filmed or irregular.	DISASSEMBLE starter-generator. CHECK armature. REPAIR commutator if necessary. Perform brush run-in procedure. Refer to SPD 1006 for brush installation, seating and run-in procedures.
	Armature is either shorted or grounded.	DISASSEMBLE starter-generator. CLEAN armature. Dielectric test armature according to procedure in CHECK section. Replace armature if shorted or grounded.
	Stator windings shorted or grounded.	DISASSEMBLE starter-generator. CLEAN stator and housing assembly. Dielectric test stator and housing assembly according to procedure in CHECK section. Replace stator and housing assembly if shorted or grounded.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive sparking at brushes	Short circuited or grounded field windings.	Replace stator and housing assembly.
	Excessive clearance in bearings or rough bearing races.	Replace bearings.
	Damaged or eccentric commutator.	Refinish commutator. See REPAIR section.
	Armature out of balance.	Balance or replace armature. See REPAIR section.
	Short circuit in armature windings.	Replace armature.
	Brushes incorrectly installed with top bevel reversed.	Reverse and reseat brushes. See SPD 1006.
	Severe overload or short circuit in electrical system.	Locate and correct fault.
	Brushes sticking in holders.	Free-up brushes. See SPD 1006.
	Weak brush springs.	Replace brush springs.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
D. Minimum Speed Test.		
Field Current Limit is exceeded or	An excessive load was applied during test.	Check and adjust applied load at load bank as necessary.
Low external field resistance	Brushes are not fully seated.	Refer to SPD 1006 for brush installation, seating and run-in procedures.
	Brushes hung up in brush holder assemblies.	DISASSEMBLE brush access cover from starter-generator. Inspect brush holder assemblies and brush leads for proper positioning. CLEAN and REPAIR starter-generator as necessary. Perform brush run-in procedure. Refer to SPD 1006 for brush installation, seating and run-in procedures.
	Surface of commutator incorrectly filmed or irregular.	DISASSEMBLE starter-generator. CHECK armature. REPAIR commutator if necessary. Perform brush run-in procedure. Refer to SPD 1006 for brush installation, seating and run-in procedures.
	Armature is either shorted or grounded.	DISASSEMBLE starter-generator. CLEAN armature. Dielectric test armature according to procedure in CHECK section. Replace armature if shorted or grounded.
	Stator windings shorted or grounded.	DISASSEMBLE starter-generator. CLEAN stator and housing assembly. Dielectric test stator and housing assembly according to procedure in CHECK section. Replace stator and housing assembly if shorted or grounded.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
E. Overspeed Test		
Noisy operation during overspeed test.	Cooling fan damaged.	NOTE: There are no authorized repair procedures to balance cooling fans. CHECK fan blades and air inlet/cover for damage. Replace cooling fan if damaged. REPAIR or replace air inlet/cover if damaged.
	Bearings are either defective and/or incorrectly installed.	Put starter-generator on vertical stator support. Remove brushes from brush holder assembly and inspect bearings. Disassemble starter-generator and replace bearings as necessary.
	Armature is striking against stator and housing assembly.	Disassemble starter-generator. CHECK armature, stator and housing for physical damage. Replace damaged parts as necessary.
Starter-generator vibrates.	Bearings are either defective and/or incorrectly installed.	Disassemble starter-generator. Replace bearings as necessary.
	Armature is out of balance.	Disassemble starter-generator. CHECK armature balance. Repair armature as necessary. Replace armature if damage is not repairable.
F. Compounding Test		
Shunt field current does not increase with load.	Stator compensating windings bad.	Disassemble starter-generator. Replace stator and housing assembly.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
G. Commutation Test.		
Excessive sparking	Brushes are incorrectly seated or installed.	If commutation exceeds pinpoints, re-seat brushes. Refer to SPD 1006.
	One or more of brush holders are loose.	DISASSEMBLE bearing and brush support assembly from starter-generator. CHECK hardware that attaches brush holder assemblies to bearing and brush support assembly. If damage is found, REPAIR and ASSEMBLE bearing and brush support assembly. Refer to SPD 1004. Dielectric test bearing and brush support assembly according to procedure in CHECK section.
	Brush spring pressure is below limit.	DISASSEMBLE starter-generator. CHECK brush spring pressure. Refer to SPD 1006. Replace brush spring(s) that do not meet limits in the FITS AND CLEARANCES section.
	An armature winding is partially or completely open	DISASSEMBLE starter-generator. Replace armature.
	Surface of commutator is incorrectly filmed or irregular	DISASSEMBLE starter-generator. REPAIR commutator surface if possible. Replace armature if damage is not repairable.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
	Stator and housing assembly is shorted or grounded.	DISASSEMBLE starter-generator. CLEAN stator and housing assembly Dielectric test stator and housing assembly according to procedure in CHECK section. Replace stator and housing assembly if stator and housing fail dielectric test.
	Armature is out of balance	DISASSEMBLE starter-generator. CHECK armature. REPAIR armature. Replace armature if correct armature balance cannot be accomplished.
H. Dielectric Test.		
Starter-generator insulation breakdown.	Bearing and brush support assembly is grounded.	Disassemble starter-generator. CLEAN anti-drive end end bell assembly. Dielectric test bearing and brush support assembly according to procedure in CHECK section. If assembly fails dielectric test, replace insulating sleeves and washers.
	Armature grounded.	Disassemble starter-generator. Clean armature. Dielectric test armature according to procedure in CHECK section. Replace armature if grounded.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
	Stator and housing assembly grounded.	Disassemble starter-generator. Clean stator and housing assembly. Dielectric test stator and housing assembly according to procedure in CHECK section. Replace stator and housing assembly if grounded.
I. No-Load Speed Test		
Voltage exceeds required maximum or speed not greater than 3,500 rpm.	Stator and housing assembly shorted or grounded.	Disassemble starter-generator. Clean stator and housing assembly. Dielectric test stator and housing assembly according to procedure in CHECK section. Replace stator and housing assembly if shorted or grounded.
	Armature shorted or grounded.	Disassemble starter-generator. Clean armature. Dielectric test armature according to procedure in CHECK section. Replace armature if shorted or grounded.
J. Locked Rotor Test		
Current level exceeded or Voltage level exceeded.	Short circuited or open stator winding.	Replace stator and housing assembly.
	Open circuit in armature.	Replace armature.

Table 1005 - Fault Isolation Table (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
K. Radial Vibration Test.(for Models 23046-019 and -020 only)		
Vibration amplitude limit exceeded.	Bearings are either defective and/or incorrectly installed.	Disassemble starter-generator. Replace bearings as necessary.
	Armature is out of balance.	Disassemble starter-generator. CHECK armature balance. Repair armature as necessary. Replace armature if damage is not repairable.
L. Commutator Run-Out Check		
Bar-to-bar runout or total indicator runout exceeded.	Commutator bars have shifted.	Disassemble starter-generator. Check commutator. Repair commutator surface as required. Replace armature if commutator is not repairable.

Table 1005 - Fault Isolation Table (Continued)

VERIFICATION / FINAL ACCEPTANCE DATA SHEET

Model Number: 23046-

Serial Number:

Modification Level

Inspected by:

Date:

Inspection/Test	Requirements/Limits	Measurements	Accept	Reject
Visual Inspection	Check for physical damage, missing parts, finishes, etc.			
Brush Seating	Per SPD 1006			
Maximum Speed for Regulation Test	Frame temperature	° F (° C)		
	Field current (0.81 A min.)	A		
	Commutation must be black			
Continuous Operating Speed and Equalizing Voltage	Air inlet temperature	° F (° C)		
	Frame temperature (stabilized)	° F (° C)		
	"D" to "E" volts (within limits of Figure 1004, 1005 or 1006)	V DC		
	Commutation must not exceed pinpoints			
Minimum Speed for Regulation	Field current (not to exceed 8.0 A)	A		
	"B" to "A" external field resistance (1.25 Ω minimum)	Ω		
	Commutation must not exceed pinpoints			
Minimum Speed	External field circuit ("B" to "A") resistance (1.25 Ω min.)	Ω		
	Shunt field current (8 A max.)	A		
Overspeed Test	No indication of failure			
Compounding (23046-001, -007, -007M, 009, -017, -019, -020, -028)	Shunt field current (must increase with load)	A		
		A		
		A		
		A		
Commutation Test	Not to exceed pinpoints			
Dielectric Test	No sign of insulation breakdown			
	Leakage current must not exceed 5mA	mA		
Starter No Load Test	Voltage must be less than 28 V DC for 23046-019 and -020	V DC		
	Speed must be greater than 3,500 rpm for all other models	rpm		
Locked Rotor Test for Models -019 and -020	"C" to "E" voltage (not to exceed 16 V DC)	V DC		
	Line current (800 A max.)	A		
Locked Rotor Test for all other Models	"C" to "E" voltage (not to exceed 13 V DC)	V DC		
	Line current (500 A max.)	A		
Radial Vibration Models -019 and -020 only	Total radial vibration (0.001 inch (0,025 mm) max.)	inch (mm)		
Commutator Runout	Total indicator reading (0.0008 inch (0,020 mm) max.)	inch (mm)		
	Bar to bar runout (0.0002 inch (0,005 mm max.)	inch (mm)		

SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

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DISASSEMBLY

1. Introduction

This section provides disassembly procedures for the 23046 Series I DC Starter-Generator. No further disassembly beyond that given in this section is necessary unless further disassembly is indicated in the CHECK or TESTING AND FAULT ISOLATION sections.

Do not open or desolder permanent connections unless replacement of worn, damaged, or defective parts is necessary.

NOTE: All soldering must be performed according to ANSI/IPC J-STD-001.

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

NOTE: 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.

2. Disassembly Tools

Other than normal shop tools, those listed in Table 3001 are needed for starter-generator disassembly.

WARNING: YOU MUST OBEY THE TOOL AND EQUIPMENT MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Tools	Reference
Anti-drive End Bearing Hub Support	Figure 9015
Arbor Press	Commercially available
Armature Shaft Adapter, Drive End	Figure 9001
Armature Shaft Adapter, Anti-drive End	Figure 9002
Bearing and Brush Support Assembly Support	Figure 9008
Bearing Puller	Commercially available
Dampener Hub Driver	Figure 9012
Drive End Hub Support	Figure 9009
Foam Cushion	Commercially available

Table 3001 - Disassembly Tools

Tools	Reference
Horizontal Stator Support	Figure 9010
Inner Race Bearing Driver	Figure 9004
Plastic or Leather Mallet	Commercially available
Pliers, External Snap Ring	Commercially available
Spline Wrench	Figure 9014
Vertical Stator Support	Figure 9011
Wire Hook Tool	Commercially available

Table 3001 - Disassembly Tools (Continued)

3. Disassembly Materials

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

NOTE: Equivalent substitutes may be used for the materials listed in Table 3002. Disassembly materials are not available from Safran Power USA. All items can be purchased commercially.

WARNING: YOU MUST OBEY THE MATERIAL MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

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

Table 3002 - Disassembly Materials

4. Disassembly of Starter-Generator

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

A. Remove QAD mounting kit (10) from starter-generator (if present).

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

(1) Loosen self-locking hex nut (-30) from T-bolt (-40) and remove rim-clenching clamp (20).

(2) Remove end bell, drive end pad (50) from starter-generator.

B. Remove identification plate (70), information plate (90), decal (110) and FAA-PMA label (-120) from stator and housing assembly (680) as applicable.

NOTE: Do not remove identification plate (70), information plate (90), decal (110), or FAA-PMA label (-120) unless damaged or illegible.

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

(1) Remove identification plate (70).

(a) Use a smooth, flat tool that will not scratch the stator housing.

(b) Wedge the tool between the edge of the identification plate and the housing near each of the four drive screws.

(c) Pry up the corners of the plate to remove the plate from the housing.

NOTE: This will break the light metal at each corner of the identification plate from the stator and housing assembly.

NOTE: Discard the old identification plate after the unit information has been transferred to the new replacement identification plate (70).

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

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

NOTE: Use a dull pair of small sidecutters so that you do not cut the head of the drive screw off.

(f) Discard drive screws (80) attaching identification plate (70).

(2) Remove information plate (90)

(a) Repeat the procedure given in Paragraph 4.B.(1) to remove the information plate (90) and two drive screws (100).

(3) Remove instruction decal (110) and FAA-PMA label (-120) from stator and housing assembly.

(a) Peel off and discard the instruction decal and/or the FAA-PMA label from the stator and housing assembly.

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.**

(b) Use isopropyl alcohol to remove adhesive residue.

(c) Wipe dry with a soft dry cloth.

C. Remove brush access cover (130) from starter-generator.

(1) Remove or sufficiently loosen screw (140) that secures brush access cover to stator and housing assembly.

(2) Remove brush access cover (130).

D. Remove brushes (160) from bearing and brush support assembly (-480).

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

NOTE: On older models a lead from the stator windings is connected to the negative brush holder. The screw that secures the brush lead and stator harness also secures this field coil lead.

(1) Remove screw (170) that secures brush lead to brush holder assembly.

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

(2) Use a wire hook tool to lift the two brush springs away from a brush set. Remove brush set from brush holder assembly. See Figure 3001.

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

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

(5) Repeat Paragraph 4.D.(1) thru Paragraph 4.D.(4) for each remaining brush holder assembly.

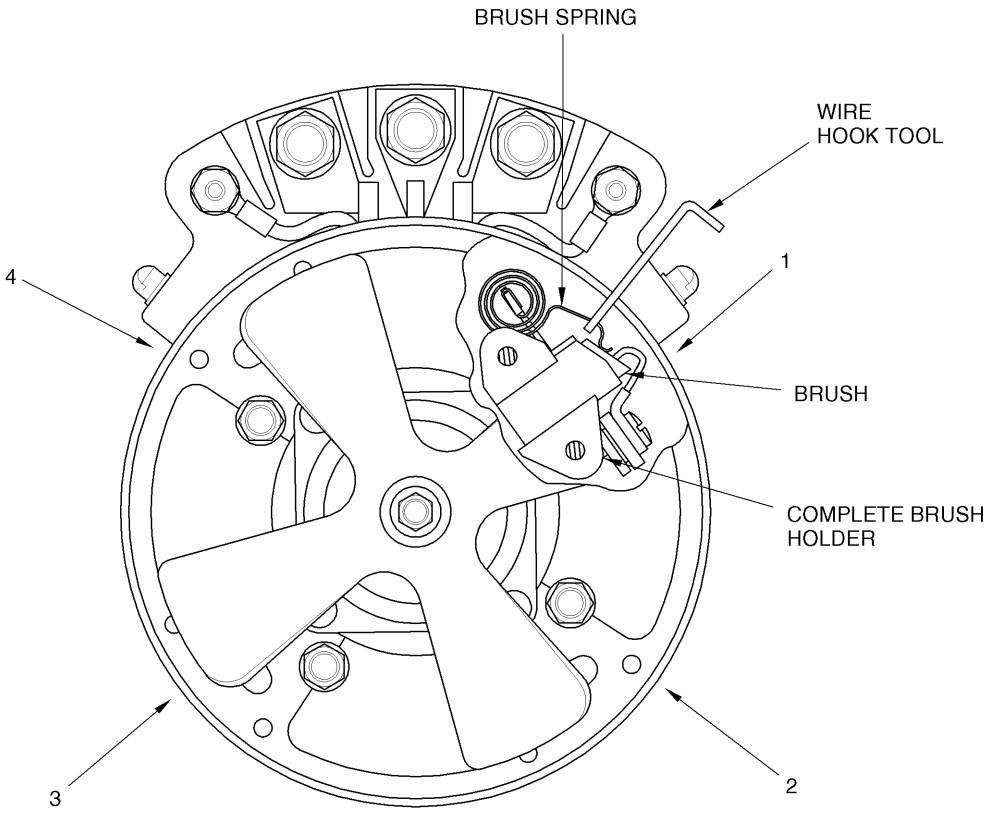

Figure 3001 - Removing Brushes

E. Remove air inlet assembly (200) and fan cover (240). (Models 23046-019 and 23046-020 only).

(1) Loosen self-locking nut on T-bolt of rim-clenching clamp (210). Remove clamp. See Figure 3002.

(2) Remove air inlet assembly (200) and fan cover (240) as a single unit from starter-generator.

NOTE: Do not perform the following step unless air inlet assembly or fan cover is worn or damaged and must be replaced.

(3) Remove the two screws (220) and washers (230) that secure fan cover (240) to air inlet assembly (200).

(4) Remove fan cover.

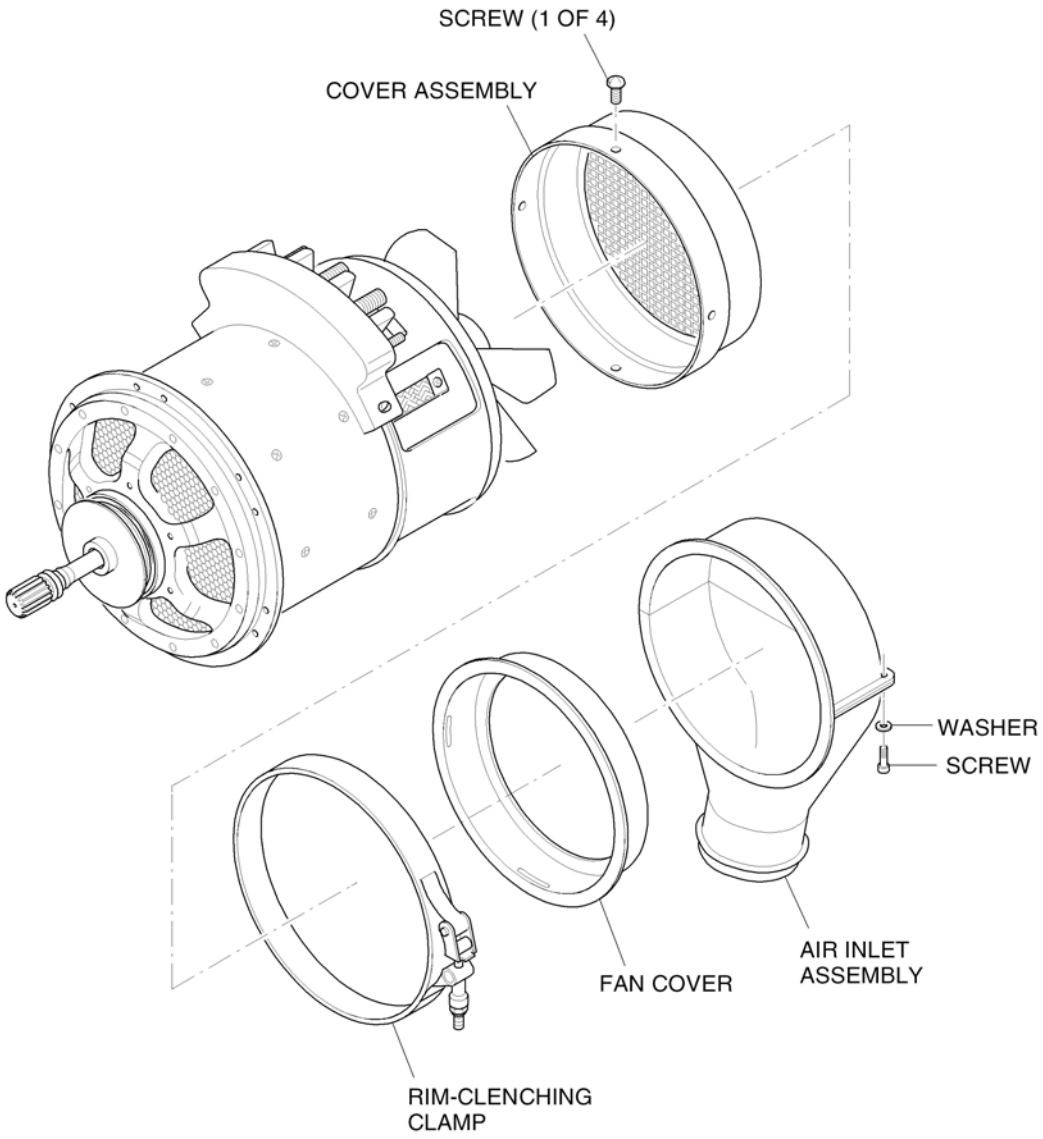

Figure 3002 - Removing Cover Assembly or Fan Cover and Air Inlet Assembly

F. Remove cover assembly (180). (All models except 23046-019 and 23046-020).

(1) Remove four screws (190) that attach the cover assembly (180) to the starter-generator. See Figure 3002.

(2) Remove cover assembly.

G. Remove fan (250) from drive shaft (290).

NOTE: Put a spline wrench on drive spline to prevent drive shaft from turning while removing self-locking nut.

(1) Remove self-locking nut (260).

(2) Remove flat washer (270).

(3) Slide fan off of drive shaft.

(4) On models 23046-019 and 23046-020 at MOD D, remove anti-drive end bearing shield (280) from drive shaft.

H. Remove drive shaft (290) with attached dampener hub (310), dampener plate (320) and friction ring (330) from armature shaft.

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

(1) Lightly tap anti-drive end of drive shaft with a plastic or leather mallet to disengage it from armature shaft. See Figure 3003.

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

(3) On models 23046-017, 23046-020 and 23046-028, remove O-ring (300) from drive shaft.

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

(4) Remove friction ring from drive shaft.

(5) Remove dampener plate from dampener hub.

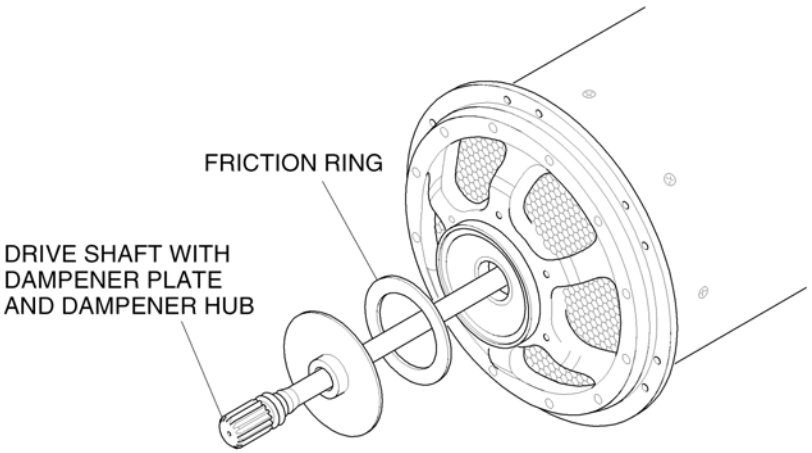

Figure 3003 - Removing Drive Shaft

I. Remove dampener hub (310) from drive shaft (290). See Figure 3004**.**

NOTE: Do not remove dampener hub unless it is damaged.

CAUTION: FAILURE TO USE A FOAM CUSHION UNDER DRIVE SHAFT WHEN REMOVING DAMPENER HUB CAN DAMAGE DRIVE SHAFT.

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

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

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

(4) Press drive shaft down into anti-drive hub support until dampener hub disengages from drive shaft.

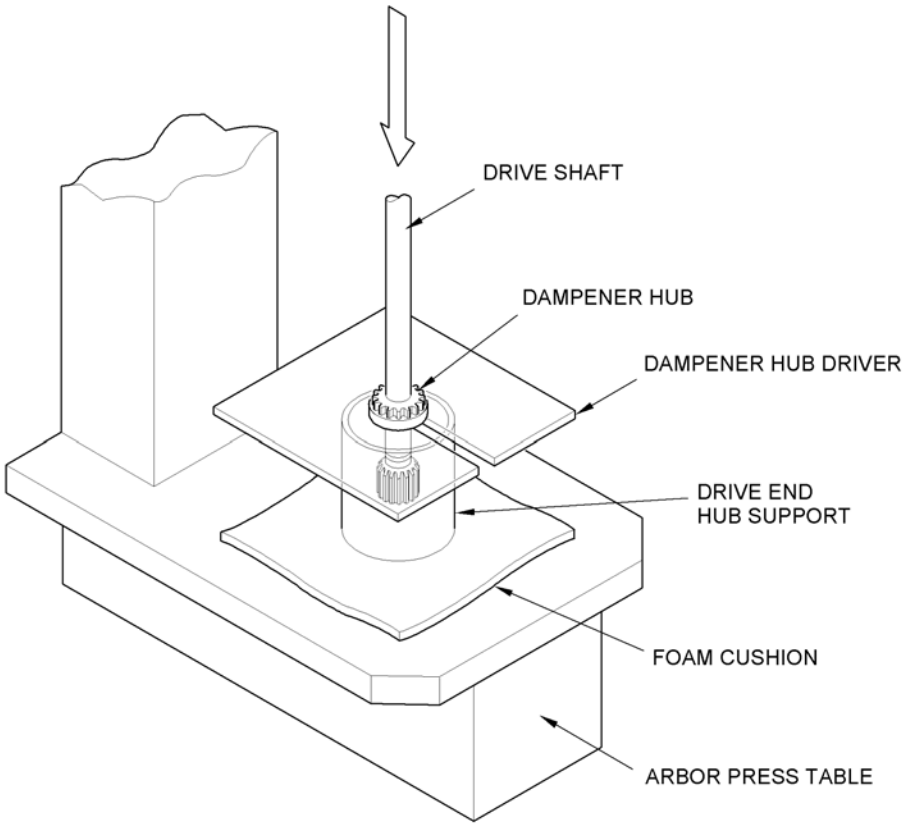

Figure 3004 - Dampener Hub Removal

J. Remove dampener backplate (340) from armature (470) shaft. See Figure 3005.

CAUTION: FAILURE TO USE A DRIVE END ARMATURE SHAFT ADAPTER WHEN REMOVING DAMPENER BACKPLATE CAN PERMANENTLY DAMAGE ARMATURE SHAFT.

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

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

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

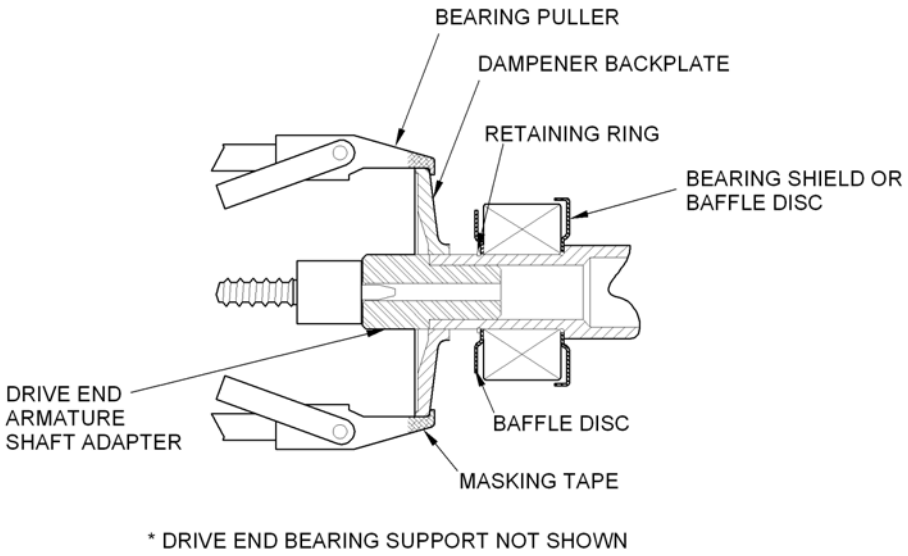

Figure 3005 - Dampener Backplate Removal

K. Remove bearing and brush support assembly (-480) and attached armature (470) from stator and housing assembly (680).

(1) Set starter-generator drive end down on a vertical stator support. See Figure 3006.

(2) Remove eight screws (490), eight lock washers (500) and eight flat washers (510) that attach bearing and brush support assembly to stator and housing assembly.

(3) Carefully lift bearing and brush support assembly, with attached armature, from stator and housing assembly.

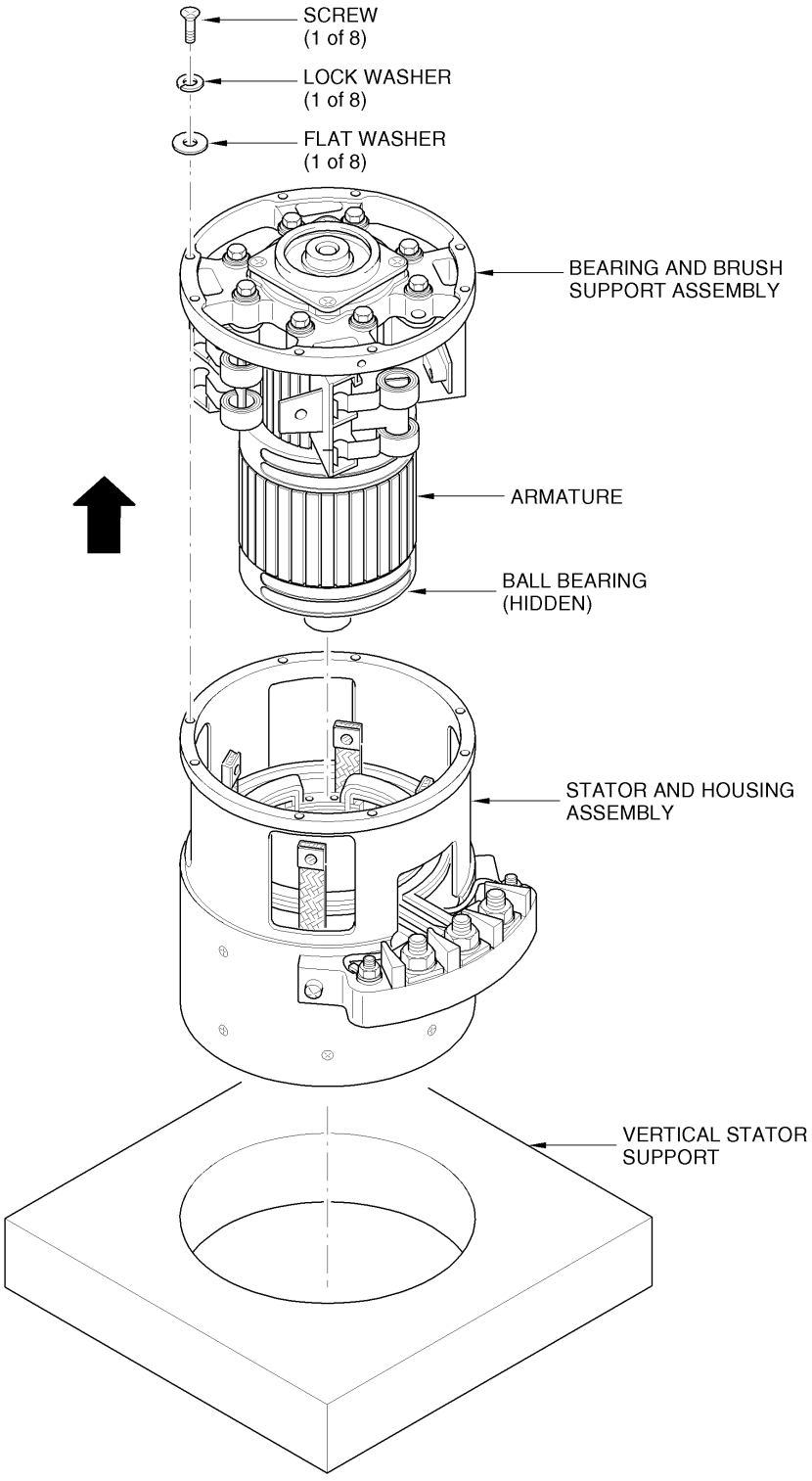

Figure 3006 - Removing Bearing and Brush Support Assembly with Attached Armature

L. Remove drive end bearing support assembly (-350) from stator and housing assembly (680).

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

(2) For unit 23046-001 remove eight screws (360B), eight lock washers (370) and eight flat washers (380) that attach drive end end bell (390C) to stator and housing assembly (680).

(3) For all other units, remove twelve screws (360) that attach drive end bearing support assembly (-350) to stator and housing assembly (680).

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

(4) Insert a wooden stick, 8 inches (20 cm) or longer, through anti-drive end and hold it against hub of drive end end bell.

(5) Lightly tap end of wooden stick using a plastic or leather mallet to loosen drive end bearing support assembly from stator and housing assembly.

(6) Remove drive end bearing support assembly from stator and housing assembly.

M. Remove armature (470) from bearing and brush support assembly (-480).

(1) Set a foam cushion and a bearing and brush support assembly support on an arbor press table. The foam cushion will help protect the armature shaft.

CAUTION: USE ONLY THE ANTI-DRIVE END ARMATURE SHAFT ADAPTER WHEN PRESSING ARMATURE FROM BEARING AND BRUSH SUPPORT ASSEMBLY TO PREVENT DAMAGE TO ARMATURE SHAFT.

(2) Set bearing and brush support assembly with attached armature onto a bearing and brush support assembly support. See Figure 3007.

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

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

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

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

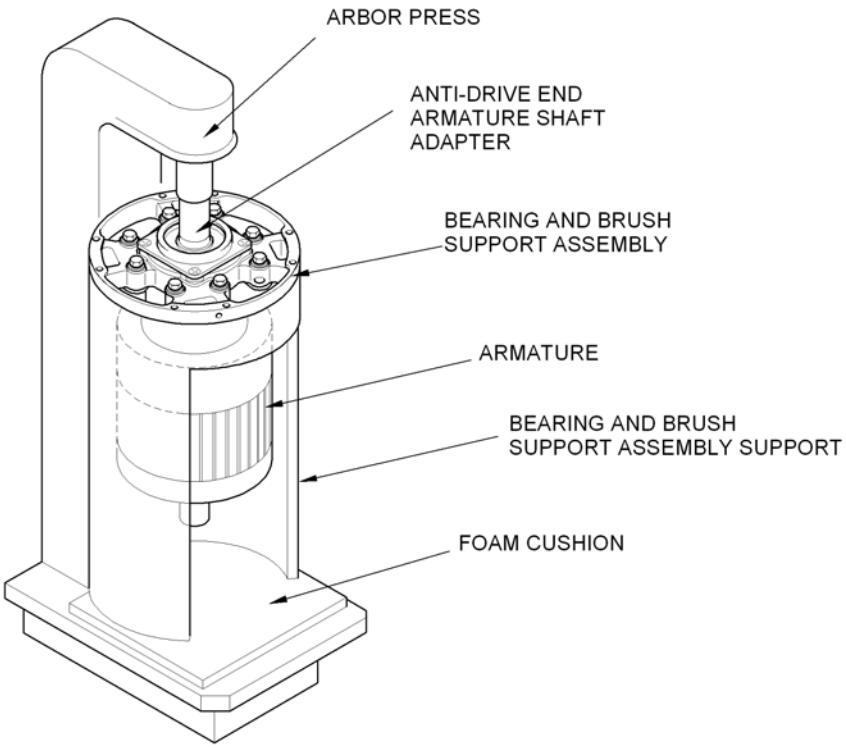

Figure 3007 - Removing Armature from Bearing and Brush Support Assembly

N. Remove ball bearing (450) and baffle disc (440) from drive end of armature (470) shaft. See Figure 3008.

(1) Remove and discard retaining ring (430) using external snap ring pliers.

(2) Remove baffle disc (440) from armature shaft.

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

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

(4) Remove bearing from armature shaft using a suitable bearing puller.

(5) Discard bearing.

(6) On units 23046-019 and 23046-020 remove drive end bearing shield (460) from armature shaft.

(7) On all other units remove baffle disc (440) from armature shaft.

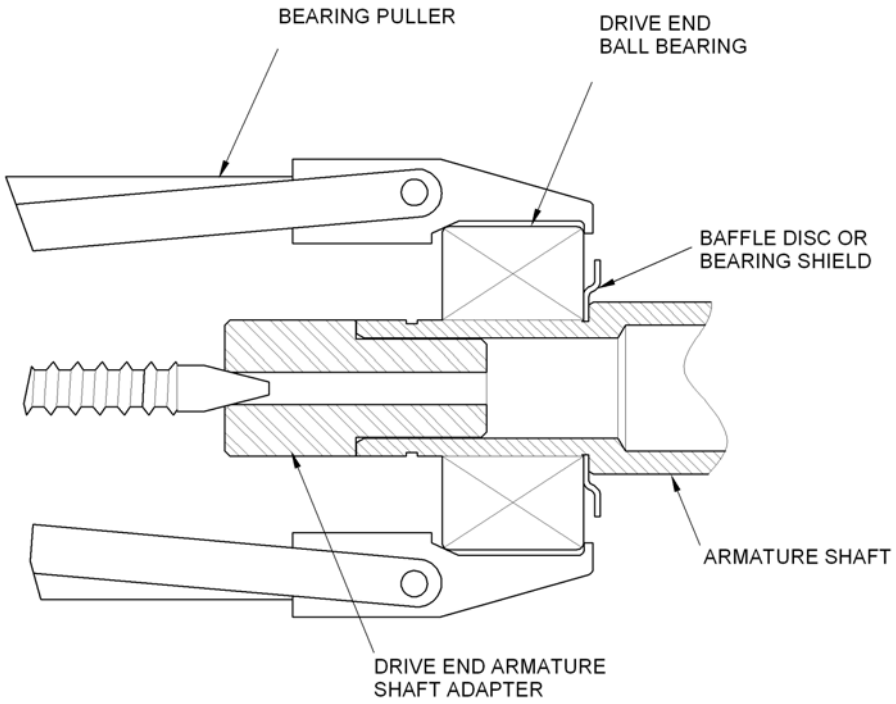

Figure 3008 - Removing Bearing from Drive End of Armature Shaft

O. Remove bearing retainer (660) from bearing and brush support assembly (-480).

(1) Remove four screws (670) that attach bearing retainer (660) to bearing and brush support assembly (-480).

(2) Remove bearing retainer.

P. Remove ball bearing (450) from bearing and brush support assembly (-480).

CAUTION: USE AN ANTI-DRIVE END BEARING HUB SUPPORT WHEN PRESSING THE BEARING FROM THE BEARING AND BRUSH SUPPORT ASSEMBLY TO PREVENT DAMAGE TO THE ASSEMBLY.

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

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

(3) Set an inner race bearing driver on inner race of ball bearing installed in bearing and brush support assembly. See Figure 3009.

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

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

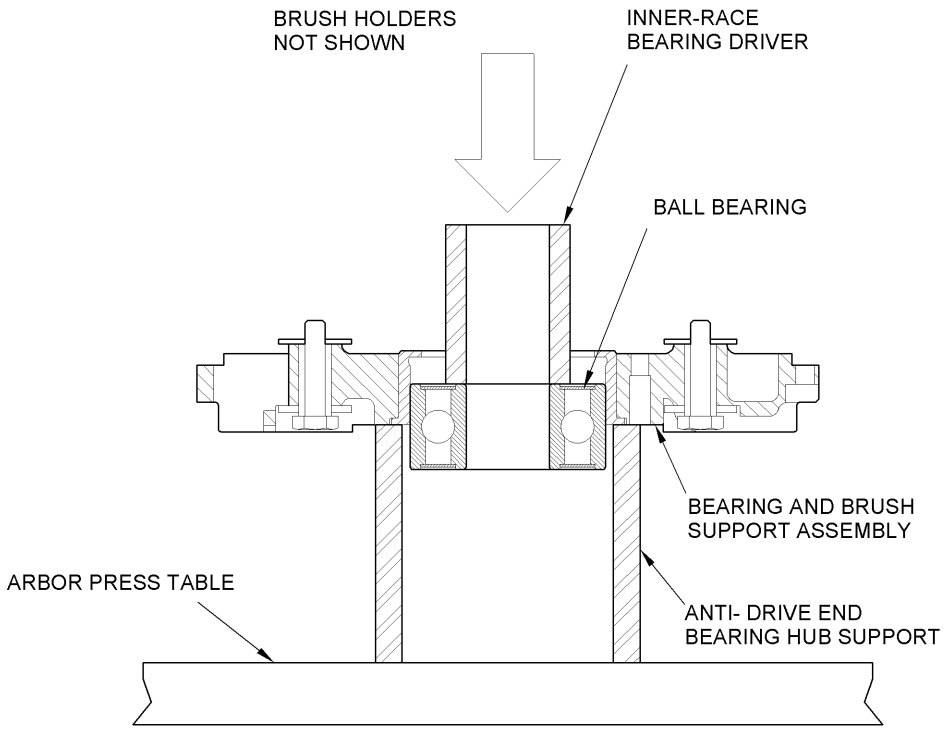

Figure 3009 - Removing Bearing from Bearing and Brush Support Assembly

Q. Remove brush holder assemblies (-550) from anti-drive end end bell (520).

NOTE: Do not remove brush holders and springs from anti-drive end end bell unless inspection reveals that replacement of part is required.

(1) Remove eight bolts (560) or self-locking nuts (570) and flat washers (580) from anti-drive end end bell (520). See Figure 3010.

(2) Remove eight non-metallic washers (590) and four insulation plates (650) and four brush holders (610) from anti-drive end end bell.

(3) Remove insulation sleeves (640) from the through holes in anti-drive end end bell.

(4) Discard non-metallic washers (590), insulation plates (650) and insulation sleeves (640).

(5) Remove two brush springs (600) from each brush holder (610).

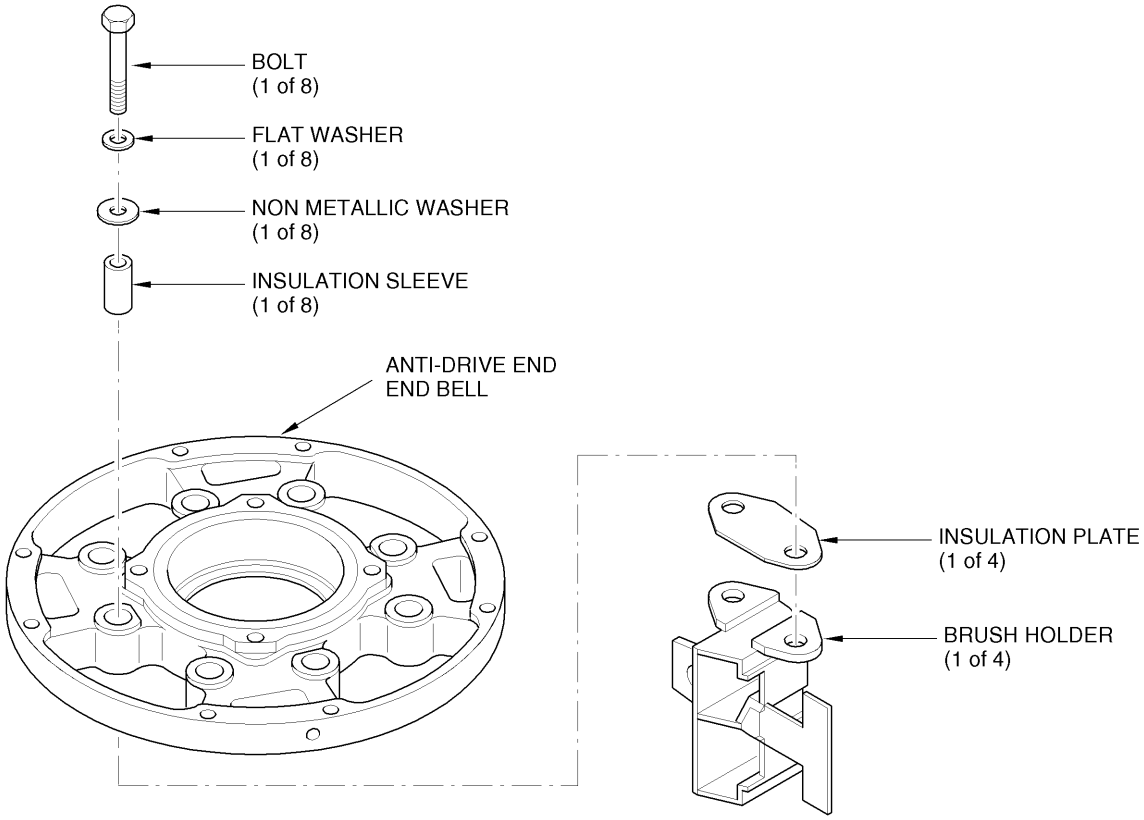

Figure 3010 - Removing Brush Holders

R. Disassembly of stator and housing assembly (680).

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

(1) Remove three self-locking nuts (760) and flat washers (770) from terminal studs E, B and C. Discard the self-locking nuts and flat washers.

(2) Remove two self-locking nuts (740) and flat washers (750) from terminal studs A and D. Discard the self-locking nuts and flat washers.

(3) Remove two screws (700), lock washers (710) and flat washers (720) to release the terminal block (690) from the stator and housing assembly (680).

(4) Carefully remove the terminal block from the stator leads.

CLEANING

1. Introduction

This section contains the cleaning procedures for the 23046 Series I DC Starter-Generator.

2. Cleaning Tools

In addition to standard shop tools, those special tools, fixtures, and equipment listed in Table 4001 are required for cleaning.

WARNING: YOU MUST OBEY THE TOOL AND EQUIPMENT MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Tools	Reference
Agitation Tank	Commercially Available
Compressed Air (The compressed air for cleaning must be free of oil and water)	Commercially Available
Oven (0 to 300°F (-18 to 149°C))	Commercially Available
Soak Tank	Commercially Available
Spray Booth	Commercially Available
Ultrasonic Cleaning Tank	Commercially Available
Black Light (The light is used to examine surfaces)	Commercially Available

Table 4001 - Cleaning Tools

3. Cleaning Materials

Table 4002 lists material and equipment required to perform the cleaning of assemblies, subassemblies and components.

NOTE: Refer to GSIL 2006-01 for the use of Brulin 815GD-NF

WARNING: YOU MUST OBEY THE MATERIAL MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

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
Desiccant	MIL-D-3464E Type II, Kraft bag, 4 unit bag size Engelhard Corporation Desiccate 25 or equivalent	Commercially Available

Table 4002 - Cleaning Materials

Material	Description/Specification	Source/CAGE Code
Detergent Refer to material technical data sheet for recommended dilution of water and detergent, and solution temperature.	Formula 815 GD or 815 GD-NF Applications: Hot tanks - aluminum safe Steam Cleaning Pressure Sprayers Ultrasonic 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)
	Formula 1990 GD Application: Spray Wash Cleaning	
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 4002 - Cleaning Materials (Continued)

4. 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 4003

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:** THE ULTRASONIC CLEANER CAN CAUSE DAMAGE IF YOU OPERATE WITH INCORRECT SOLUTION, OR HIGHER THAN THE RECOMMENDED CLEANING TIME AND TEMPERATURES.
	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 soak for 15 to 20 minutes maximum.
	Remove all evidence of dirt with a soft bristle brush or cleaning rag.
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 4003 - Cleaning Procedures

C. Rinse the parts.

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

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

E. Dry the parts.

WARNING: ISOPROPYL ALCOHOL IS 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) Examine each part for carbon particles by wiping with isopropyl alcohol on a clean lint-free cloth.

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

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

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

5. 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.

6. 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 HANDING 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 an oven at a temperature of 200 to 250° F (93,3 to 121° C) for 2 to 3 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.

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CHECK

1. Introduction

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

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

Refer to the FITS AND CLEARANCES section for dimensional acceptance limits. Reject a part if wear or damage is outside acceptance limits or is not serviceable.

2. Inspection Tools

In addition to standard shop tools, those special tools, fixtures, and equipment listed in Table 5001 are required for inspection.

WARNING: YOU MUST OBEY THE TOOL AND EQUIPMENT MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Tools	Reference
Ammeter	Commercially Available
Dial Indicator	Commercially Available
Dynamic Balancer	Safran Power USA SPD1001
Growler	Commercially Available
High Potential (Dielectric) Tester	Table 1001
LCR Meter	Commercially Available
Magnifier, 7X to 10X	Commercially Available
Pull Scale	Commercially Available
V-blocks	Commercially Available

Table 5001 - Inspection Tools

3. Inspection Materials

The following materials are needed to inspect the starter-generator and its components.

WARNING: YOU MUST OBEY THE MATERIAL MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Material	Description/Specification	Source/CAGE Code
Brush	Nonmetallic, soft bristle	Commercially Available
Cleaning Pads/Wiping Cloths	Lint-free, soft fabric	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

Table 5002 - Inspection Materials

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. This 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. A feeler of iron, is held along the slot containing the other side of the same winding. If the winding is shorted, the feeler will pull towards the lamination stack and vibrate. The feeler can also be used on the same side of the winding that is spanned by the growler.

4. General Information

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

A. Examine 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
- torn or cracked seals
- galling or glazing of friction lining residue
- bent or distorted springs
- rounding, stripping or uneven wear on spline teeth

B. Examine electrical components visually for:

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

5. Initial Inspection

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

A. Visual Examinations

(1) Visually examine starter-generator in a brightly lit work area in accordance with Paragraph 4.A. and Paragraph 4.B.

(a) If shipping or handling damage exists, stop inspection and notify supervisor.

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

(2) Examine seating between housing and both end bell assemblies. Make sure that all attaching hardware is in place.

B. Clean exterior of starter-generator.

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 surface of starter-generator using a lint-free cleaning cloth moistened with isopropyl alcohol.

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

6. Non-Destructive Test (NDT) Inspections.

A. Magnetic Particle Inspection

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. Liquid Penetrant Inspection

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

7. Replacing Service Parts and Common Hardware

A. Overhaul

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

B. Service repair

During repair, inspection or servicing, replace hardware and flat washers that are damaged, show signs of deformation, show corrosion, or have other apparent faults. Always replace bearings, retaining rings, lock washers and self-locking nuts regardless of their condition if removed during disassembly.

8. Inspection of Starter-Generator Parts and Assemblies

A. Overhaul inspection

At starter-generator overhaul, examine all components of starter-generator.

B. Repair or service inspection

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

NOTE: Brushes and commutator must be inspected according to inspection criteria in SPD1006 during repair inspection.

C. The following terms are referenced in this section:

- DISCARD -

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

- REPAIR -

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

- DISASSEMBLE -

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

- REPLACE -

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

D. Dimensions and points

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

E. Surfaces

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

9. Inspection of Parts and Assemblies

Unless otherwise specified, item numbers in parentheses ( ) refer to items found in Figure 10001 in the ILLUSTRATED PARTS LIST.

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

A. Rim-clenching clamp (20)

Examine part IAW procedures found in Paragraph 4.A.

(1) DISCARD clamp if cracks, dents, nicks, or scratches exist.

(2) REPAIR T-bolt (-40) with two or less damaged thread turns. DISCARD if damage exceeds that.

(3) DISCARD nut (-30) if removed.

B. End bell, drive end pad (50)

(1) Examine part IAW procedures found in Paragraph 4.A.

(2) DISCARD part if cracks are found.

(3) REPAIR part if minor dents, nicks and scratches or mating surface gouging, scoring, or glazing exist.

(4) Visually examine mating surfaces (See Figure 5001) for corroded surface coatings and pitting.

DISCARD drive end pad if pilot flange diameter is not within limits in the FITS AND CLEARANCES section.

(5) 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.

(6) If the visual inspection under 10X magnification finds indications which can be cracks, perform a liquid penetrant inspection IAW Paragraph 6.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.

(7) Examine pad for damaged or missing guide pins (-60).

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

(b) REPLACE guide pin(s) if guide pin height is not within limits in the FITS AND CLEARANCES section.

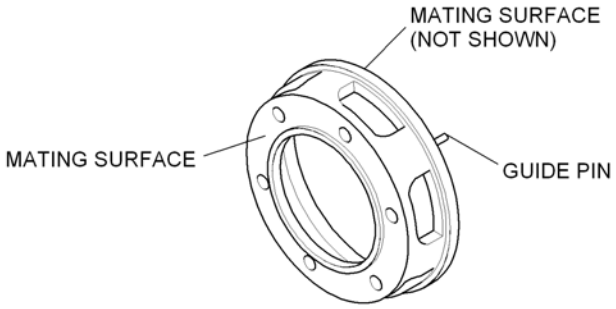

Figure 5001 - Inspecting End Bell, Drive End Pad

C. Identification plate (70). See Figure 5002.

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

(1) Examine the part IAW the procedures found in Paragraph 4.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 (70).

(c) DISCARD the original identification plate.

(2) Make sure that drive screws (80) that attach identification plate are in place, and tight.

(a) DISCARD loose drive screws (80).

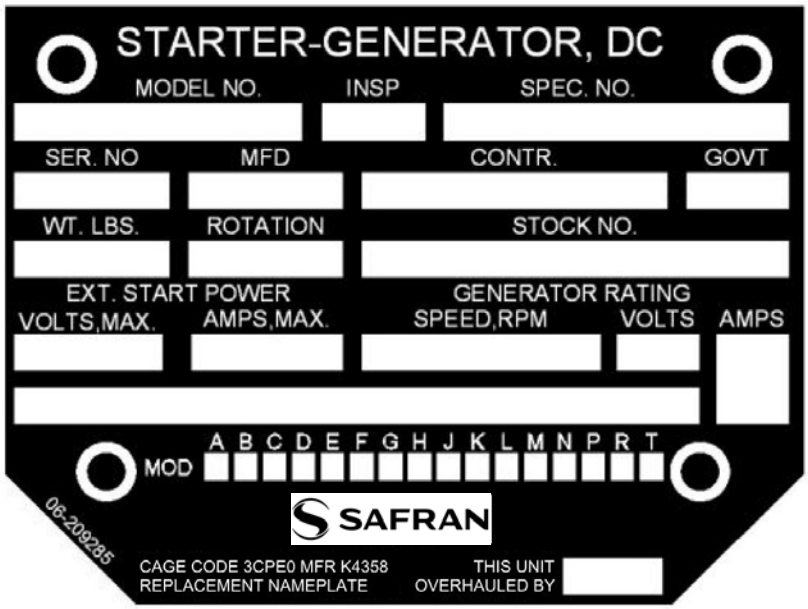

Figure 5002 - Typical Replacement Identification Plate

D. Brush access cover (130). See Figure 5003.

(1) Examine the part IAW the procedures found in Paragraph 4.A.

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

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

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

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

(3) Examine the screw (140) threads IAW the procedures found in Paragraph 4.A.

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

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

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

(5) Examine the blind rivet nut (150) threads IAW the procedures found in Paragraph 4.A.

(a) DISCARD the part if damage is found.

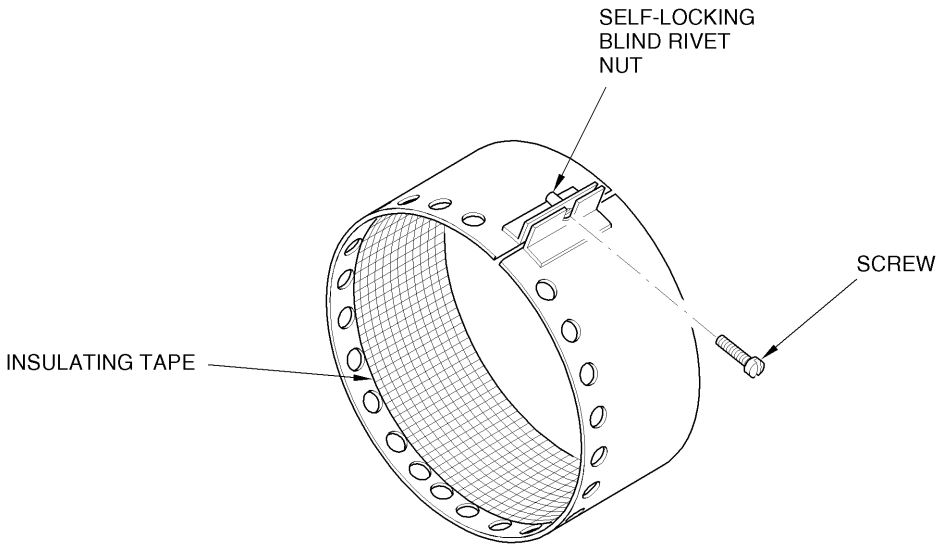

Figure 5003 - Brush Access Cover

E. Brushes (160)

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

(1) Examine part IAW procedures found in Paragraph 4.A. and Paragraph 4.B.

(2) REPLACE if defective.

(3) Replace brushes if remaining allowable wear will be exceeded before the next scheduled maintenance or overhaul.

(4) For proper brush seating procedures, refer to SPD 1006.

F. Cover assembly (180)

(1) Examine part IAW procedures found in Paragraph 4.A.

(2) DISCARD part if cracks are found.

G. Air inlet assembly (200) and fan cover (240)

(1) Examine part IAW procedures found in Paragraph 4.A.

(2) DISCARD part if cracks are found.

H. Rim-clenching clamp (210) for air inlet assembly

Examine part IAW procedures found in Paragraph 4.A.

(1) DISCARD clamp if cracks, dents, nicks, or scratches exist.

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

(3) DISCARD self-locking nut if removed.

I. Fan (250)

(1) One and two part fans.

(a) Examine the part IAW the procedures found in Paragraph 4.A.

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

1 DISCARD the part if cracks, scoring, gouging, glazing on mating surfaces, or major damage exists.

2 REPAIR the fan if minor surface damage is found.

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

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

(c) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW Paragraph 6.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.

1 REPLACE if damage is found.

(2) Two part fan, P/N 23046-1020

(a) Dimensionally inspect the fan assembly as follows. Refer to Figure 5004.

1 Back edge of blade must not be less than 0.100 inch (2,54 mm) from the locating shoulder of the hub.

2 Forward edge of blade must not be more than 0.830 inch (21,082 mm) from the locating shoulder of the hub.

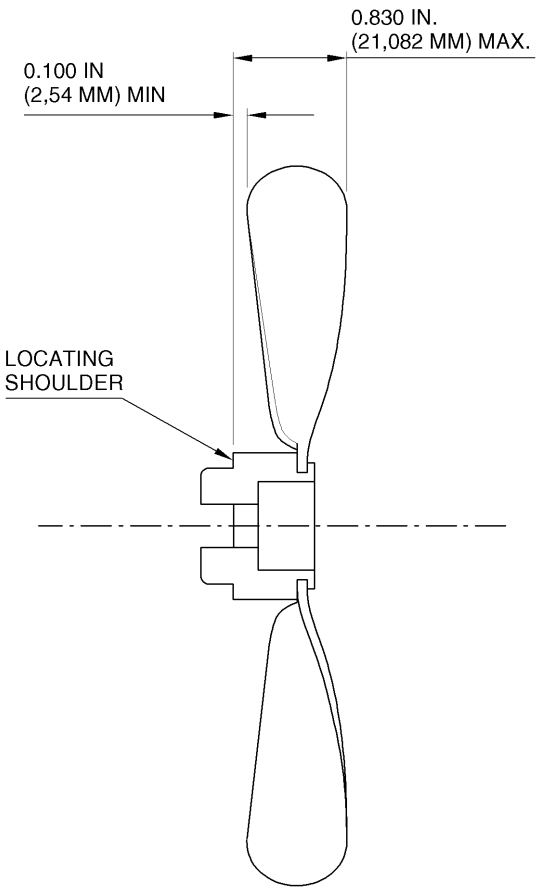

Figure 5004 - Two Part Fan

J. Anti-drive end bearing shield (280). See Figure 5005.

(1) Examine the part IAW the procedures found in Paragraph 4.A.

(a) DISCARD the part if damaged.

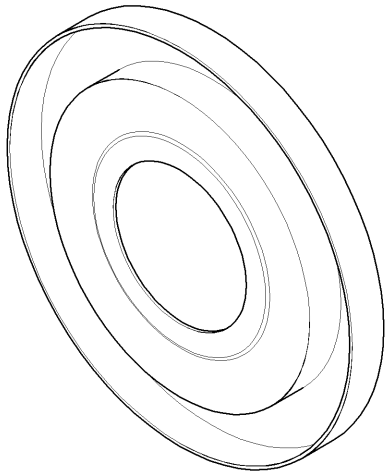

Figure 5005 - Anti-Drive End Bearing Shield

K. Drive shaft (290) and dampener hub (310). See Figure 5006.

(1) Examine part IAW procedures found in Paragraph 4.A.

(a) DISASSEMBLE drive shaft (290) and dampener hub (310) if cracks or thread damage beyond two threads exist. DISCARD damaged part.

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

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

DISASSEMBLE drive shaft and dampener hub if damaged. DISCARD damaged part.

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

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

(4) Perform a magnetic particle inspection IAW procedures found in Paragraph 6.A.

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

(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.

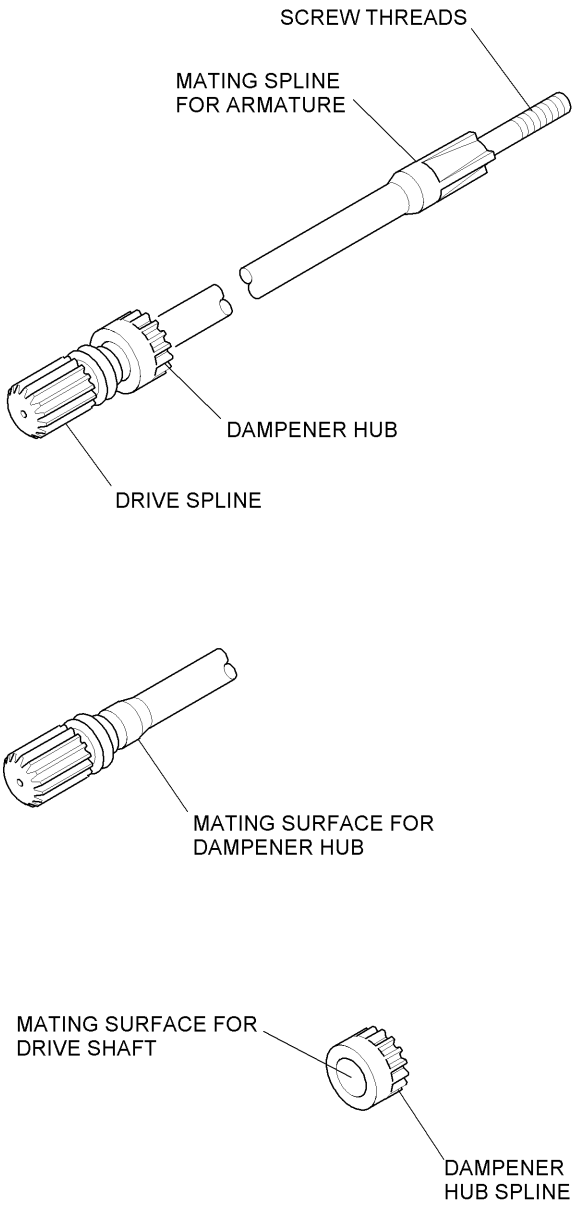

Figure 5006 - Inspecting Drive Shaft and Dampener Hub

L. Dampener plate (320). See Figure 5007.

(1) Examine part IAW procedures found in Paragraph 4.A.

(a) DISCARD part if cracks exist.

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

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

(a) DISCARD part if damaged.

(3) Measure dampener plate thickness.

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

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

(a) DISCARD if distance is above the acceptance limit in the FITS AND CLEARANCES section.

(5) Perform a magnetic particle inspection IAW the procedures found in Paragraph 6.A.

(a) DISCARD the part if damaged.

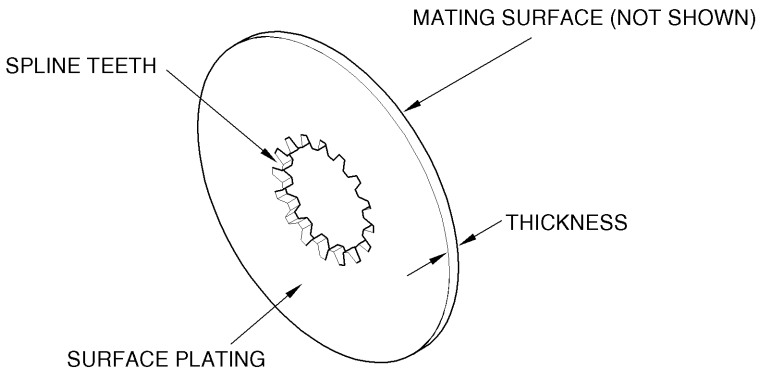

Figure 5007 - Dampener Plate

M. Friction ring (330). See Figure 5008.

WARNING: DO NOT CUT, RIP, OR SAND ASBESTOS-CONTAINING MATERIALS. LEAVE UNDAMAGED MATERIALS ALONE AND, TO THE EXTENT POSSIBLE, PREVENT THEM FROM BEING DAMAGED, DISTURBED, OR TOUCHED. DISCARD MATERIAL BY FIRST CHECKING WITH LOCAL HEALTH, ENVIRONMENTAL, OR OTHER APPROPRIATE OFFICIALS TO FIND OUT ABOUT PROPER HANDLING AND DISPOSAL PROCEDURES. REFER TO THE SIL 02-5600 FOR THE IDENTIFICATION AND MORE INFORMATION ABOUT THE ASBESTOS FRICTION RING.

(1) If friction ring is P/N 02-5600-05, it must be discarded because it contains asbestos. Install only new friction rings with no asbestos material that have a black color.

(2) Examine the part IAW the procedures found in Paragraph 4.A.

(a) DISCARD the part if damage is found.

(3) Measure the friction ring (330) thickness.

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

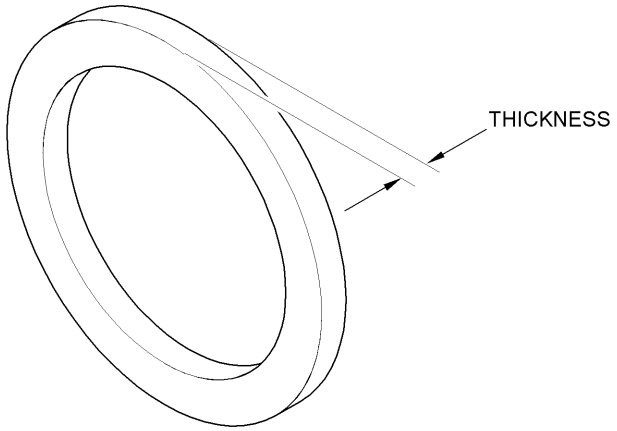

Figure 5008 - Friction Ring

N. Dampener backplate (340). See Figure 5009.

(1) Examine part IAW procedures found in Paragraph 4.A.

(a) DISCARD part if cracks exist.

(b) REPAIR if minor nicks or scratches exist.

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

(2) Perform a magnetic particle inspection IAW the procedures found in Paragraph 6.A.

(a) DISCARD part if cracks are found.

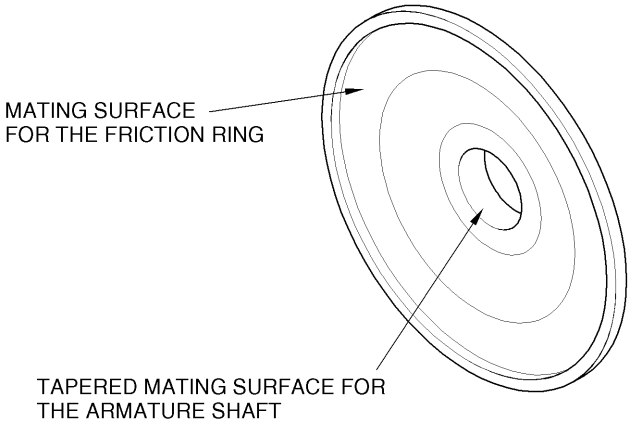

Figure 5009 - Inspecting Dampener Backplate

O. Drive end bearing support assembly (-350). See Figure 5010.

(1) Examine part IAW procedures found in Paragraph 4.A.

(a) DISCARD part if cracks or fretting and/or corrosion on 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 6.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 using a gage and equipment with an accuracy of 0.00004 inch. (0,0010 mm).

(a) REPAIR part if diameter is not within the limits of the FITS AND CLEARANCES section.

(5) Examine screen (400) for damage.

(a) DISCARD screen if damage is found.

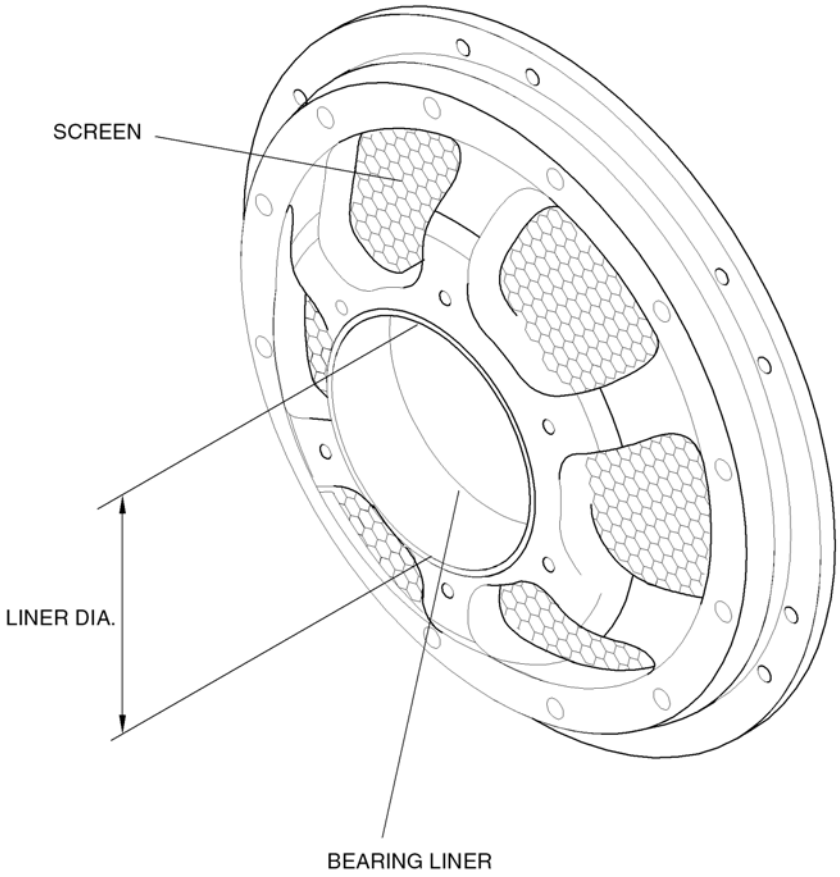

Figure 5010 - Drive End Bearing Support Assembly

P. Baffle disc (440). See Figure 5011.

(1) Examine part IAW procedures found in Paragraph 4.A.

(a) DISCARD part if damaged.

(2) Carefully examine mating surfaces 1, 2, and 3 for gouging, scoring, or glazing. See Figure 5011.

(a) DISCARD part if damaged.

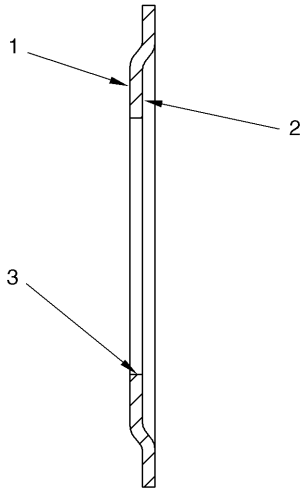

Figure 5011 - Inspecting Baffle Disc

Q. Drive end bearing shield (460). See Figure 5012.

(1) Examine the part IAW the procedures found in Paragraph 4.A.

(a) DISCARD the part if damaged.

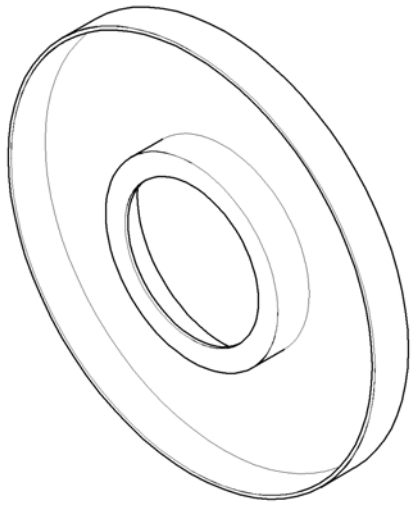

Figure 5012 - Bearing Shield

R. Armature (470). See Figure 5013.

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

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

(a) REPLACE armature (470) if bar-to-bar run-out is more than the limits of the FITS AND CLEARANCES section before refinishing the armature. NO REPAIR IS PERMITTED.

(2) Examine the part IAW procedures found in Paragraph 4.A.

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

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

(3) Examine the armature for insulating enamel (Glyptal or equivalent).

(a) REPLACE the armature if insulating enamel (Glyptal or equivalent) is found on the armature windings.

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

(a) REPAIR bearing journals if damaged.

(b) REPLACE armature if damage is not repairable.

(5) Measure bearing journal diameters, A and C, as shown in Figure 5013.

(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.

(6) Measure commutator diameter B, as shown in Figure 5013.

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

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

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

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

(b) REPLACE armature if damaged.

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

(a) REPLACE armature if damaged.

(9) Examine commutator bars for burning and discoloration.

(a) REPAIR commutator if damaged.

(b) REPLACE armature if damage is not repairable.

(10) Measure commutator undercut.

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

(b) REPLACE armature if damage is not repairable.

(11) After the commutator is refinished, measure commutator bar-to-bar and total indicator reading (TIR) run-out in a full circumference. Support the armature (470) on two “V” blocks.

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

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

(b) Measure commutator TIR run-out.

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

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

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

(13) Test armature windings for shorts using a growler and iron feeler. Refer to Paragraph 3.A. of this section for additional information about use of growler during inspection.

(a) REPLACE the armature (470) if a short exists.

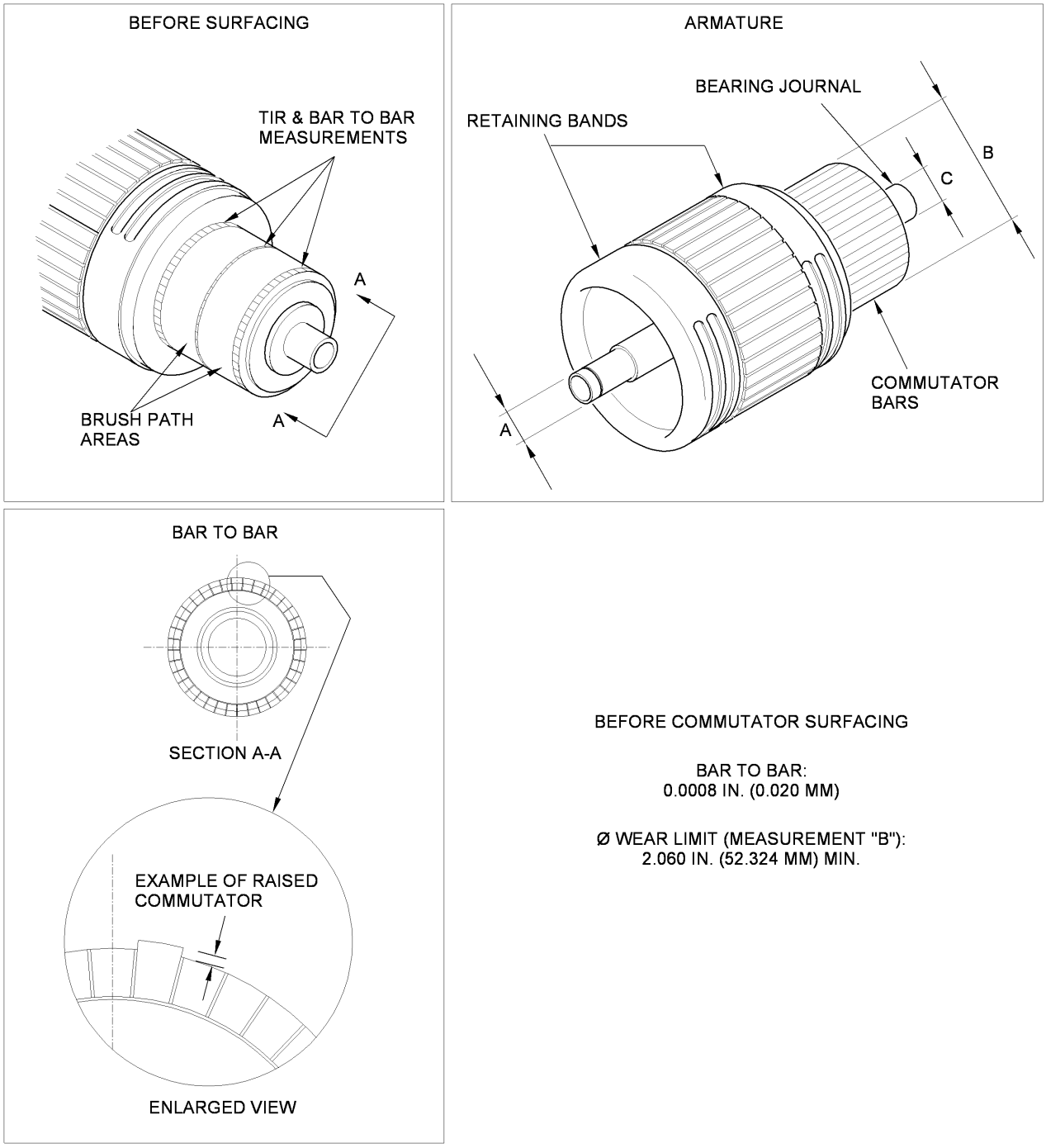

Figure 5013 - Armature Check

(14) 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.

(a) Set the power of the high potential tester to the OFF position. Connect the positive test lead of the high potential tester to an exposed surface of the commutator.

(b) Connect negative test lead on the armature shaft.

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

(d) 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 voltage back to 0.

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

(f) Remove negative test lead.

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

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

(i) Do the dielectric test between the drive end retaining band and commutator.

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

(k) Remove negative test lead.

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

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

(n) Do the dielectric test between anti-drive end retaining band and commutator.

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

(p) Disconnect all test leads.

(q) Acceptance limits:

1 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.

2 If the armature does not pass the acceptance limits of the dielectric test after you clean it again, replace armature.

S. Bearing and brush support assembly (-480). See Figure 5014 and Figure 5015.

(1) Examine the part IAW the procedures found in Paragraph 4.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 5014) 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 6.B.

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

(a) REPLACE if damage is found.

(4) Measure bearing liner diameter ‘A’ using a gage with an accuracy of ± 0.00004 inch (0,0010 mm). See Figure 5014.

(a) DISASSEMBLE the bearing and brush support assembly (-480) if damage exists.

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

(5) Examine the helical coil inserts (540, 530) (marked 4 and 5 on Figure 5014) for damage.

(a) REPAIR helical coil inserts if damage is found.

(b) REPAIR damaged parts.

(6) Hand tighten a machine screw into the thread in each brush holder (610) to make sure that the self-locking feature is functional. The machine screw should bind in the thread before it is fully engaged.

(a) REPAIR the brush holder (610) if the self-locking feature does not function properly, but the brush holder has a helical coil insert.

(b) REPLACE the brush holder (610) if the self-locking feature does not function properly, but the brush holder does not have a helical coil insert.

(7) Examine the brush holders (610), including the brush spring supports and center supports for cracks, warping, and discoloration caused by electrical arcing.

(a) DISCARD the brush holder (610) if damage exists.

(8) Measure brush spring (600) force using a pull scale with harness. See Figure 5015.

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 section.

(9) 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 ELECTRICAL SHOCK**

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

CAUTION: BEARING AND BRUSH SUPPORT ASSEMBLY (-480) MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

(a) With power OFF, connect positive test lead of dielectric 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 dielectric tester output voltage at 0, turn power ON.

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

(e) Turn dielectric 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 (-480) 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, disassembly bearing and brush support assembly, replace all insulating materials (i.e., washers, sleeves, plates), and repeat dielectric test.

If bearing and brush support assembly (-480) fails dielectric test, REPLACE bearing and brush support assembly.

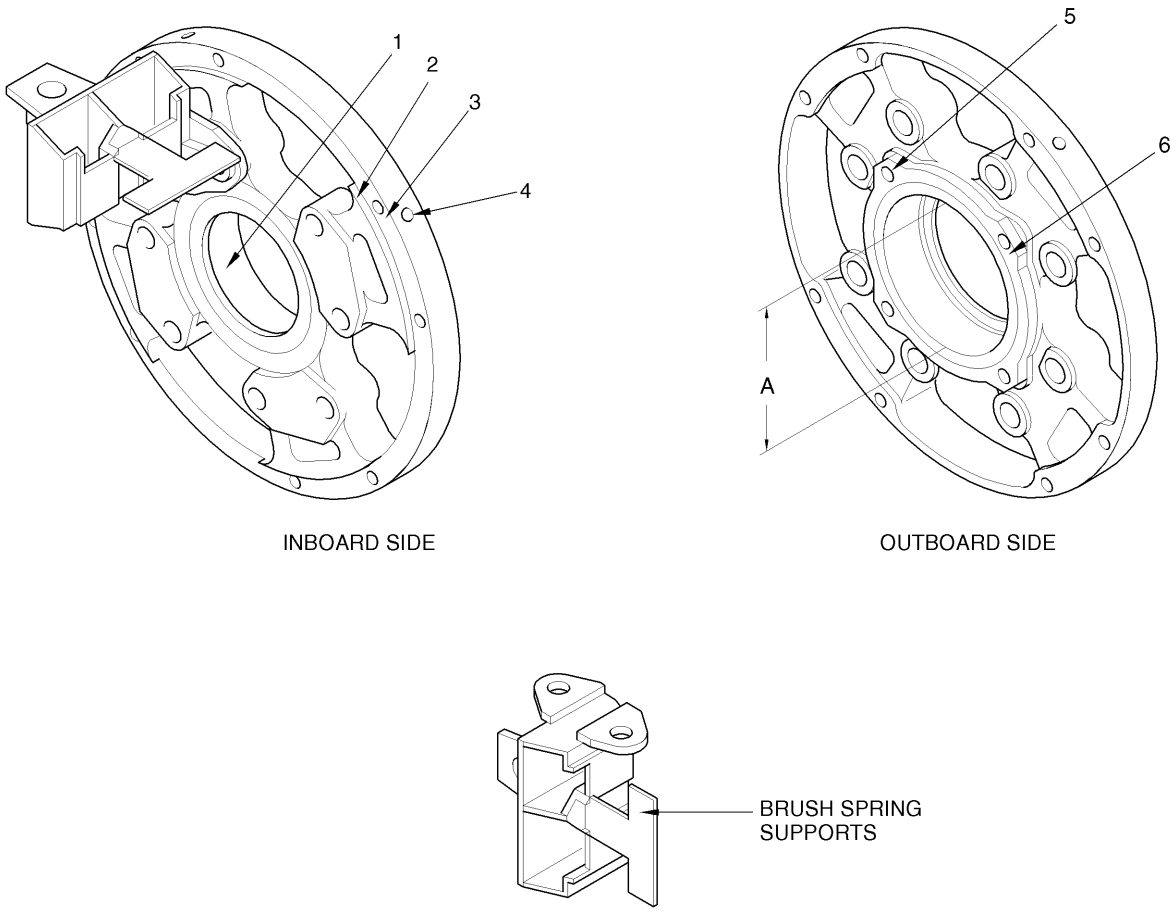

Figure 5014 - Bearing and Brush Support Assembly

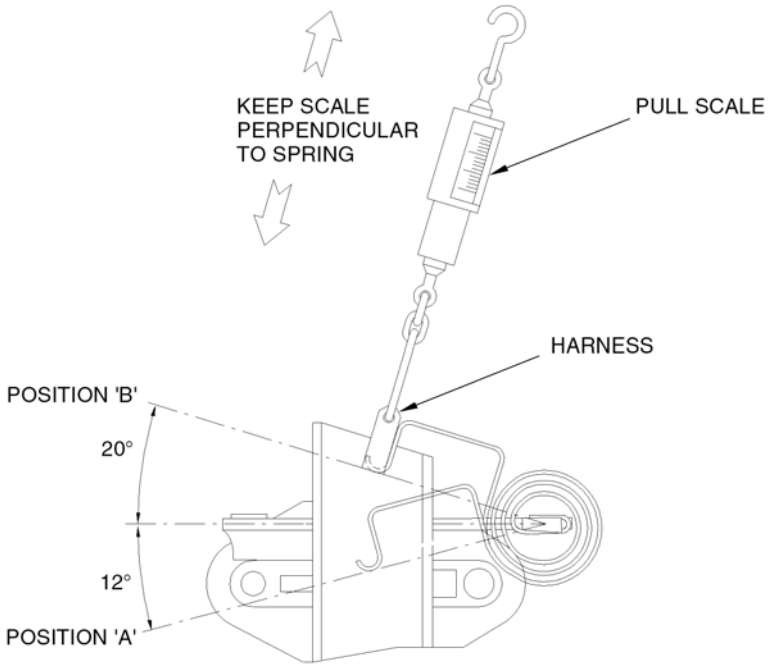

Figure 5015 - Determine Spring Force

T. Bearing retainer (660)

(1) Examine part IAW procedures found in Paragraph 4.A.

(a) DISCARD part if damaged.

(2) Carefully examine mating surfaces one and two for gouging, scoring, or glazing. See Figure 5016.

(a) DISCARD part if damaged.

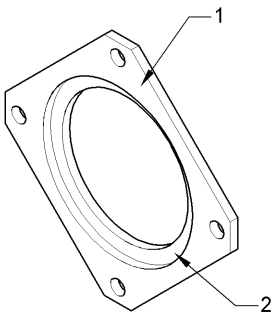

Figure 5016 - Inspecting Bearing Retainer

U. Stator and housing assembly (680). See Figure 5017.

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 4.A. and Paragraph 4.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 stator for insulating enamel (Glyptal or equivalent).

(a) REPLACE the stator if insulating enamel (Glyptal or equivalent) is found on the stator windings.

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

(a) If brush lead damage is more than 5 percent of the brush lead, REPLACE the stator and housing assembly (680).

(b) If stator lead damage is found, REPLACE the stator and housing assembly (680).

(4) Perform a dielectric test.

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

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

CAUTION: STATOR AND HOUSING ASSEMBLY (680) MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A DIELECTRIC CHECK.

CAUTION: USE A DUMMY TERMINAL BLOCK, OR DISCONNECT GROUNDING LEAD FROM ATTACHED TERMINAL BLOCK BEFORE TEST.

(a) If grounding lead is disconnected from attached terminal block, cover the lead with electrical tape.

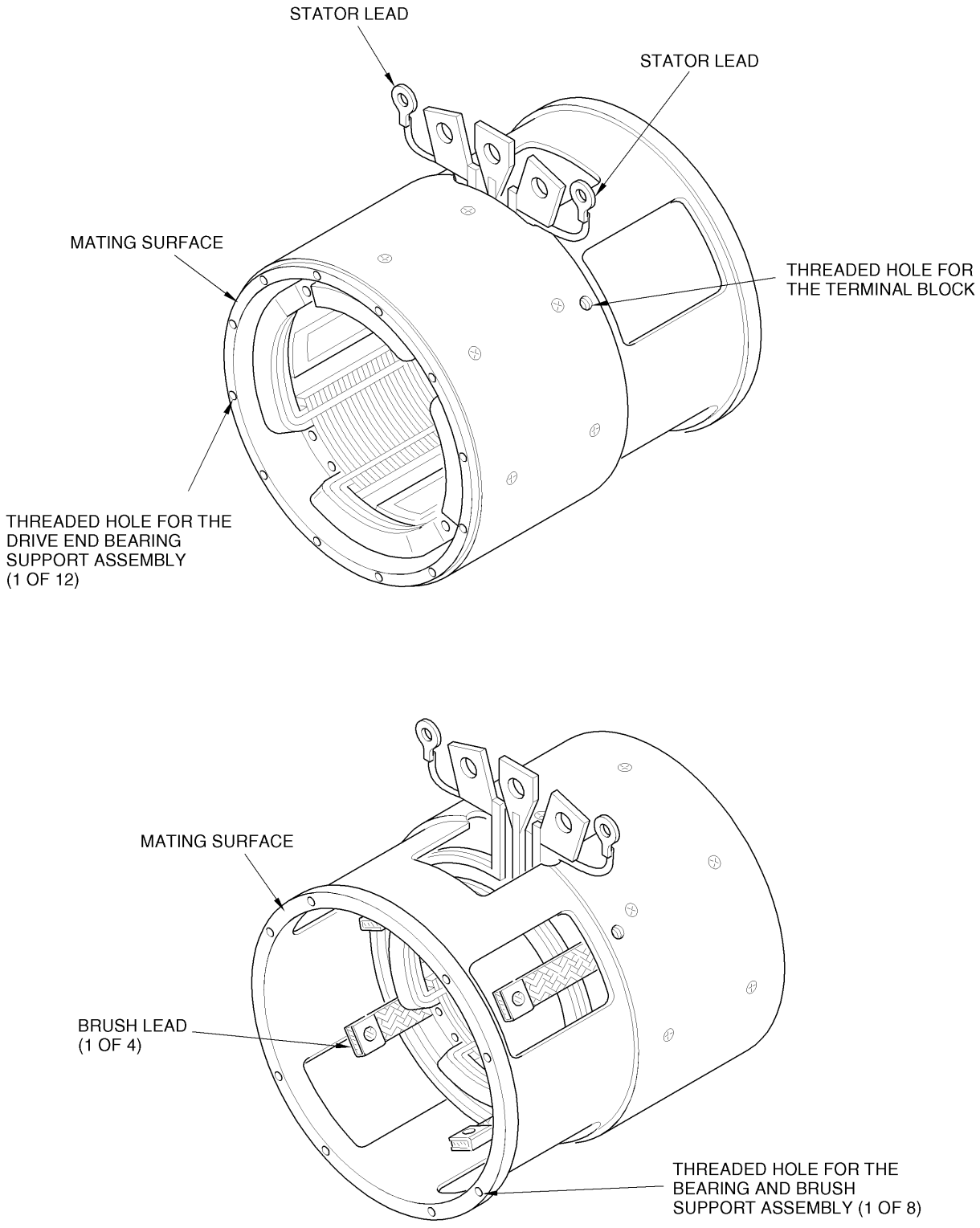

Figure 5017 - Stator and Housing Assembly

(b) Jumper all stator leads together.

(c) With power OFF, connect positive test lead of dielectric tester to jumpered stator leads.

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

(e) With dielectric tester output voltage at 0, turn power ON.

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

(g) Turn dielectric tester power OFF.

(h) Disconnect test leads.

(i) Disconnect jumper from stator leads.

(j) 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 and housing assembly (680) fails dielectric test, clean stator and housing assembly and repeat dielectric test.

2 If stator and housing assembly (680) fails dielectric test after cleaning, replace stator and housing assembly.

V. Terminal block (690). See Figure 5018.

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

(1) Examine the part IAW the procedures found in Paragraph 4.A. and Paragraph 4.B.

(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) REPLACE the terminal block (690) if thread damage of more than two turns exists.

(2) Using an LCR (inductance, capacitance and resistance) meter, measure the capacitance values as shown.

(a) Measure the capacitance values between B and E at the frequency shown in the FITS AND CLEARANCES section.

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

(b) Measure the capacitance values between terminal C and ground at the frequency shown in the FITS AND CLEARANCES section.

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

(c) Measure the capacitance values between terminal B and ground at the frequency shown in the FITS AND CLEARANCES section.

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

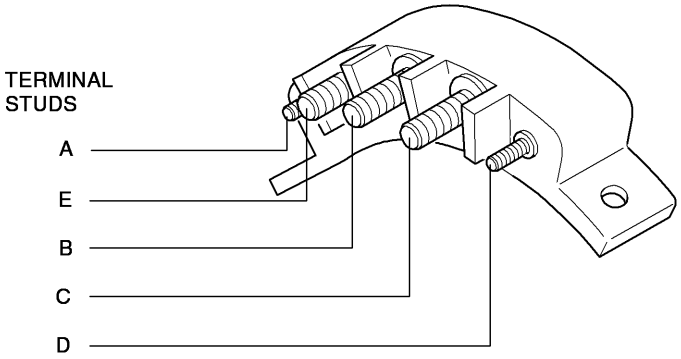

Figure 5018 - Terminal Block

10. 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.
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 of dulling of edges.	Result of abrasion, vibration, or poor mating surfaces.
Scoring	A deep scratch following a path of part travel.	Result of localized lubrication break-down between sliding surfaces.

Table 5003 - Terminology

Term	Definition	Probable Cause
Scratch	A very shallow furrow or irregularity, usually longer than wide.	Movement of a sharp object across the surface.
Short	Evidenced by sparking, arcing, or high current. Electrical condition where two conductors are connected by a path of very low resistance.	The result when two carrying conductors are connected by a path of negligible resistance.
Stripped Thread	Thread of a nut, stud, bolt, or screw damaged by tearing away parts of the thread.	Incorrect installation of threaded mating parts.
Tear	Parting of material.	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)

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REPAIR

1. Introduction

CAUTION: ANY USE OF PARTS, MATERIALS, OR PROCESSES NOT AUTHORIZED BY SAFRAN POWER USA 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 restoration
- Commutator refinishing
- Armature balancing
- Restoring surface coatings of parts and assemblies
- Correcting output voltage polarity
- Replacing brush access cover insulating tape
- Replacing brush access cover self-locking blind rivet nut
- Replacing terminal lugs
- Removal and replacement of mounting adapter guide pin

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

In addition to specific repairs authorized by Safran Power USA in this manual, standard repair procedures for starter-generators are described in the following Safran Power USA 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. The tools listed are not available for purchase from Safran Power USA.

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

WARNING: YOU MUST OBEY THE TOOL AND EQUIPMENT MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Tool Description	Source/Figure Reference
Arbor Press	Commercially Available
Bump Switch	Rating: 30 V DC, 10 A
Commutator Turning Fixture	Figure 9006
Crimp Tool	Commercially Available
Helical Coil Insert Removal and Insertion Tool	Commercially Available
India Stone	Commercially Available
PlusNut® Fastener Header P/N C1000-1032	Figure 9016
6 V Battery of Equivalent DC Power Source	Commercially Available
Thread Chasers	Commercially Available
V-blocks	Commercially Available

Table 6001 - Repair Tools

3. Repair Materials

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

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

WARNING: YOU MUST OBEY THE MATERIAL MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Material	Description/Specification	Source/CAGE Code
Abrasive paper	400/600 grit (non-aluminum oxide only)	Commercially Available
Black Enamel, Color 17038	TT-E-489G, Class B	Commercially Available
Chemical Film Solution Alodine 1200 or Pen, Touch-N-Prep	Chemical Film Solution MIL-C-5541, Class 1A or Class 3 or Alodine 1132 Touch-N-Prep Pen IAW MIL-DTL-81706B	Henkel Surface Technology Madison Heights, MI 48071-5514 (V1N6B3)
Coating, Zinc Phosphate	TT-C-490, Type 1	Commercially Available
Epoxy Primer, Yellow	MIL-P-23377F, Type I	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
Tape, Insulating	P/N SG13-06R 7 to 9 mil (0.007 to 0.009 inch), PTFE coated, fiberglass, acrylic adhesive	Philpott Brunswick, Ohio www.philpottrubber.com (V1T7E9)

Table 6002 - Repair Materials

Material	Description/Specification	Source/CAGE Code
White Polyurethane Enamel, Color 17925	MIL-PRF-85285, Type I	Commercially Available

Table 6002 - Repair Materials (Continued)

4. Surface Repair

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

A. Repair procedure

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

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

5. Thread Repair

A. Repair damaged threads as needed.

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: Unless otherwise specified, item numbers in parentheses ( ) refer to items found in Figure 10001 of the ILLUSTRATED PARTS LIST

A. Remove and replace damaged helical coil inserts (530, 540) in anti-drive end end bell (520) as needed.

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

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

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

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

(3) Apply thin coat of zinc chromate primer to outer surface of replacement 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: **KEEP CHEMICAL FILM AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. CHEMICAL FILM IS FLAMMABLE.**

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

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

B. Remove and replace damaged helical coil inserts (-620) in brush holder (-610B) as needed.

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

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

(3) Install helical coil insert in brush holder to the depth shown in Figure 6001 below part surface.

(4) Break off helical coil insert installation tang.

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

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

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

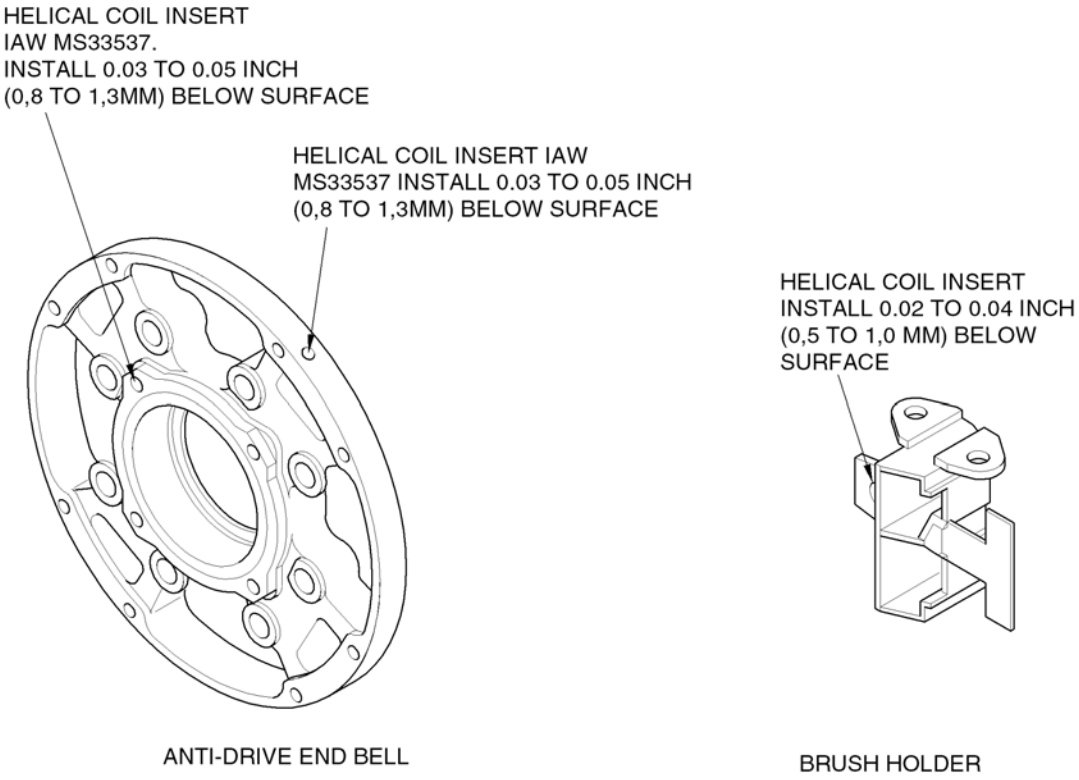


Figure 6001 - Helical Coil Insert Replacement

7. Bearing Journal and Liner Restoration

A. Bearing journals

(1) If the armature shaft bearing journals are worn beyond limits in the FITS AND CLEARANCES section, restoration may be possible by electrodeposition plating in accordance with Safran Power USA Standard Practice Document (SPD) 1000.

NOTE: If armature shaft is out of concentricity, machine shaft within concentricity before plating.

(2) Maximum allowable thickness of plating shall be 0.01 inch (0,254 mm), or 0.02 inch (0,508 mm) measured across a diameter.

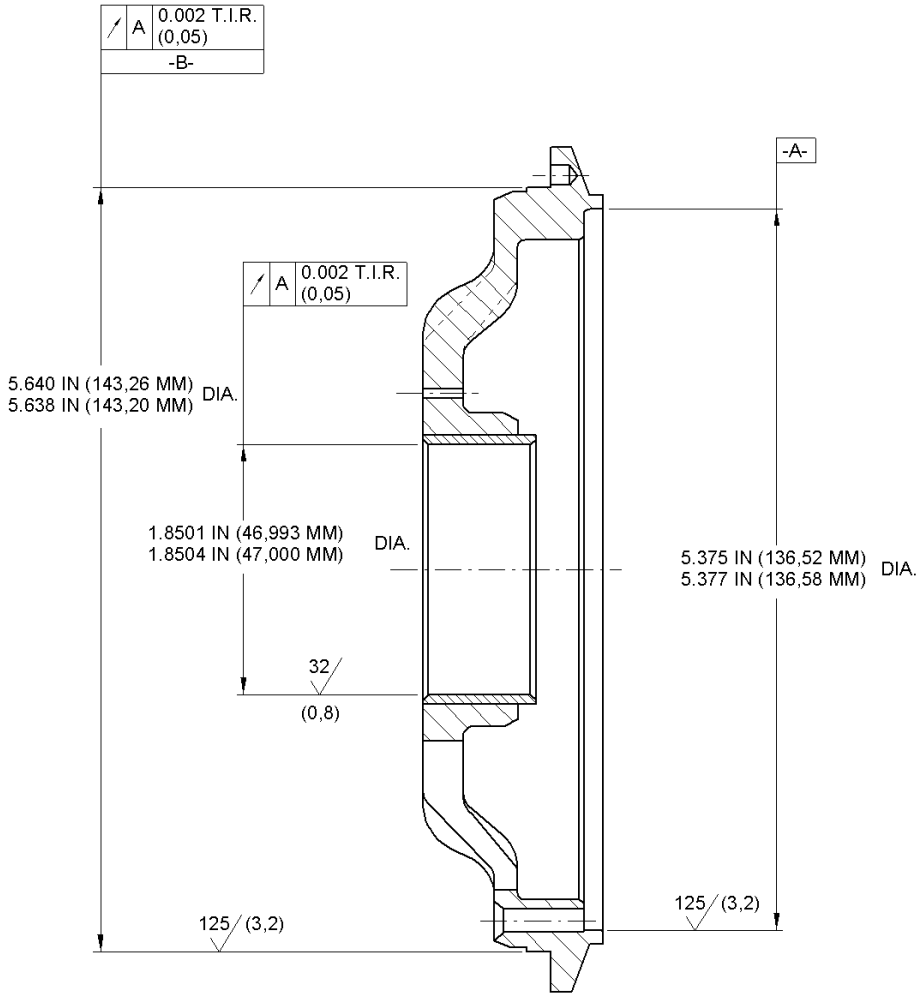
(3) Armature shaft bearing journals may be plated to final dimensions, or over plated then ground to final dimensions listed in the FITS AND CLEARANCES section.

B. Bearing liner restoration

(1) If bearing liners are worn beyond limits in the FITS AND CLEARANCES section, restoration may be possible by electrodeposition plating in accordance with Safran Power USA Standard Practice Document (SPD) 1000.

(2) Components not in compliance with the dimensions in Figure 6002 or Figure 6003 must be reworked or replaced.

(3) The bearing liners in drive end end bells, part no. 23046-1191, 23046-1630 and 23046-2080 cannot be restored because of the bearing liner hardness.



UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FOLLOWED BY MILLIMETERS
IN PARENTHESES

Figure 6002 - Drive End End Bell Machining Specifications

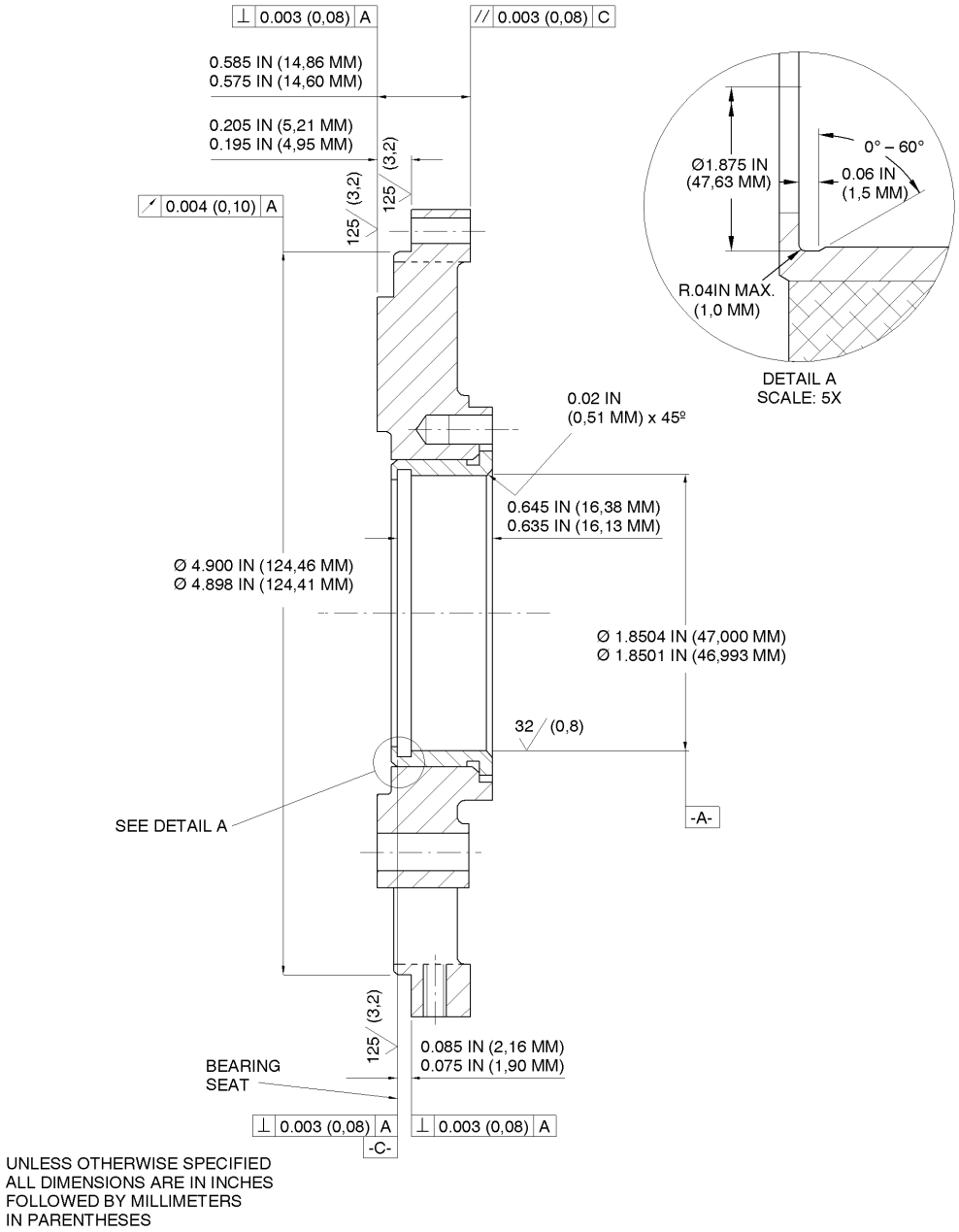


Figure 6003 - Anti-Drive End End Bell Machining Specifications

8. Commutator Refinishing

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

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

A. Setup

WARNING: WHILE PREPARING MACHINE FOR COMMUTATOR RE-FINISHING, MAKE SURE THAT POWER TO LATHE IS SHUT OFF OR "LOCKED OUT". USE ALL SAFETY PRECAUTIONS WHILE WORKING WITH OR AROUND POWER MACHINE TOOLS. WEAR EYE PROTECTION.

(1) Install bearing (450) into the commutator turning fixture.

(2) Install commutator turning fixture into tail stock of lathe.

CAUTION: AVOID TOUCHING COMMUTATOR WITH BARE HANDS. SKIN ACIDS AND OILS CAN CONTAMINATE CONDUCTING SURFACES, CAUSING CORROSION AND POOR ELECTRICAL CONTACT.

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

(4) Position tail stock so that drive end of armature shaft slides into head stock chuck.

(5) Secure tail stock.

(6) Tighten head stock chuck until armature is secure.

B. Repair procedure. Refer to Figure 6004.

CAUTION: DO NOT REMOVE EXCESS MATERIAL FROM COMMUTATOR. REMOVAL OF TOO MUCH MATERIAL WILL RESULT IN SHORTENED COMMUTATOR LIFE AND REDUCTION OF COMMUTATOR DIAMETER.

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

(1) Cut commutator to a surface finish of 64 to 100 micro inches (1,6 to 2,5 microns) rms.

NOTE: The suggested feed rate is 0.006 to 0.007 inches (0,15 to 0,18 mm) per revolution at a surface speed of 1000 to 1500 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 armature (470) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

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

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

NOTE: The beginning of mica undercut must be 0.010 to 0.030 inch (0,25 to 0,76 mm) from the finished face of the risers. All cuts must be equally spaced and parallel with the centerline of the armature shaft within 0.005 inch (0,13 mm) of true position. All mica must be removed from the edges of the undercut.

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

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

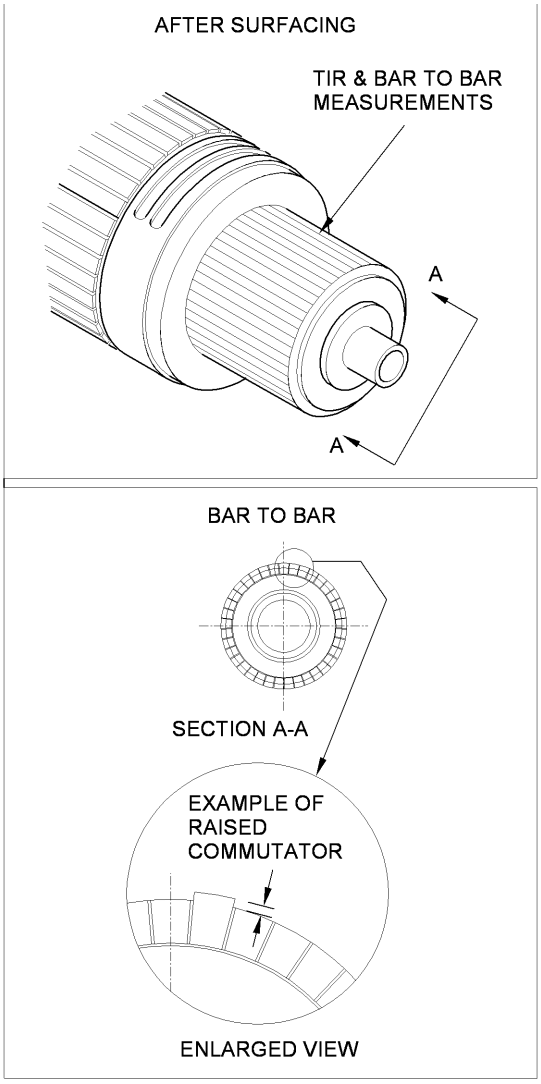
WARNING: **WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, CONTROL PRESSURE TO 29 PSIG (200 KPA) OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES. TAKE PRECAUTIONS TO AVOID INJURY TO OTHER PERSONNEL IN AREA.**

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 (470) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(8) After the commutator is refinished, measure the commutator bar-to-bar and total indicator reading (TIR) run-out in full circumference of the commutator. Support the armature (470) on two “V” blocks.

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



AFTER COMMUTATOR SURFACING

BAR TO BAR:
0.0001 IN. (0.003 MM)

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

MICA UNDERCUT:
DEPTH: 0.050 MIN. to 0.070 IN. (1.27 TO 1.78 MM) MAX.
WIDTH: 0.035 to 0.045 IN. (0,89 to 1.14 MM)

SURFACE FINISH:
64 TO 100 µin. (1.6 TO 2.5 µM.) rms

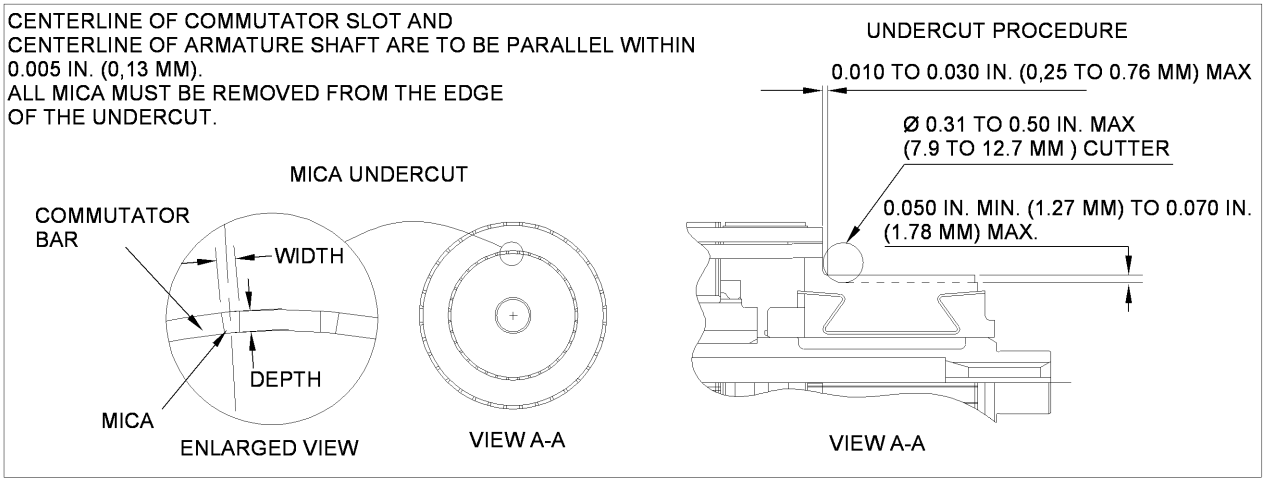


Figure 6004 - Armature Repair

9. Balancing Armature

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

A. Procedure

Balance the armature (470) 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 coatings of parts and assemblies with materials and procedures given in Safran Power USA SPD 1002.

11. Polarizing Output Voltage Field

NOTE: If polarity of output voltage of starter-generator has been reversed, use following procedure to correct output voltage polarity.

A. Turn power OFF and make connections.

(1) As illustrated in Figure 6005, connect negative power lead of 6 volt battery (or equivalent DC power source) to stud E of terminal block.

(2) Connect positive power lead and bump switch to stud A of terminal block.

CAUTION: NO OTHER POWER SUPPLY IS TO BE CONNECTED TO THE STARTER-GENERATOR. DO NOT POLARIZE FIELD WHILE STARTER-GENERATOR IS IN OPERATION.

(3) Turn power supply ON for one to two seconds to polarize field.

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

(4) Turn power OFF and disconnect power leads.

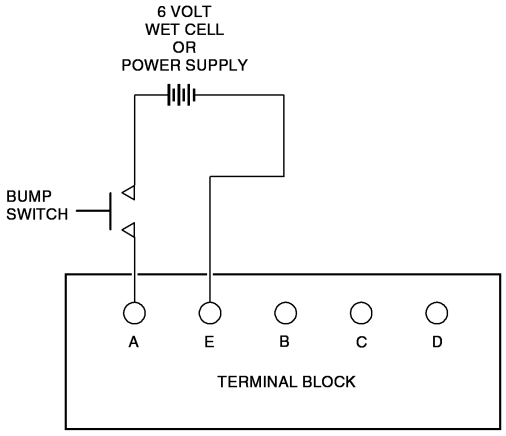


Figure 6005 - Polarization Connection Diagram

12. Brush Access Cover. See Figure 6006.

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

A. Replacing brush access cover (130) insulating tape.

(1) Removal

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

(b) Touch up surface coating, if necessary. Refer to Paragraph 10. or details.

(2) Installation

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

(b) Starting at the side of the brush access cover (130) with holes, line up the side of the roll with the edge of the holes.

(c) Apply insulating tape to inner surface of brush access cover (130).

NOTE: Edge of tape to be flush to 0.03 inch (0,76 mm) maximum from edges of holes and 0.06 inch (1,5 mm) maximum inside the opposite edge of the band and both ends. Tape can be 0.02 inch (0,5 mm) wider than band on side with no holes.

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

B. Brush access cover (130) self-locking blind rivet nut (150) replacement.

NOTE: Use a PlusNut® Fastener Head Crimping Tool for repair procedure.

(1) Removal

(a) Turn fillister head screw (140) in a COUNTERCLOCKWISE direction until screw is fully disengaged from self locking blind rivet nut (150).

(b) Remove damaged self-locking blind rivet nut (150) from brush access cover (130) by drilling a 0.25 inch (6,35 mm) hole through self-locking blind rivet nut. The inboard and outboard sides of nut should become loose and fall off.

(2) Rivet Nut Replacement

(a) Using a PlusNut® Fastener Header Tool, loosen ½ inch (12,7 mm) nut by turning COUNTERCLOCKWISE until stud is fully extended.

(b) Thread the tool completely into the self-locking blind rivet nut (150) until it stops.

(c) Tighten the ½ inch (12,7 mm) nut down until hand-tight against washer and tool body.

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

CAUTION: TO AVOID UNREPAIRABLE THREAD DAMAGE, DO NOT OVERTIGHTEN NUT.

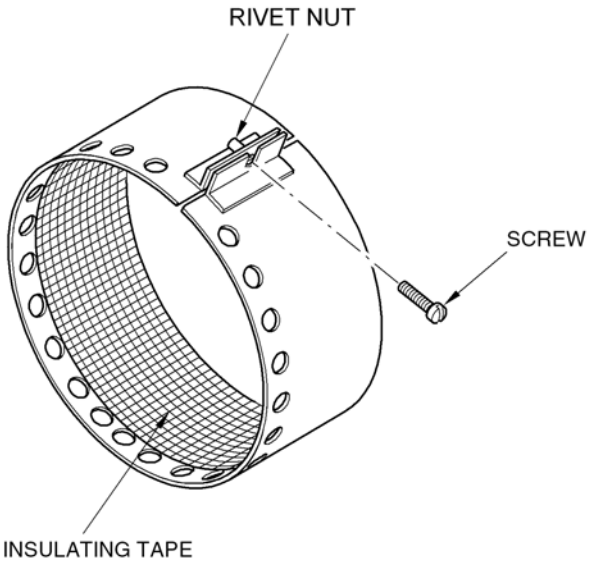
(e) Use a ¾ inch (19 mm) open ended wrench on tool body while holding tool stationary using a ¾ inch (19 mm) wrench. While holding tool perpendicular to hole, turn tool CLOCKWISE.

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

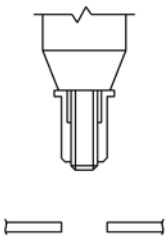
(g) Remove fastener header tool from self-locking blind rivet nut (150) by turning COUNTERCLOCKWISE.

(h) TORQUE test self-locking blind rivet nut (150) to 60 lbf.in. (6,8 Nm).

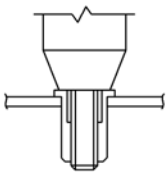
(i) Touch up the chemical film IAW the instructions in Paragraph 10.



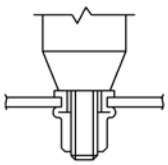
INSTALLATION OF NEW RIVET NUT



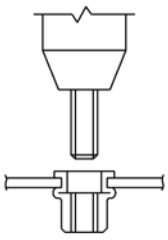
1. INSTALL RIVET NUT ON SHAFT OF TOOL



2. INSTALL RIVET NUT IN BRUSH ACCESS COVER

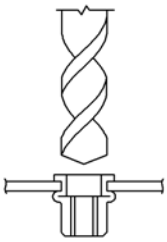


3. TIGHTEN NUT OF TOOL

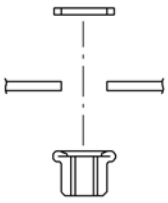


4. REMOVE SHAFT OF TOOL FROM RIVET NUT

REMOVAL OF DEFECTIVE RIVET NUT



1. DRILL THROUGH HEAD OF RIVET NUT



2. REMOVE REMAINING PARTS OF RIVET NUT

Figure 6006 - Replacement of the Brush Access Cover Rivet Nut and Insulating Tape

13. Terminal Lug Replacement

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

A. Remove and replace damaged terminal lugs (730 and 780) as needed.

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

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

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

14. Removal and Replacement of the Drive End Pad End Bell Guide Pin

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

Use the following repair procedure to remove and replace mounting adapter guide pins (60).

A. Tools

A set of pliers, vice grips or any suitable tool that lets you grip the guide pin (60) and pull it out.

B. Procedure. See Figure 6007.

(1) Secure the drive end pad end bell (50) in a vice making sure it is secured enough to handle the force required to pull the guide pin (60).

(2) Using the suitable tool, twist and pull on the guide pin (60) until it releases from the drive end pad end bell (50).

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 (60) before inserting into the drive end pad end bell (50).

(4) Insert a new guide pin (60) into the hole in the drive end pad end bell (50).

NOTE: If the guide pin is grooved, make sure the grooves are oriented as shown in enlarged view A of Figure 6007.

(5) Using an arbor press or light hammer, lightly tap the guide pin (60) into the hole.

NOTE: The finished height of the guide pin (60) is 0.11 to 0.13 inch (2,8 to 3,3 mm)

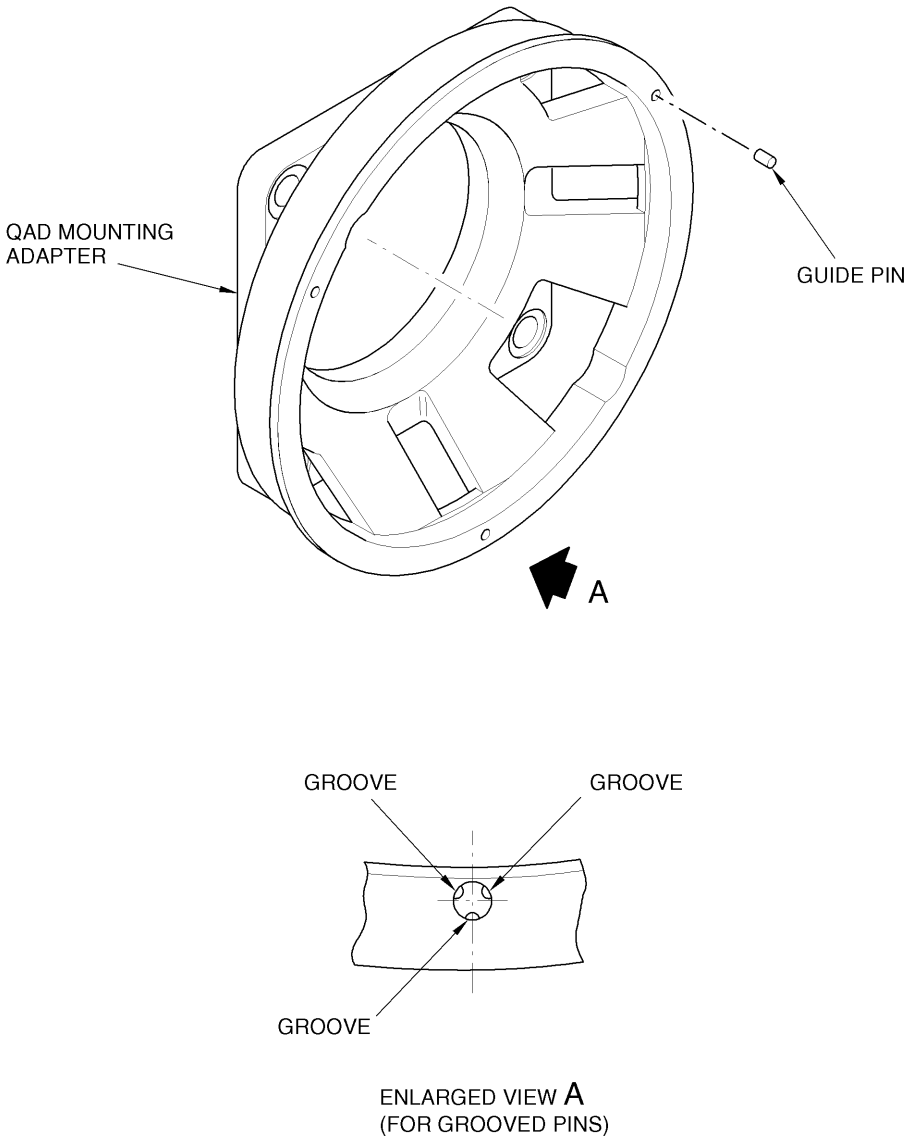


Figure 6007 - Repair of the Mounting Adapter Guide Pin

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ASSEMBLY

1. Introduction

This Section gives assembly instructions for 23046 Series I DC Starter-Generators. Assemble unit in a clean work area away from machining or other metal removing operations. Clean all parts per instructions in CLEANING section before final assembly.

2. Required Tools for assembly

In addition to normal shop tools, tools in Table 7001 are needed for starter-generator assembly. The tools listed are not available for purchase from Safran Power USA.

WARNING: YOU MUST OBEY THE TOOL AND EQUIPMENT MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

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

Tool Description	Reference
Arbor Press	Not illustrated
Armature Support	Figure 9007
Drive End Hub Support	Figure 9009
Inner Race Bearing Driver	Figure 9004
Outer Race Bearing Driver	Figure 9005
Leather or Plastic Mallet	Not illustrated
Pliers, External Snap Ring	Not illustrated
Spline Wrench	Figure 9014
Horizontal Stator Support	Figure 9010
Vertical Stator Support	Figure 9011
Wire Hook Tool	Not illustrated
High Potential Tester	Not illustrated
Dampener Plate Driver	Figure 9013

Table 7001 - Assembly Tools

3. Materials Required for Assembly

Table 7002 lists materials required to assemble the starter-generator. Equivalent materials may be used.

WARNING: YOU MUST OBEY THE MATERIAL MANUFACTURER WARNINGS AND CAUTIONS SHOWN ON THE PACKAGE, CONTAINERS AND/OR INSTRUCTIONS. YOU CAN CAUSE DEATH OR INJURY TO PERSONS AND DAMAGE TO EQUIPMENT OR PROPERTY IF YOU DO NOT OBEY SAFETY PRECAUTIONS.

Material	Description/Specification	Source/CAGE Code
Acrylic Coating	MIL-I-46058/HumiSeal 1B31, Type AR	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 Fax: (718) 932-4345 www.humiseal.com (V0SR97)
Anti-seize Compound	Gasoila, soft set, lead free	GSA Supply on-line www.gsasupplyco.com or Federal Process Co 4620 Richmond Road Beachwood, OH44128
Anti-Seize Compound, Never-Seez (Only used on brush band clamp)	Never-Seez, Regular Grade or, Meets MIL-A-907E	Never-Seez Compound Corp. or Denco Industrial Products, Vermilion, Ohio
Enamel, Red Insulating	Synthite ER-41	John C. Dolph Company Monmouth NJ www.dophs.com (V72688)
Isopropyl Alcohol	TT-I-735, Grade A See **WARNING** before using this material. Flash Point: 53° F (12° C), FLAMMABLE Refer to Material Safety Data (MSD) Sheet for the material for additional safety information.	Commercially Available

Table 7002 - Assembly Materials

Material	Description/Specification	Source/CAGE Code
Lubricating and Assembly Paste	Altemp QNB 50	Klueber Lubrication Londonderry, NH Ph: (603) 647-4104 www.klueber.com (V3EZL6)
Sandpaper	180 Grit, non-aluminum oxide	Commercially available
Thread-locking Adhesive	MIL-S-22473/Loctite grade D	Loctite Corporation Aurora, IL www.loctite.com (V7V827)
Thread-locking Primer	MIL-S-22473/Loctite grade N	

Table 7002 - Assembly Materials (Continued)

4. Assembly Procedure

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

A. Attach the terminal block (690) to the stator and housing assembly (680).

NOTE: 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 (690).

(1) Set the stator and housing assembly (680) onto a horizontal stator support.

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

(2) Set the terminal block (690) onto the stator and housing assembly and slide it into position in the large stator leads C, B+ and E-.

NOTE: Pass the leads with terminal lugs between the large stator leads and the terminal block (690).

(3) Put one terminal lug (780) onto each of terminal studs A and D.

(4) Put a lock washer (710) and a flat washer (720) onto each of two screws (700).

(5) Put the two screws into the end holes of the terminal block (690) and tighten the screws to a torque of 22.7 to 35.0 lbf.in. (2,6 to 4,0 Nm)

NOTE: Lockwire is not used on screw (700 or 700A).

B. Install hardware on terminal block (690).

(1) Install one new nut (760) and flat washer (770) each on terminals C, B+ and E-.

NOTE: Do not tighten the nuts (760) on terminals C, B+ and E-. They will be tightened at the time of installation into the aircraft.

(2) Install one flat washer (750) and one new nut (740) on each terminal A and D.

NOTE: Do not tighten the nuts (740) on terminals A and D. They will be tightened at the time of installation into the aircraft. It is necessary to install the wires from the GCU at that time.

C. Assemble brush springs (600) to brush holder (610). See Figure 7001.

CAUTION: DO NOT OVER-WIND BRUSH SPRINGS. OVER-STRESSING BRUSH SPRINGS CAN RESULT IN REDUCED BRUSH SPRING PRESSURE.

(1) Wind each brush spring (600) ¾ of a turn in tension from spring resting position.

CAUTION: CORRECT SEATING OF BRUSH SPRINGS ON BRUSH SPRING SUPPORT IS CRITICAL DURING ASSEMBLY.

(2) Press brush springs (600) onto brush spring support. Make sure brush springs are properly seated on brush spring support.

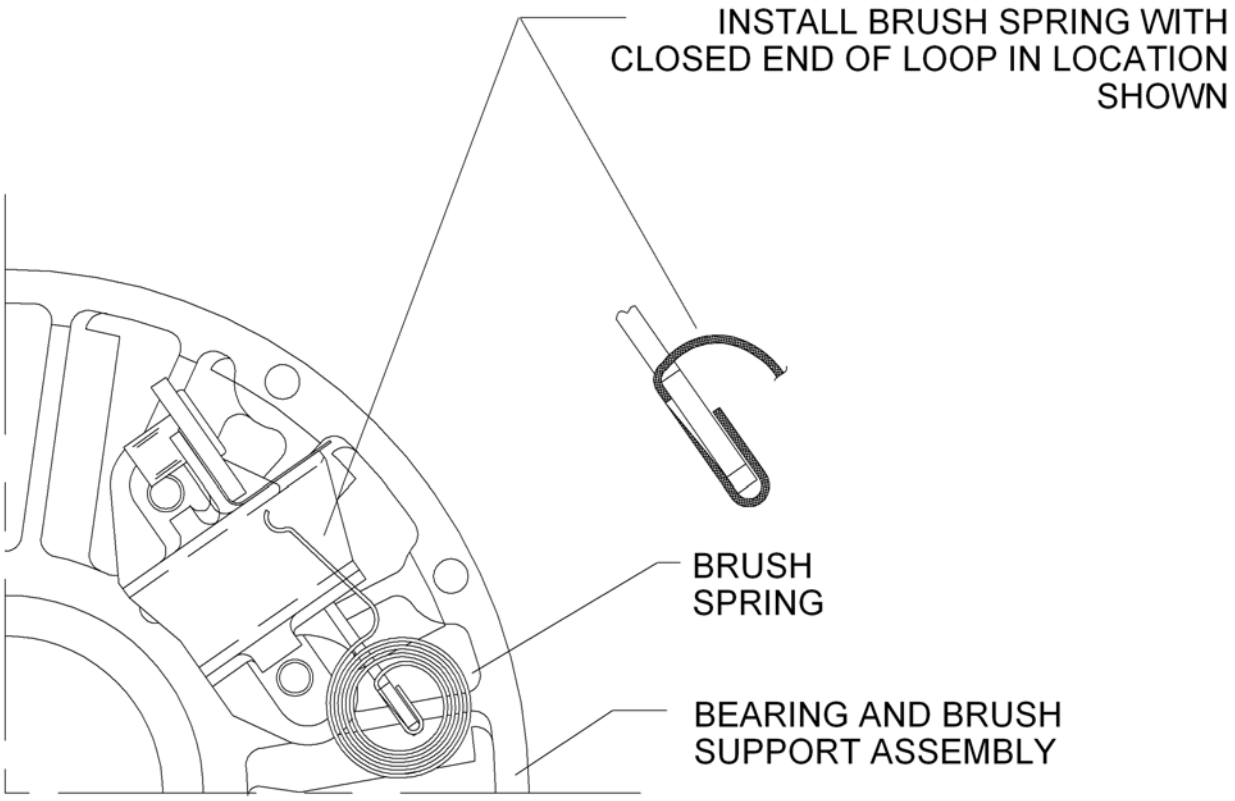

Figure 7001 - Brush Spring Assembly

D. Assembly of bearing and brush support assembly. Reference SPD 1004. See Figure 7002.

CAUTION: PROPER INSTALLATION OF INSULATION SLEEVES IS CRITICAL. USE EXTREME CARE WHEN PRESSING INSULATION SLEEVES INTO MOUNTING HOLES IN ANTI-DRIVE END END BELL. IF INSULATION SLEEVE IS PINCHED BETWEEN ANTI-DRIVE END END BELL AND BRUSH HOLDER ASSEMBLY DURING ASSEMBLY, CARBON WILL BUILD UP IN AREA WHERE INSULATION SLEEVE IS DAMAGED, RESULTING IN A PATH TO GROUND AND EQUIPMENT FAILURE. DAMAGE IS NOT DETECTABLE DURING HIGH POTENTIAL TESTING AFTER ASSEMBLY BECAUSE BEARING AND BRUSH SUPPORT AND BRUSH HOLDER ASSEMBLIES ARE CLEAN AT TIME OF ASSEMBLY.

(1) Carefully press one insulation sleeve (640) into each mounting hole in anti-drive end end bell (520).

(2) If brush holder assembly (-550) has studs (630), proceed as follows:

(a) Place an insulation plate (650) on the studs (630) of a brush holder assembly (-550).

(b) Carefully pass the studs of the brush holder assembly through two insulation sleeves on the anti-drive end end bell (520).

NOTE: Make sure the brush holder assembly is on the inboard side of the anti-drive end end bell.

(c) Put a non-metallic washer (590), flat washer (580) and self-locking nut (570) on each stud.

NOTE: Do not tighten the self-locking nuts (570) at this time.

(d) Repeat Paragraph 4.D.(2)(a) thru Paragraph 4.D.(2)(c) for remaining brush holder locations.

(3) If brush holder assembly (-550) does not have studs, proceed as follows:

(a) Put a flat washer (580) and non-metallic washer (590) on two bolts (560).

(b) Insert bolts (560) in mounting holes in anti-drive end end bell (520).

(c) Put an insulation plate (650) on bolts (560).

WARNING: **THREAD LOCKING PRIMER AND ADHESIVE MAY IRRITATE SENSITIVE SKIN. WASH THOROUGHLY AFTER CONTACT WITH SKIN. REFER TO APPLICABLE MATERIAL SAFETY DATA SHEET FOR ADDITIONAL MATERIAL AND SAFETY INFORMATION.**

WARNING: **THREAD LOCKING PRIMER AND ADHESIVE IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.**

(d) Apply thread locking primer, Grade N, followed by adhesive, Grade D, to the threads of the two bolts (560).

NOTE: Let the thread locking primer, Grade N, dry for a few minutes before applying thread locking adhesive, Grade D.

(e) Put a brush holder assembly (-550) against the two bolts (560) on the inboard side of the anti-drive end end bell (520).

(f) Attach the brush holder assembly (-550) loosely until correctly aligned.

NOTE: Do not tighten the bolts (560) at this time.

(g) Repeat Paragraph 4.D.(3)(a) thru Paragraph 4.D.(3)(f) for remaining brush holder locations.

CAUTION: MAKE SURE THE COMPLETE BRUSH HOLDERS ARE PROPERLY ALIGNED IN THE BRUSH HOLDER ALIGNMENT FIXTURE. IMPROPER ALIGNMENT CAN CAUSE ELECTRICAL FAILURE.

(4) Adjust all brush holder assemblies (-550) until they are properly aligned. Refer to SPD 1004.

(5) Tighten bolts (560) to a torque of 25 to 30 lbf.in. (2,8 to 3,4 Nm) or tighten self-locking nuts (570).

(6) Remove the bearing and brush support assembly (-480) 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.**

(7) Apply a thick coat of red insulating enamel IAW SPD 1002 to the exposed surfaces of the bearing and brush support assembly.

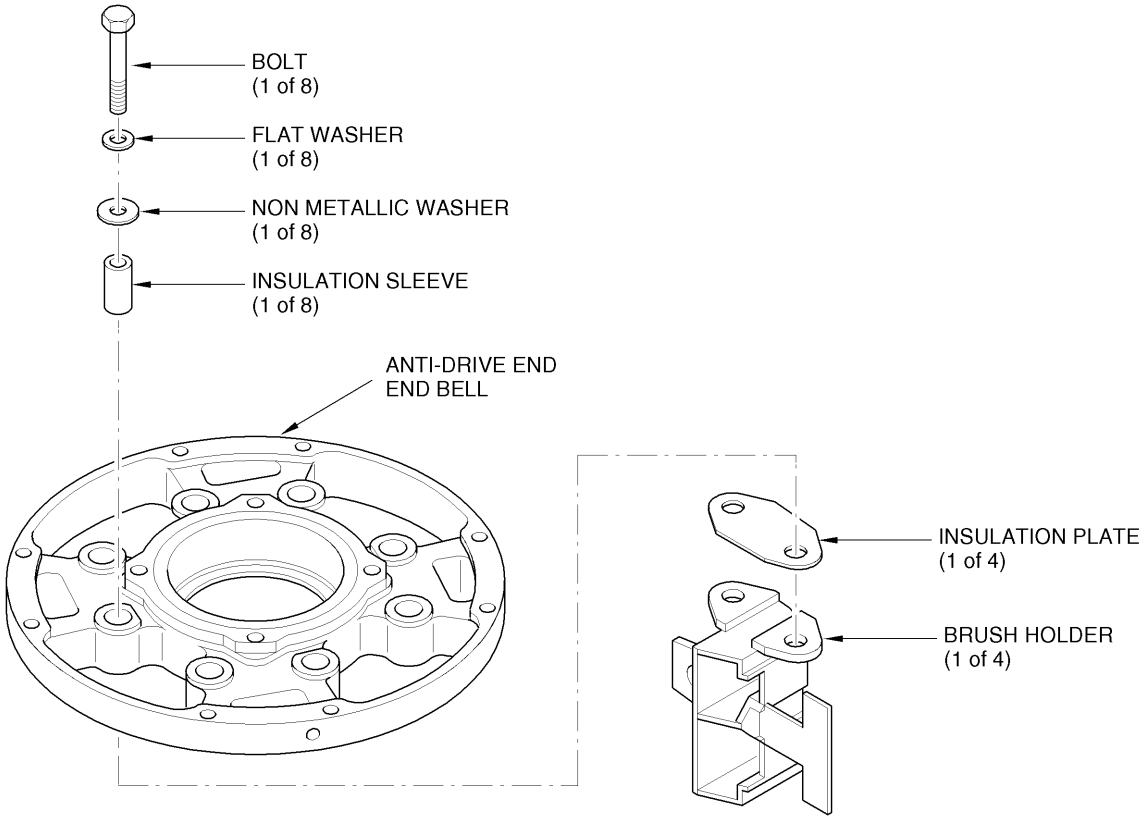

Figure 7002 - Bearing and Brush Support Assembly Detail (with Bolts)

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

E. Press a ball bearing (450) into bearing and brush support assembly (-480). See Figure 7003.

(1) Set a 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 lubricating and assembly paste to the inside diameter of the bearing liner of the bearing and brush support assembly.

(3) Set bearing and brush support assembly, brush holder side down, on drive end hub support. See Figure 7003.

(4) Set a ball bearing onto bearing liner of anti-drive end end bell (520).

(5) Set an outer race bearing driver onto ball bearing.

(6) Press ball bearing into bearing liner of anti-drive end end bell (520).

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

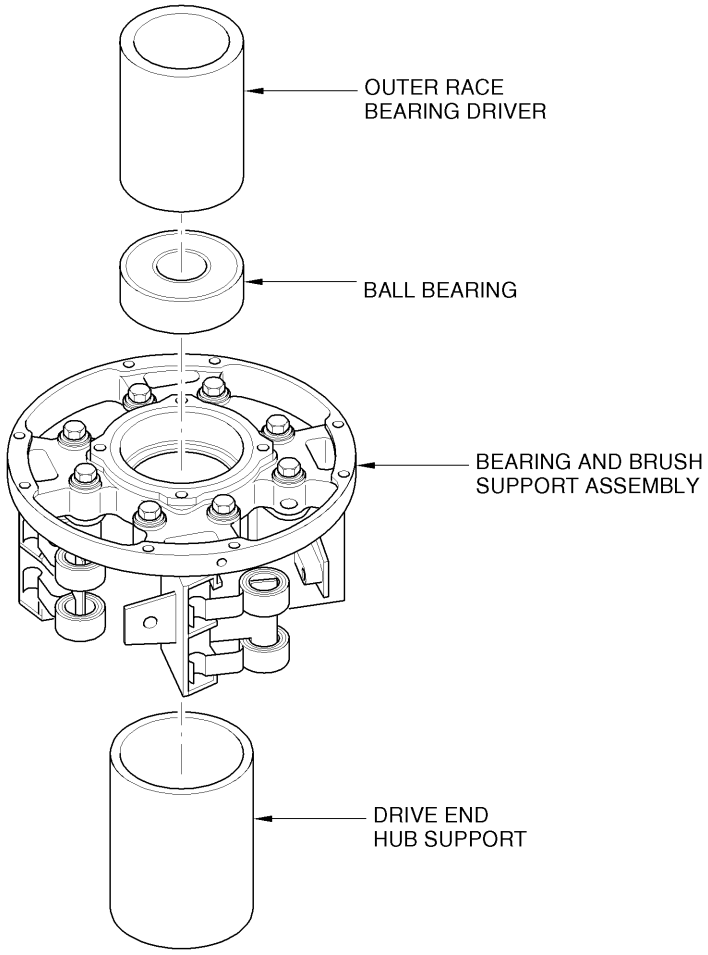

Figure 7003 - Ball Bearing Installation into Bearing and Brush Support Assembly.

F. Attach bearing retainer (660) to bearing and brush support assembly (-480). See Figure 7004.

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

(1) Apply anti-seize compound to threads of the four attaching screws (670).

(2) Attach bearing retainer (660) to bearing and brush support assembly (-480) using attaching screws.

(3) Tighten the screws (670) to a torque of 15.5 to 18.5 lbf.in. (1,75 to 2,09 Nm).

NOTE: Lockwire is not used on screw (670 or 670A).

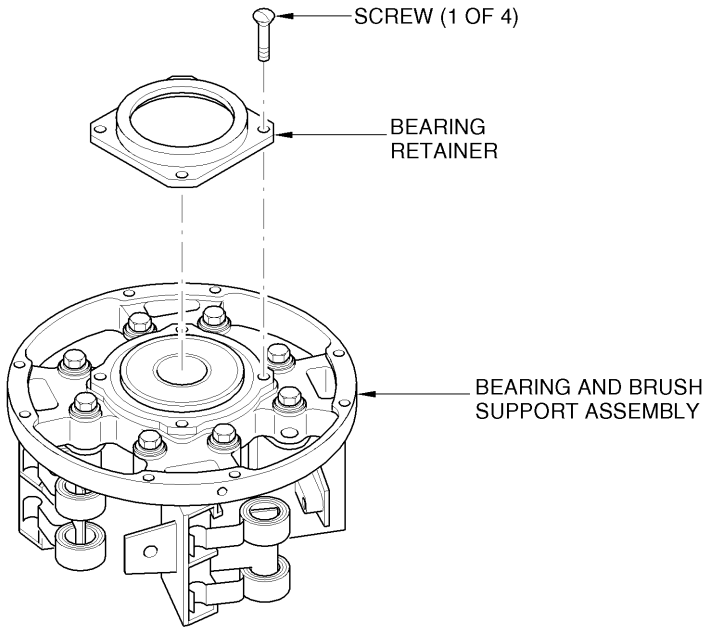

Figure 7004 - Attaching Bearing Retainer

G. Install baffle disc (440) or bearing shield (460) and ball bearing (450) onto drive end of armature (470) shaft. See Figure 7005.

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) Put an armature support on arbor press table.

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

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

NOTE: For models 23046-019 and 23046-020 refer to SB 23046-0XX-24-06. If these models are at MOD D they have a drive end bearing shield (460) assembled instead of the baffle disc (440).

(4) Set a ball bearing onto armature shaft.

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

(6) Press ball bearing down onto armature shaft.

(7) Make sure that ball bearing is fully seated against baffle disc or drive end bearing shield.

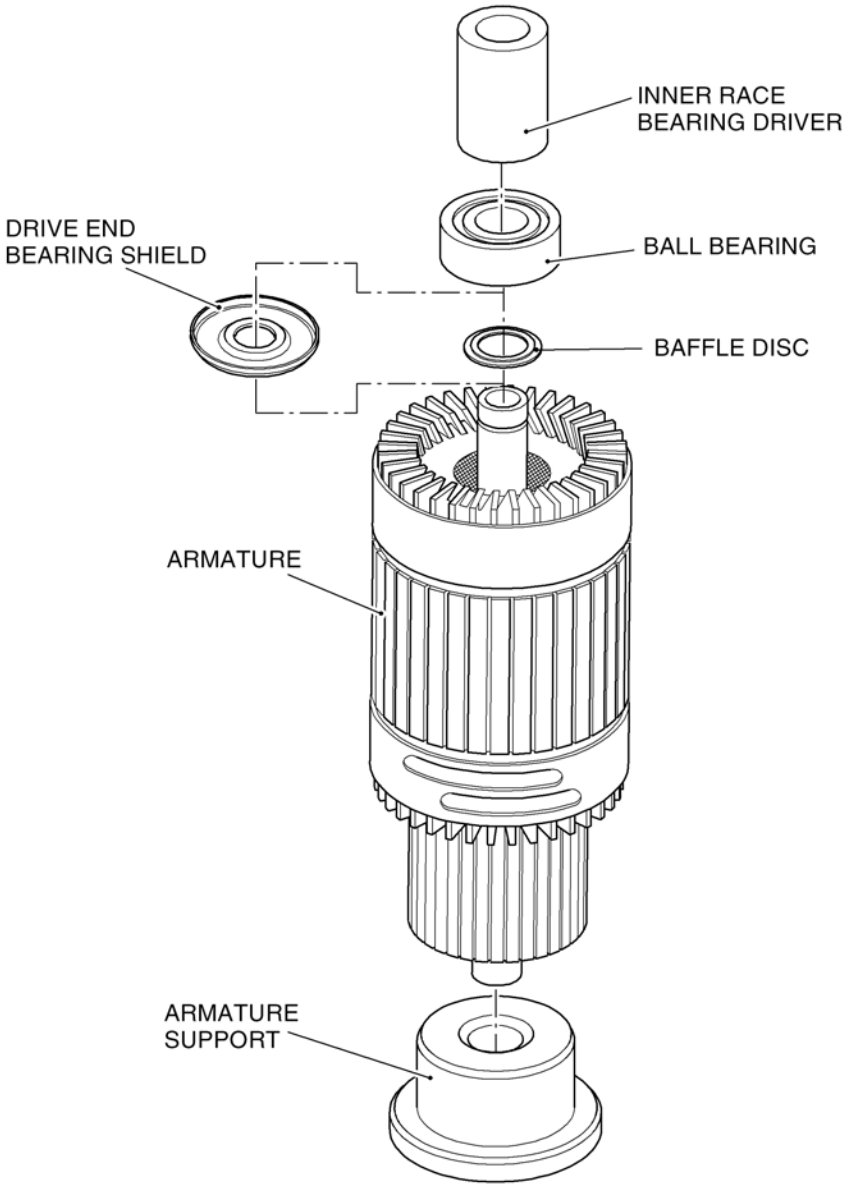

Figure 7005 - Baffle Disc or Bearing Shield and Ball Bearing Installation on Drive End of Armature Shaft.

H. Install baffle disc (440) and retaining ring (430) onto drive end of armature (470) shaft. See Figure 7006.

(1) Put an outer baffle disc (440) on drive end of armature shaft with concave side facing away from armature stack.

(2) Put a retaining ring (430) in groove on drive end of armature shaft using external snap ring pliers. Make sure it is fully engaged in groove of armature shaft.

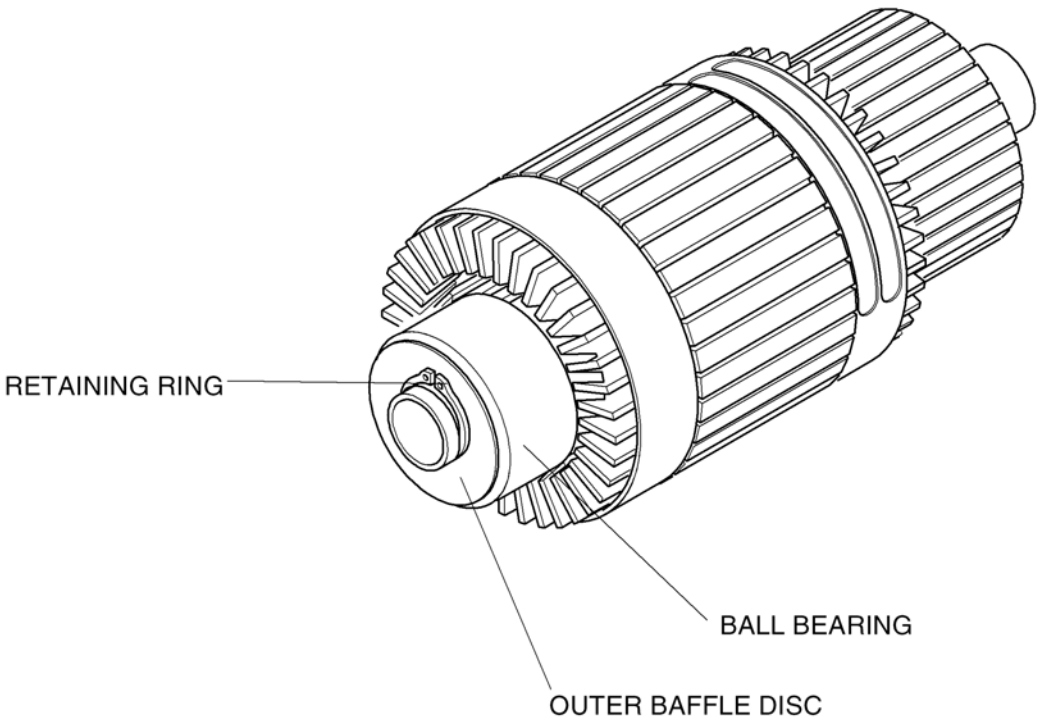

Figure 7006 - Installing Outer Baffle Disc and Retaining Ring

I. Attach bearing and brush support assembly(-480) to armature (470).

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) Put armature support on arbor press table.

(2) Set armature, drive end down, on armature support.

(3) Set bearing and brush support assembly, brush holder side down, onto armature shaft. Refer to Figure 7007.

(4) Set an inner race bearing driver onto ball bearing installed in bearing and brush support assembly.

(5) Press ball bearing in bearing and brush support assembly onto armature shaft.

(6) Make sure that ball bearing is fully seated against shoulder of armature shaft.

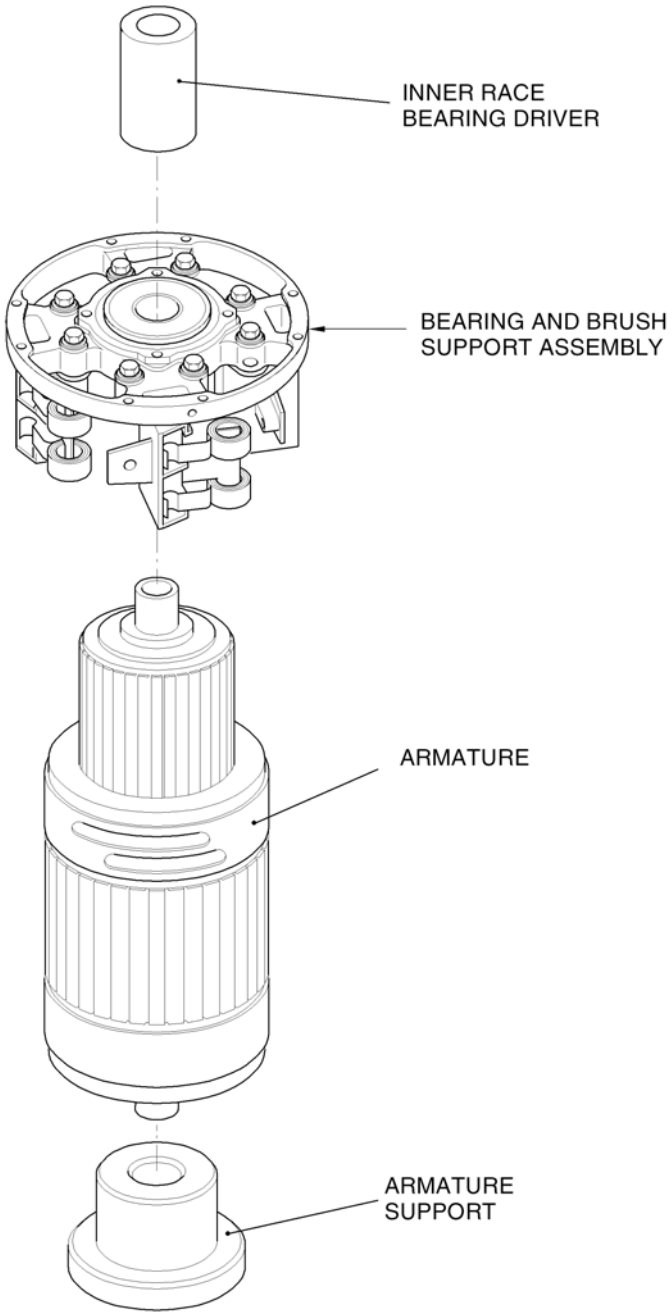

Figure 7007 - Attaching Bearing and Brush Support Assembly and Armature

J. Attach bearing and brush support assembly, (-480), with attached armature (470), to stator and housing assembly (680). See Figure 7008.

(1) Set a vertical stator support onto a flat work surface.

(2) Carefully set stator and housing assembly (680), anti-drive end up, on vertical stator support.

(3) Insert armature (470), with attached bearing and brush support assembly (-480), into stator and housing assembly (680).

(4) Make sure that brush stator leads are aligned with each brush holder assembly. If necessary, use a probe to move brush stator leads to their correct position.

NOTE: On older models a lead from the stator windings should be connected to the negative brush holder. Keep this lead with the negative stator lead. It will be secured when the brushes are installed.

(5) Place a lock washer (500) and flat washer (510) on each of the eight attaching screws (490).

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

(6) Apply anti-seize compound to the threads of eight attaching screws (490).

(7) Attach bearing and brush support assembly to stator and housing assembly with the eight attaching screws.

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

(9) Tighten the screws (490) to a torque of 13.5 to 18.0 lbf.in, (1,5 to 2.0 Nm).

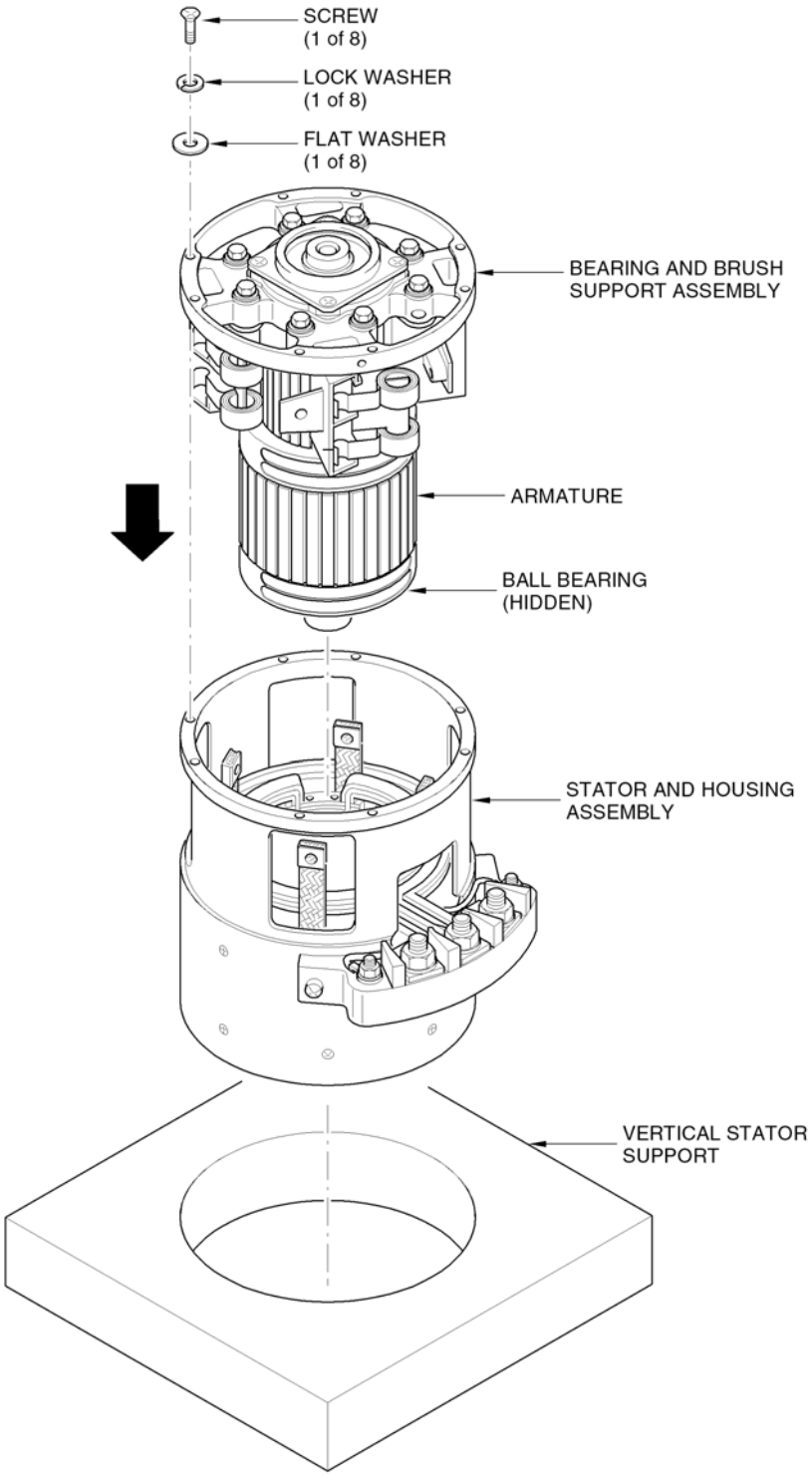

Figure 7008 - Assembling Bearing and Brush Support Assembly with Stator and Housing Assembly

K. Attach drive end bearing support assembly (-350) to stator and housing assembly (680).

(1) Set a vertical stator support onto a flat work surface.

(2) Place stator and housing assembly, drive end up, on vertical support.

WARNING: DO NOT LET PASTE TOUCH THE EYES OR SKIN. OBEY THE MANUFACTURER'S INSTRUCTIONS. REFER TO MSDS SHEET BEFORE PASTE IS USED.

(3) Apply lubricating and assembly paste to the inside diameter of the bearing liner of the drive end bearing support assembly.

(4) Position drive end bearing support assembly on stator and housing assembly. Ensure that it is firmly seated against the bearing (450).

NOTE: For model 23046-001 make sure that one flat of the mounting flange is parallel with the top of the starter-generator.

NOTE: For all other models make sure that one dowel hole on the mounting flange is in the 12 o'clock position (looking from the drive end).

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

(5) Apply anti-seize compound to the threads of 12 attaching flat-head screws (360). (Eight socket-head screws (360B) for Model 23046-001)

(6) For all units, except 23046-001, install and tighten twelve screws (360) to secure drive end bearing support assembly (-350) to the stator and housing assembly (680). Tighten the screws (360) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

(7) For unit 23046-001, assemble lock washers (370) and flat washers (380) on eight socket head screws (360B). Install the screws to secure the drive end bearing support assembly (-350) to the stator and housing assembly (680). Tighten the socket head screws (360B) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

L. Install dampener backplate (340) onto armature (470) shaft.

CAUTION: DO NOT USE AN ARBOR PRESS TO FORCE DAMPENER BACK PLATE ONTO ARMATURE SHAFT OR DAMPENER HUB ONTO DRIVE SHAFT. PROPER TIGHTENING OF FAN NUT (260) WILL PRODUCE CORRECT SEATING OF THESE COMPONENTS.

(1) Set stator and housing assembly (680) on a horizontal stator support.

(2) Twist dampener backplate (340) onto drive end of armature (470) shaft until it is fully seated.

(3) Check the runout of the radial surface of the backplate while rotating the armature on its bearings.

Runout must not exceed 0.003 inch (0,0762 mm) T.I.R.

M. Install dampener hub (310) and dampener plate (320) onto drive shaft (290). See Figure 7009**.**

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

(1) If dampener hub (310) was removed from drive shaft (290), twist dampener hub by hand onto drive shaft taper and make sure it is fully seated.

(2) Insert drive shaft (290) through dampener plate (320) and dampener plate driver. Align plate and hub splines.

(3) Lightly tap drive end of drive shaft using a leather or plastic mallet to seat dampener plate onto hub. Make certain that spline on plate fully engages the dampener hub spline.

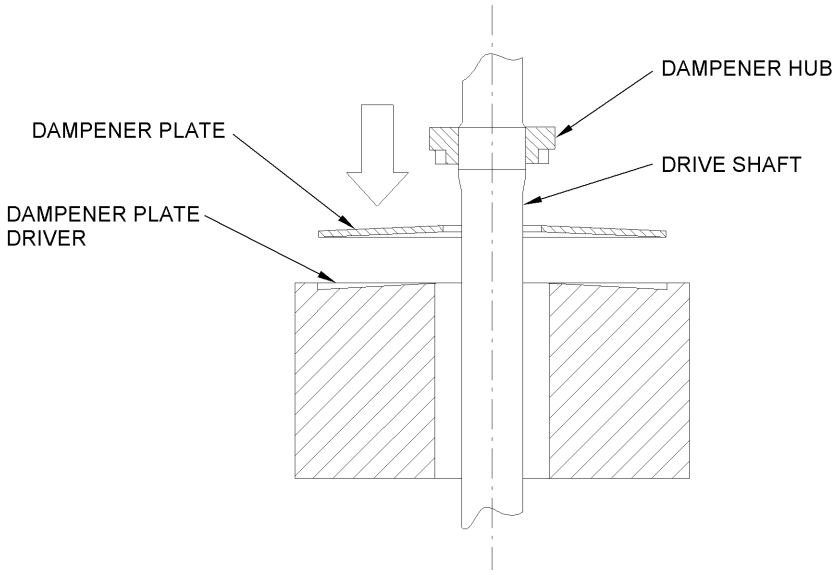

Figure 7009 - Dampener Plate and Driver

N. Insert drive shaft (290) into armature (470) shaft. See Figure 7010.

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

(1) Put friction ring (330) in recess of dampener backplate (340).

(2) Insert drive shaft (290) into drive end of armature (470) shaft.

(3) Push drive shaft through armature shaft until dampener plate (320) is fully engaged against friction ring (330).

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

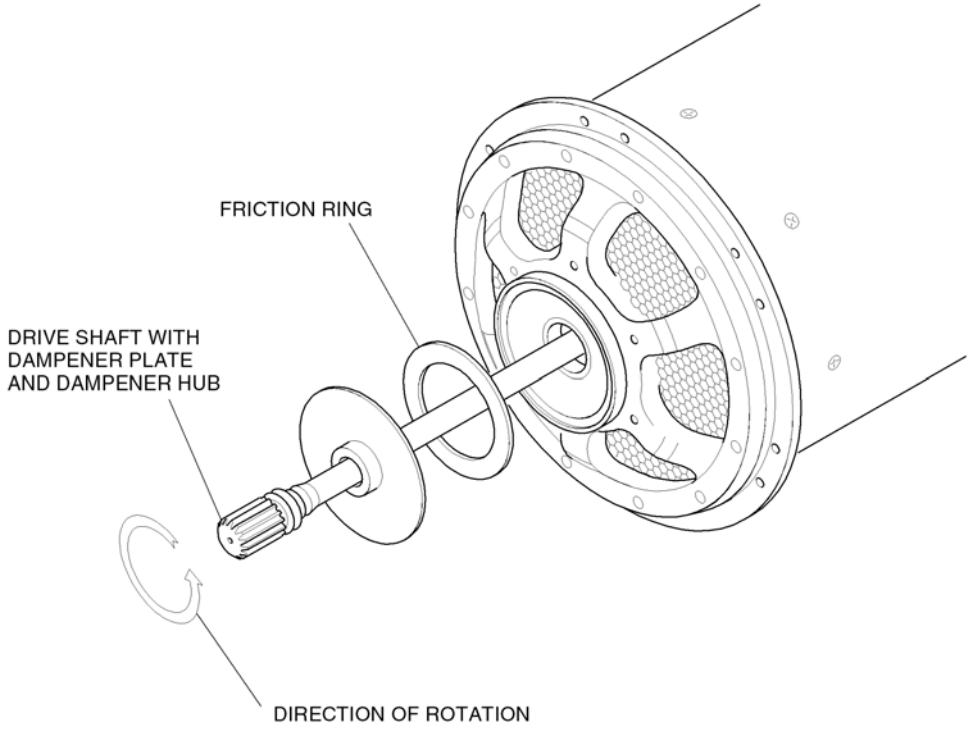

Figure 7010 - Installing Drive Shaft into Armature Shaft

O. Attach fan (250) to drive shaft (290). See Figure 7011.

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

(1) For models 23046-019 and 23046-020 at MOD D (Refer to SB 23046-0XX-24-06), assemble the anti-drive end bearing shield (280) on the flange of the fan (250). Make sure the part identification stamping on the anti-drive end bearing shield faces the fan blades.

(2) Put fan (250) onto drive shaft (290).

(3) Attach fan to drive shaft with a flat washer (270) and a self-locking nut (260).

(4) Tighten the nut to a torque of 100 to 120 lbf.in. (11,3 to 13,6 Nm).

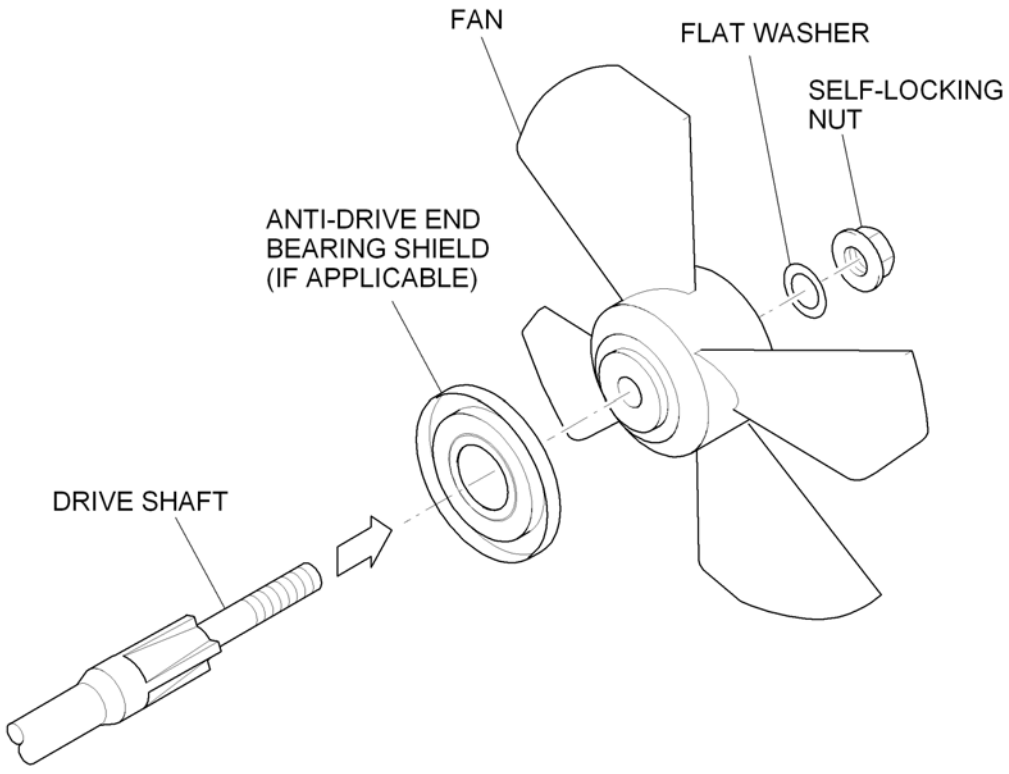

Figure 7011 - Installing Fan

P. Install brushes (160) into starter-generator. See Figure 7012.

NOTE: If new brushes (160) are to be used, identify the brushes with the numbers 1 through 4 as shown in Figure 7011.

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.

CAUTION: FAILURE TO PROPERLY FORM THE BRUSH LEADS CAN RESULT IN BRUSH HANG UP.

(4) Form the brush leads IAW SPD 1006.

(5) Attach the four brush (160) leads and four braided stator leads to the brush holders (610) with four screws (170). Tighten the screws to a torque of 22.7 to 35.0 lbf.in. (2,6 to 4,0 Nm).

NOTE: On older models there is an extra negative brush lead with a terminal lug. Attach this lead immediately under the screw (170) head when attaching brush number 1. Refer to Figure 7012.

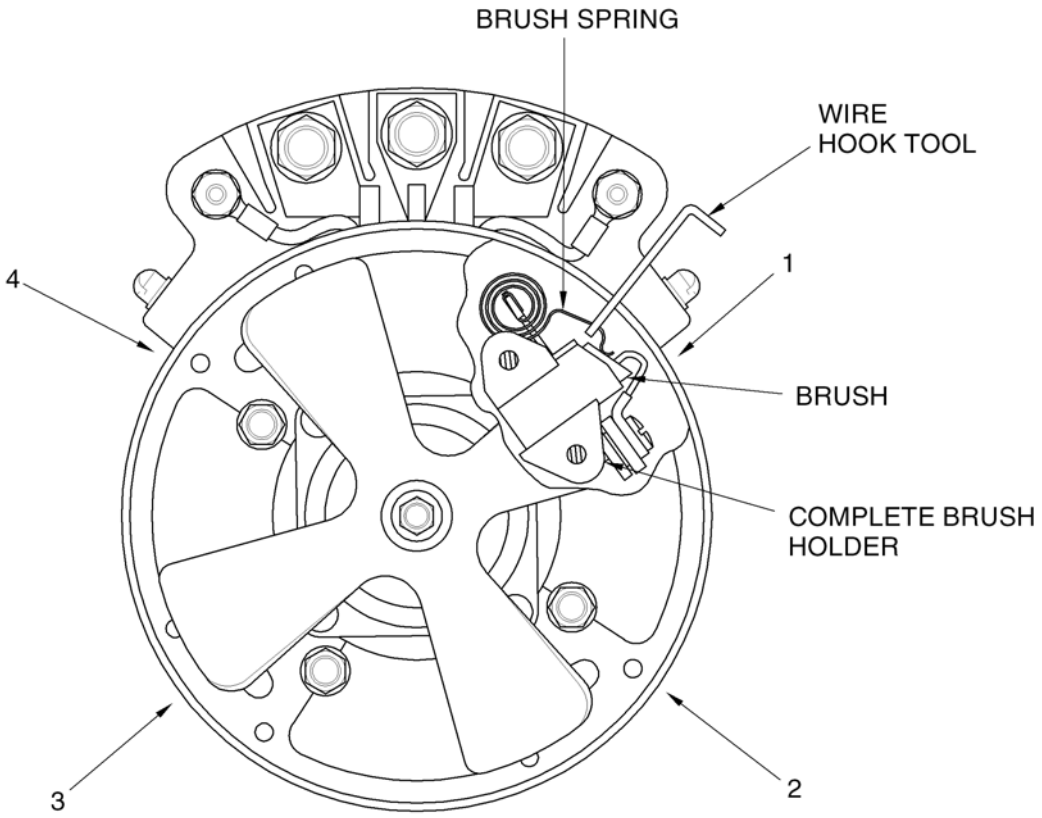

Figure 7012 - Installing Brushes

Q. Coarse seat the new brushes (160).

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

(1) Coarse seat the brushes (160) IAW SPD 1006.

NOTE: The sandpaper should first touch leading edge (short side) of brush (160) when armature (470) is rotated in its normal direction.

(2) Remove sandpaper IAW SPD 1006 when done with brush seating.

R. Final run-in.

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

CAUTION: DO NOT LET THE STARTER-GENERATOR HANG UNSUPPORTED DURING INSTALLATION ONTO AND REMOVAL FROM THE DRIVE STAND. TOO MUCH LOAD ON THE DRIVE SHAFT SHEAR SECTION CAN DAMAGE THE UNIT.

(1) Run-in the brushes (160) IAW SPD 1006.

NOTE: A correctly run-in brush (160) has a smooth and semi-gloss contact surface.

S. Attach commutation viewing adapter to starter-generator.

(1) Put commutation viewing adapter over openings in stator and housing assembly (680).

CAUTION: THE JOINT FORMED BY THE BRUSH ACCESS COVER MUST NOT BE POSITIONED OVER AN ACCESS WINDOW IN THE HOUSING. THE BRUSH SHUNT WIRES CAN SHORT TO THIS AREA.

(2) Center brackets of commutation viewing adapter between two brush access openings in stator and housing assembly (680).

(3) Tighten screw (140) into blind rivet nut attached to commutation viewing adapter.

NOTE: Lockwire is not used on screw (140).

T. Attach cover assembly (180) to bearing and brush support assembly (-480). (All models except 23046-019 and 23046-020).

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

(2) Position cover assembly (180) on brush support assembly (-480).

(3) Install and tighten screws (190) to secure cover assembly (180) to the bearing and brush support assembly (-480). Tighten the screws to a torque of 7.7 to 10.3 lbf.in. (0,87 to 1,16 Nm).

U. Attach air inlet assembly (200) with accompanying fan cover (240) to starter-generator. (Models 23046-019 and 23046-020 only).

(1) If air inlet assembly (200) and fan cover (240) have been disassembled, re-assemble as follows:

(a) Place a washer (230) on each of the two screws (220).

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

(b) Apply anti-seize compound to the threads of two screws (220).

(c) Place the fan cover (240) in the air inlet assembly (200).

(d) Attach the two halves of the air inlet assembly with the two screws (220) and washers (230).

(e) Tighten the two screws (220) to a torque of 22.7 to 35.0 lbf.in. (2,6 to 4,0 Nm).

NOTE: Lockwire is not used on screw (220).

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

(3) Place air inlet assembly (200) in position on anti-drive end of generator.

(4) Bring rim-clenching clamp (210) into position and tighten self-locking nut onto T-bolt. Tighten the self-locking nut to the torque etched on the clamp.

V. Attach identification plate (70), information plate (90), instruction decal (110) and FAA-PMA label (-120) to stator and housing assembly (680).

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

(1) Identification plate (70) replacement, if required.

NOTE: When re-identifying a starter-generator, refer to ILLUSTRATED PARTS LIST section for applicable modification status.

(a) Transfer information from old identification plate to replacement identification plate (70).

(b) Position replacement identification plate (70) on stator and housing assembly (680) in place of the old identification plate and secure with four drive screws (80).

WARNING: **KEEP ACRYLIC COATING AWAY FROM SOURCES OF IGNITION. CONFORMAL COATING IS FLAMMABLE.**

WARNING: **DO NOT GET ACRYLIC COATING ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ACRYLIC COATING IS A POISONOUS MATERIAL.**

(c) Coat replacement identification plate (70) with acrylic coating and let the coating air dry.

(2) Information plate (90) replacement, if required.

(a) Transfer information from old information plate to replacement information plate (90).

(b) Position replacement information plate (90) on stator and housing assembly (680) in place of the old information plate and secure with two drive screws (100).

WARNING: **KEEP ACRYLIC COATING AWAY FROM SOURCES OF IGNITION. CONFORMAL COATING IS FLAMMABLE.**

WARNING: **DO NOT GET ACRYLIC COATING ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ACRYLIC COATING IS A POISONOUS MATERIAL.**

(c) Coat replacement information plate (90) with acrylic coating and let the coating air dry.

(3) If instruction decal (110) or FAA-PMA label (-120) is damaged or unreadable:

(a) Remove instruction decal (110) or FAA-PMA label (-120) from stator and housing assembly (680).

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.**

(b) Clean surface of stator and housing assembly (680) with cloth moistened with isopropyl alcohol.

(c) Apply new instruction decal (110) to stator and housing assembly (680) next to terminal block.

(d) Apply new FAA-PMA label (-120) to stator and housing assembly (680) next to identification plate (70).

NOTE: Make sure decals are oriented to read in the same direction as the identification plate.

5. Performance Acceptance Test on Starter-Generator

CAUTION: ACCEPTANCE TESTING CAN DAMAGE CAPACITORS IN THE STARTER-GENERATOR.

A. Attach a dummy terminal block, refer to DISASSEMBLY section and ASSEMBLY section for details.

NOTE: Alternatively, remove the screw that secures the terminal block to the housing that is adjacent to terminal D. Cover the terminal lug attached to the terminal block with electrical tape.

B. Perform acceptance test procedure on the assembled generator as detailed in the TESTING AND FAULT ISOLATION section.

6. Final Assembly After Acceptance Testing

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

NOTE: After starter-generator has successfully completed and passed acceptance testing, proceed with following final assembly instructions.

A. Attach a serviceable terminal block (690) to stator and housing assembly (680) or replace the screw (700) that secures the terminal block to the housing.

NOTE: A dummy terminal block is used during acceptance testing, or the terminal block securing screw was removed.

(1) Remove dummy terminal block according to instructions in Paragraph 4.R. of the DISASSEMBLY section.

(2) Attach a terminal block according to instructions in Paragraph 4.A. of this section.

B. Remove commutation viewing adapter.

Unthread screw (140) from blind rivet nut that secures commutation viewing adapter to starter-generator.

C. Attach brush access cover (130).

(1) Position brush access cover (130) around stator and housing assembly (680) with air bleed holes towards terminal block.

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

(2) Apply anti-seize compound (Never-Seez) to the threads of self-locking blind rivet nut (150A).

CAUTION: TO PREVENT ELECTRICAL SHORTS. DO NOT POSITION BRACKETS DIRECTLY OVER OPENING IN STATOR AND HOUSING ASSEMBLY.

(3) Thread screw (140) into blind rivet nut (150 or 150A). Tighten screw to a torque of 25.0 to 35.0 lbf.in. (2,8 to 4,0 Nm).

D. If present, attach QAD mounting kit (10) to starter-generator.

NOTE: When a starter-generator has been removed from service, the QAD mounting kit usually stays on the aircraft.

(1) Engage guide pins (-60) of end bell, drive end pad (50) to pin holes in drive end bearing support assembly (-350).

(2) Be sure that guide pins are correctly located and that pilot diameters of drive end pad and drive end end bell assembly are fully engaged.

(3) While holding pad firmly in place, put rim-clenching clamp (20) over flanges of pad and drive end end bell assembly.

(4) Tighten self-locking nut (-30) onto T-bolt (-40) to lock QAD mounting kit to starter-generator. Tighten the self-locking nut to the torque etched on the clamp.

E. Prepare starter-generator for storage/shipment.

Refer to STORAGE section for storage/shipment instructions.

FITS AND CLEARANCES

1. Torque Values

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

Table 8001 gives information necessary to tighten fasteners to specified torque. Values shown do not include frictional torque caused by self-locking devices or rundown resistance. Frictional torque values must be added to the specified torque.

Nuts, bolts, and screws not listed in Table 8001 are to be tightened in accordance with Safran Power USA methods and techniques or practices acceptable to your administration as specified in FAR PART 43.

Nomenclature and IPL Number	Torque Acceptance Limits
Screw (140)	25.0 to 35.0 lbf.in. (2,8 to 4,0 Nm)
Screw (170)	22.7 to 35.0 lbf.in. (2,6 to 4,0 Nm)
Screw, Binding Head (190)	7.7 to 10.3 lbf.in. (0,87 to 1,16 Nm)
Screw (220)	22.7 to 35.0 lbf.in. (2,6 to 4,0 Nm)
Nut, Self-locking (260)	100 to 120 lbf.in. (11,3 to 13,6 Nm)
Screw, Flat Head (360)	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
Screw (490)	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
Bolt (560)	25 to 30 lbf.in. (2,8 to 3,4 Nm)
Screw (670)	15.5 to 18.5 lbf.in. (1,75 to 2,09 Nm)
Screw (700)	22.7 to 35.0 lbf.in. (2,6 to 4,0 Nm)

Table 8001 - Torque Values

2. Component Acceptance Limits

Refer to Table 8002 for acceptance limits applicable to starter-generator components and subassemblies. Paragraph designations in the CHECK column refer to applicable inspection procedures found in the CHECK section, except where noted.

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

CHECK	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
9.B.	Drive End Pad End Bell (Mounting Adapter) (50)	Pilot flange diameter P/N 23046-1660 and 23046-1662	4.122 to 4.120 inch (104,70 to 104,65 mm)
		P/N 23046-1790	3.185 to 3.184 inch (80,90 to 80,87 mm)
		P/N 23046-2090	3.185 to 3.183 inch (80,90 to 80,85 mm)
		P/N 23046-1761	3.249 to 3.247 inch (82,52 to 82,47 mm)
		Guide pin height	0.11 to 0.13 inch (2,8 to 3,3 mm)
9.K.	Drive Shaft (290)	16-tooth spline, diameter over 0.096 inch (2,438 mm) gage pins	0.921 inch (23,393 mm) min.
		12-tooth spline, diameter over 0.1094 inch (2,779 mm) gage pins	0.757 inch (19,228 mm) min.
9.L.(3)	Dampener Plate (320)	Thickness	0.038 inch (0,965 mm) min.
		Internal spline diameter between 0.090 inch (2,28 mm) diameter gage pins	0.6547 inch (16,629 mm) max.
9.M.	Friction Ring (330)	Thickness	0.060 inch (1,524 mm) min.
9.O.	Drive End Bearing Support Assembly (-350)	Bearing liner diameter.	1.8501 to 1.8504 inch (46,993 to 47,000 mm). See Figure 8001.

Table 8002 - Acceptance Limits

CHECK	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
9.R.	Armature (470)	Commutator bar to bar (Before refinishing)	Bar to Bar. 0.0008 inch (0,020 mm) max.
		Bearing journal diameter (A,C) See Figure 5001.	0.7872 to 0.7875 inch (19,995 to 20,003 mm). See Figure 8002.
		Commutator outside diameter (B)	2.060 inch (52,324 mm) min.
		Mica undercut (before recut)	Depth: 0.045 inch (1,14 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.035 inch (0,89 mm) to 0.045 inch (1,14 mm)
		Mica undercut (after recut)	Depth: 0.050 inch (1,27 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.035 inch (0,89 mm) to 0.045 inch (1,14 mm)
		Commutator bar to bar acceptance test values	Bar to Bar: 0.0002 inch (0,005 mm) max. T.I.R: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar 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 gram mm) max. See SPD 1001
9.S.	Bearing and brush support assembly (-480)	Bearing liner diameter.	1.8501 to 1.8504 inch (46,993 to 47,000 mm) See Figure 8001.
		Brush spring force P/N 23033-1120	Position ‘A’ 2.0 lb (0,9 kg) min. Position ‘B’ 3.85 lb (1,7 kg) max.
		P/N 23064-1350	Position ‘A’ 2.7 lb (1,2 kg) min. Position ‘B’ 3.6 lb (1,6 kg) max.
		P/N 23033-1121	Position ‘A’ 2.62 lb (1,2 kg) min. Position ‘B’ 3.4 lb (1,5 kg) max.

Table 8002 - Acceptance Limits (Continued)

CHECK	Nomenclature and IPL Number	Inspect for…	Acceptance Limits
9.V.	Terminal block (690)	Capacitance values B+ to E- C to Ground B+ to Ground	 1.6 to 3.0 µF. Tested at 110 to 130 Hz, 77° F (25° C) ± 10%. 1.6 to 3.0 µF. Tested at 110 to 130 Hz, 77° F (25° C) ± 10%. 0.0176 to 0.033 µF. Tested at 900 to 1100 Hz, 77° F (25° C) ±10%.

Table 8002 - Acceptance Limits (Continued)

3. Bearing Liner and Journal Limits

A. Bearing liners. See Figure 8001.

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 8001. 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 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.

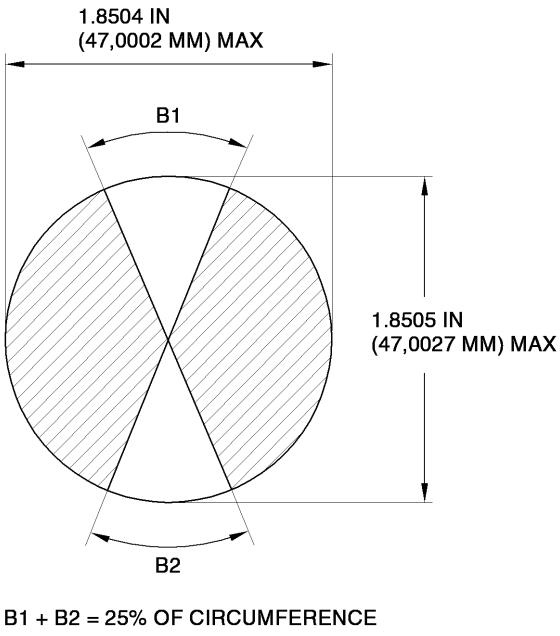

Figure 8001 - Measuring Bearing Liner Diameters

B. Bearing journals. See Figure 8002.

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 8002. 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 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.

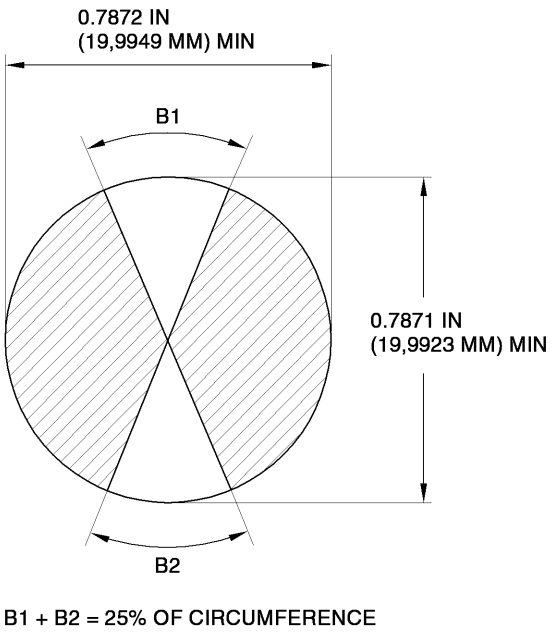

Figure 8002 - Measuring Armature Bearing Journal Diameters

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SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Introduction

Table 9001 lists the approved special tools, fixtures, and equipment necessary for use during repair and overhaul of 23046 Series I starter generators.

Reference Standard Practice Document (SPD) 1004 for the 23046 Series I Brush Holder Alignment Fixture.

Item	Figure No.
Armature Shaft Adapter, Drive End	Figure 9001
Armature Shaft Adapter, Anti-drive End	Figure 9002
Commutation Viewing Adapters	Figure 9003
Inner Race Bearing Driver	Figure 9004
Outer Race Bearing Driver	Figure 9005
Commutator Turning Fixture	Figure 9006
Armature Support	Figure 9007
Bearing and Brush Support Assembly Support	Figure 9008
Drive End Hub Support	Figure 9009
Horizontal Stator Support	Figure 9010
Vertical Stator Support	Figure 9011
Dampener Hub Driver	Figure 9012
Dampener Plate Driver	Figure 9013
Spline Wrench	Figure 9014
Anti-Drive End Bearing Hub Support	Figure 9015
PlusNut® Fastener Header	Figure 9016

Table 9001 - Special Tools, Fixtures, and Equipment

2. Illustrated Description of Tools

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.

The tools and fixtures cannot be procured from Safran Power USA. Equivalent tooling and fixture requirements meeting with Safran Power USA specifications can be used.

A. Armature shaft adapters. See Figure 9001 and Figure 9002.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Materials: Brass.

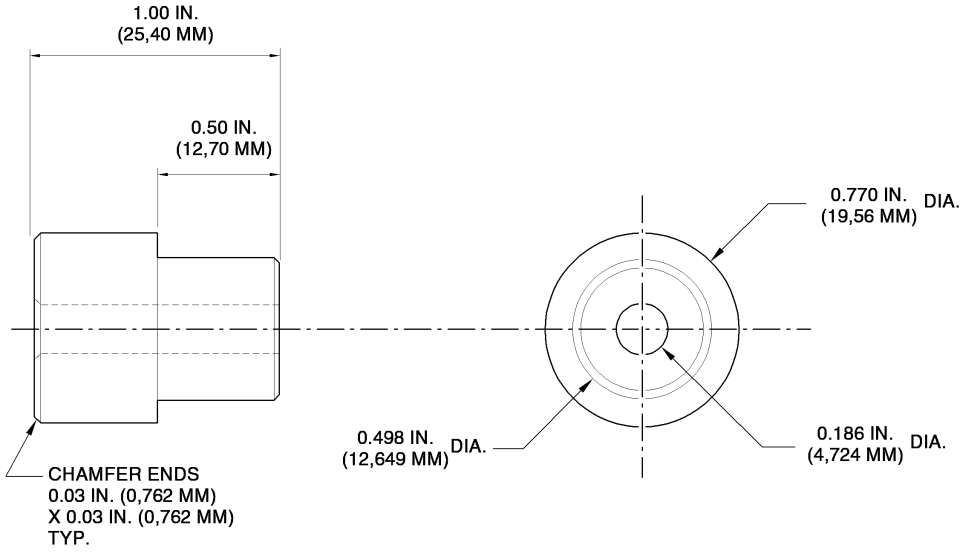


Figure 9001 - Armature Shaft Adapter, Drive End

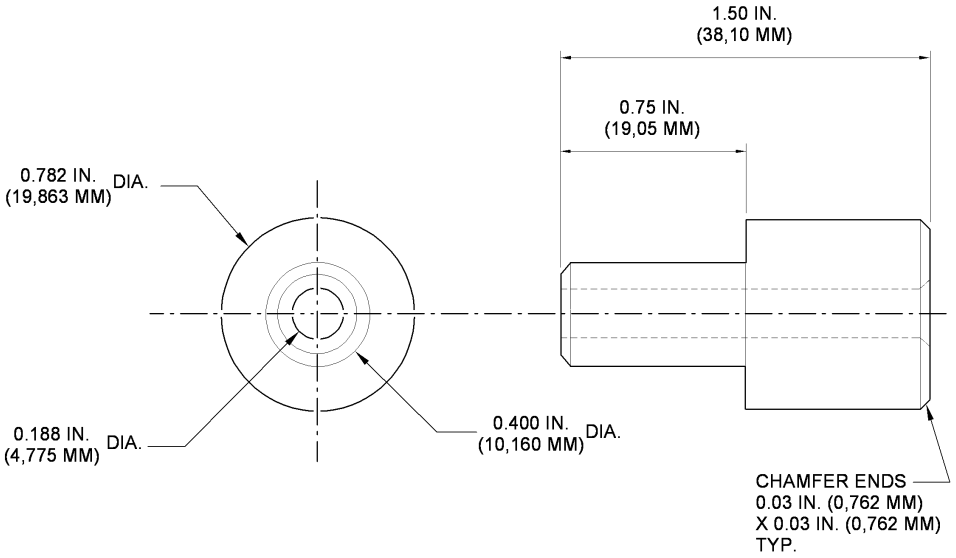


Figure 9002 - Armature Shaft Adapter, Anti-Drive End

B. Commutation viewing adapters. See Figure 9003.

This adapter is constructed using a used brush access cover. Two designs are shown. Design one uses four pieces of acrylic, 2.00 inch (50,8 mm) high by 1.75 inch (44,5 mm) wide by 0.63 inch (1,60 mm) thick. Design two uses one piece of acrylic, 19.00 inch (482,6 mm) long by 2.30 inch (58,4 mm) wide by 0.063 inch (1,60 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 brackets from a used brush access cover.

(b) Attach brackets to a piece of clear acrylic.

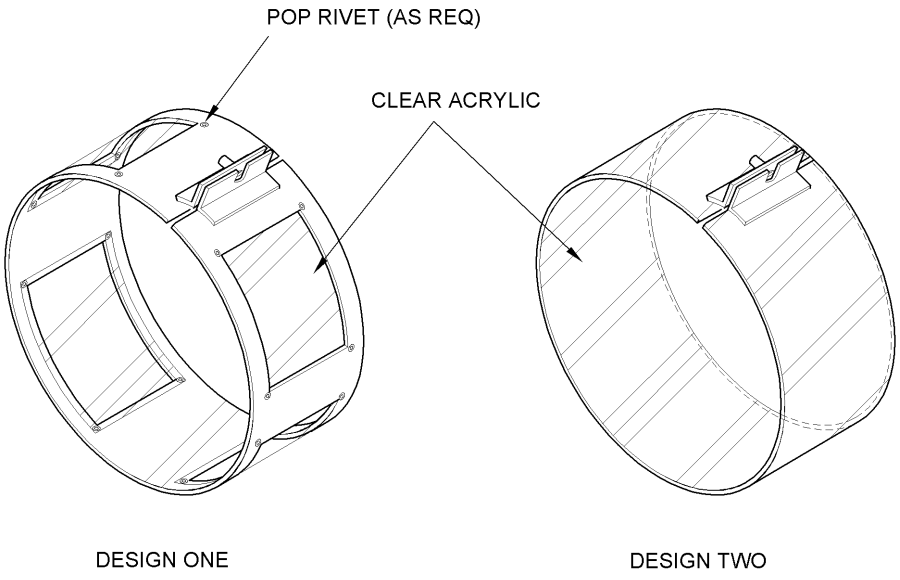


Figure 9003 - Commutation Viewing Adapters

C. Bearing drivers. See Figure 9004 and Figure 9005

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Harden steel to Rockwell Rc 55-60. Material: 1040 Steel, 2.00 inch (50,8 mm) diameter stock size.

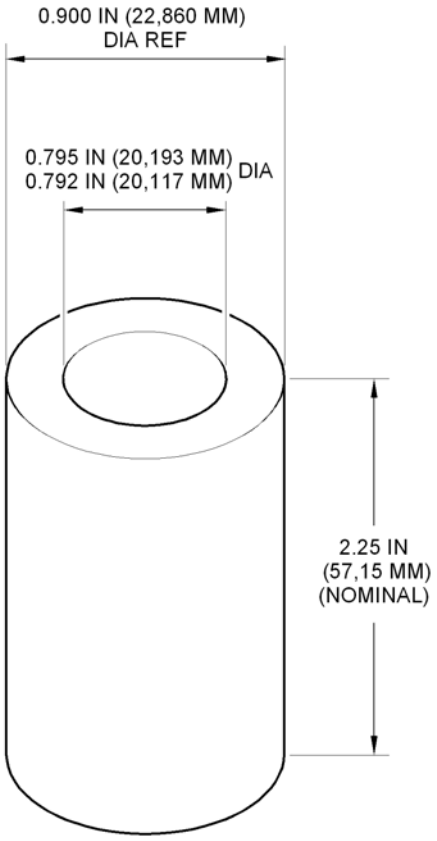


Figure 9004 - Inner Race Bearing Driver

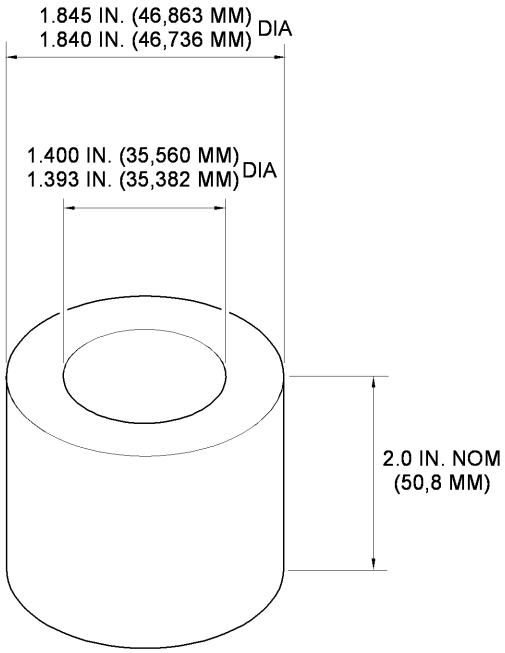


Figure 9005 - Outer Race Bearing Driver

D. Commutator turning fixture. See Figure 9006.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Harden steel to Rockwell Rc 35-40. Material: 1040 Steel, Stock size: 2.50 inch (63,5 mm) diameter.

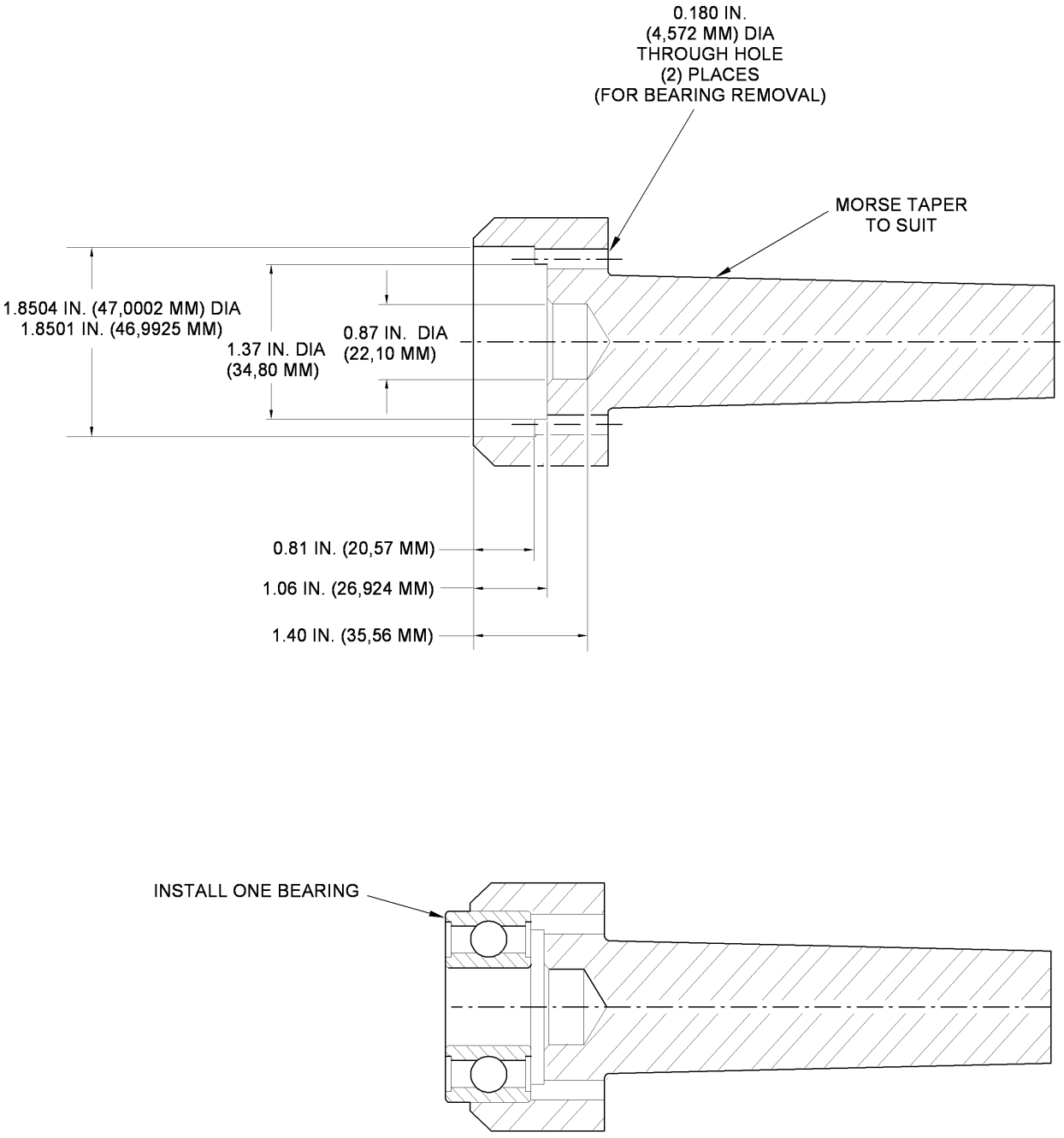


Figure 9006 - Commutator Turning Fixture

E. Armature support. See Figure 9007.

Material 0-1 tool steel, Rc 35-40. Tolerances on decimal 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with bore within ± 0.05 degree.

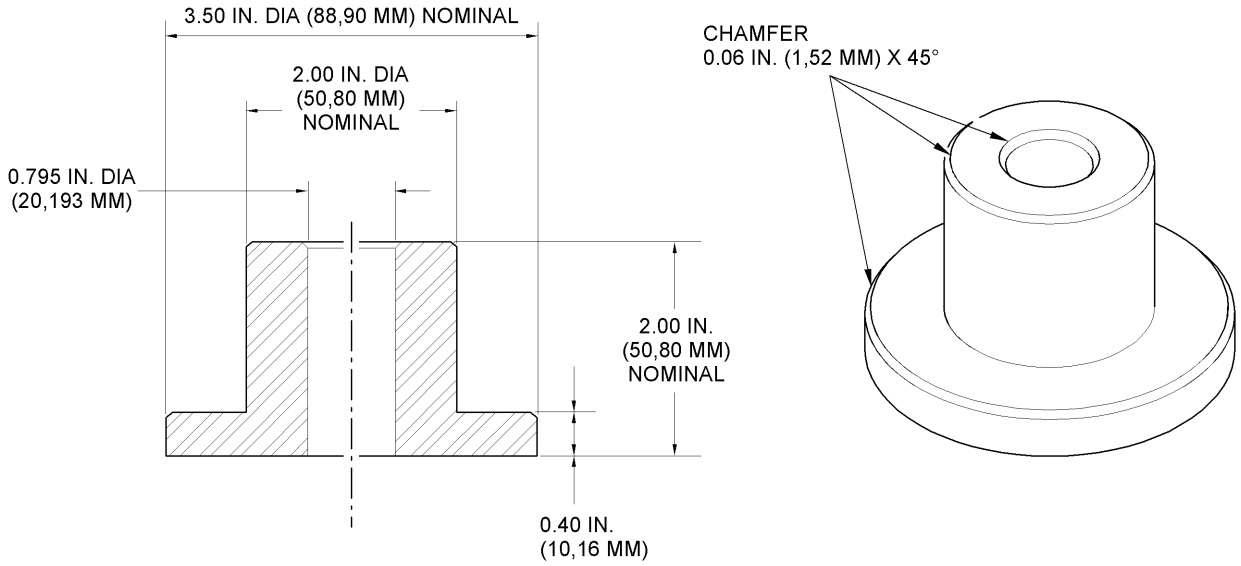


Figure 9007 - Armature Support

F. Bearing and brush support assembly support. See Figure 9008.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Tolerance on angles ± 5 degree. Material: 01 tool steel or equivalent.

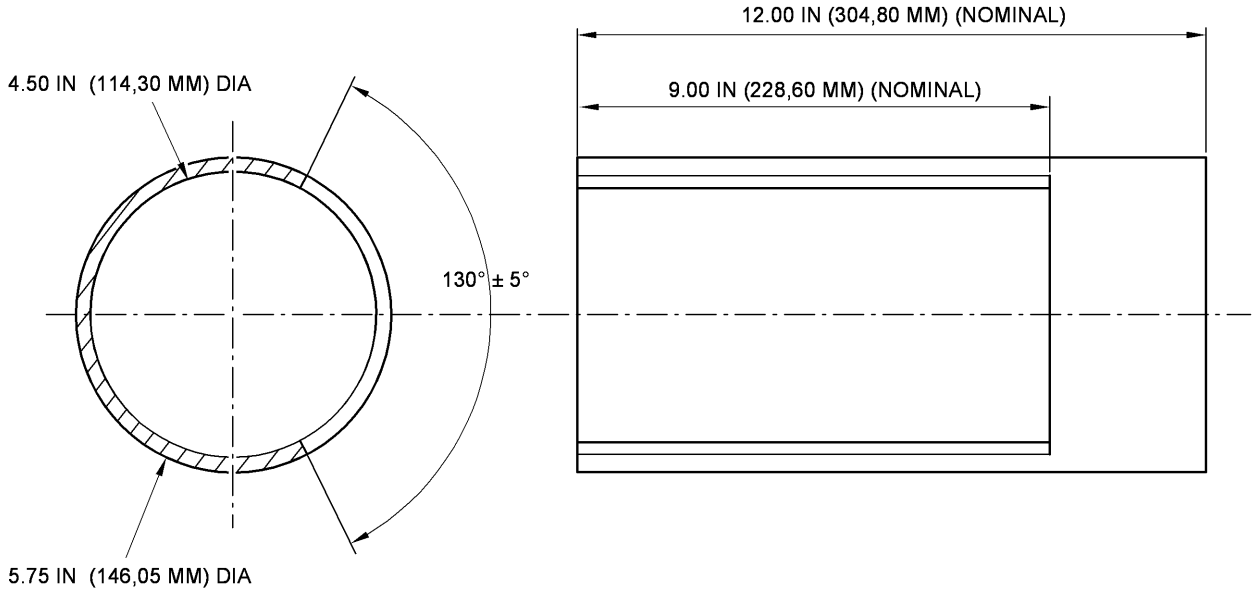


Figure 9008 - Bearing and Brush Support Assembly Support

G. Drive end hub support. See Figure 9009.

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.

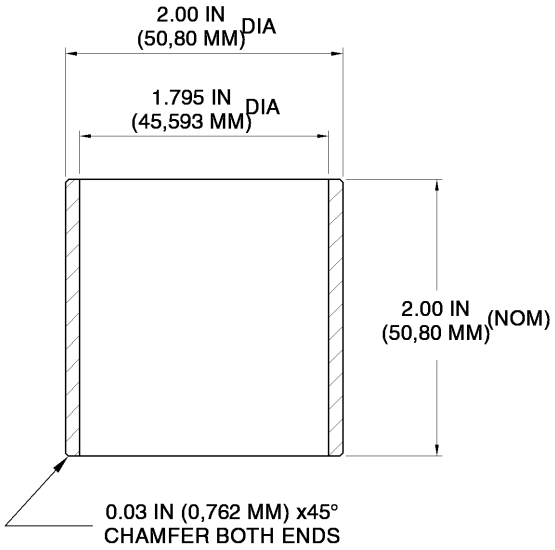


Figure 9009 - Drive End Hub Support

H. Horizontal stator support. See Figure 9010.

All dimensions are nominal. The material is a suitable hardwood.

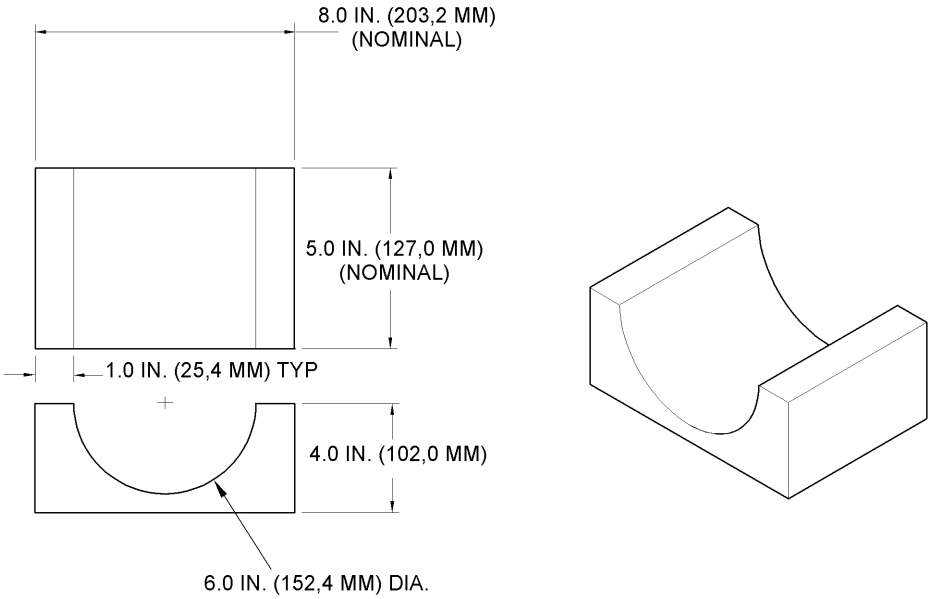


Figure 9010 - Horizontal Stator Support

I. Vertical stator support. See Figure 9011.

All dimensions are nominal. The material is a suitable hardwood.

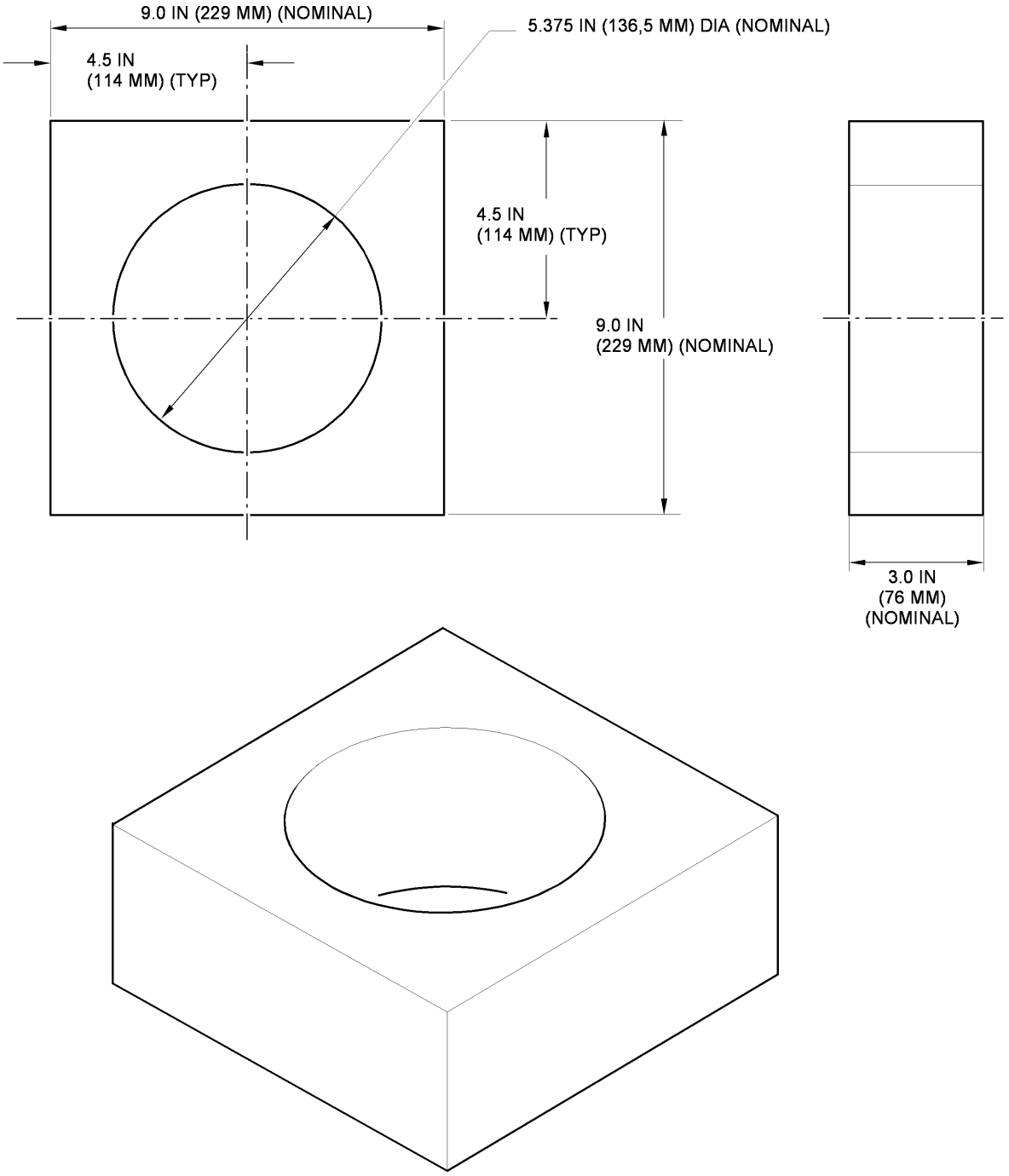


Figure 9011 - Vertical Stator Support

J. Dampener hub driver. See Figure 9012.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm).
Material: 1040 Steel.

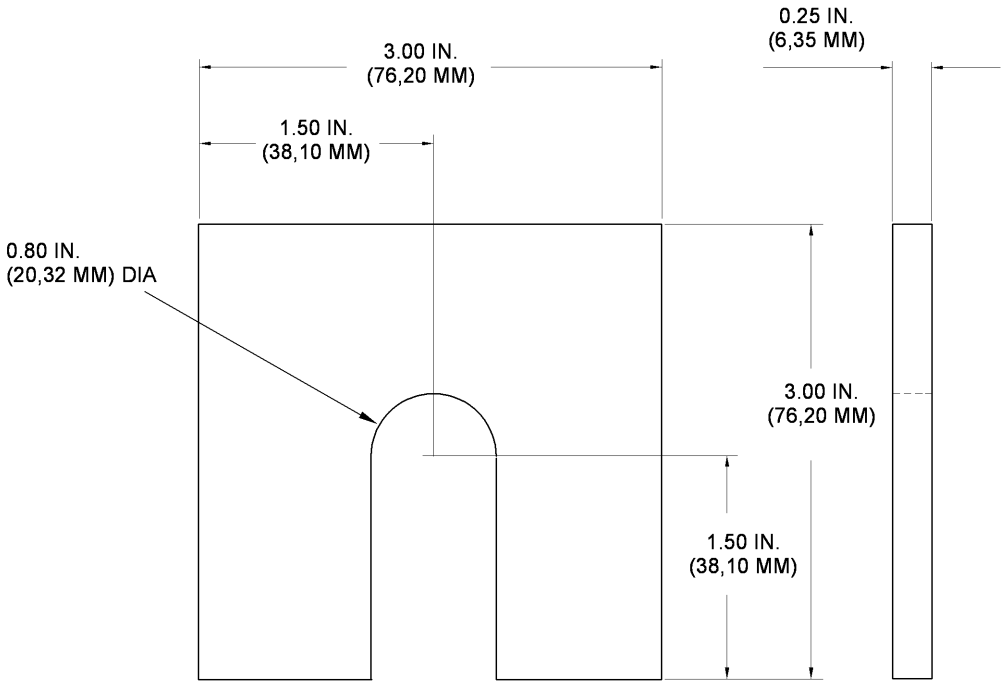


Figure 9012 - Dampener Hub Driver

K. Dampener plate driver. See Figure 9013.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Tolerance on angles ± 1 degree. Material: 01 tool steel or equivalent.

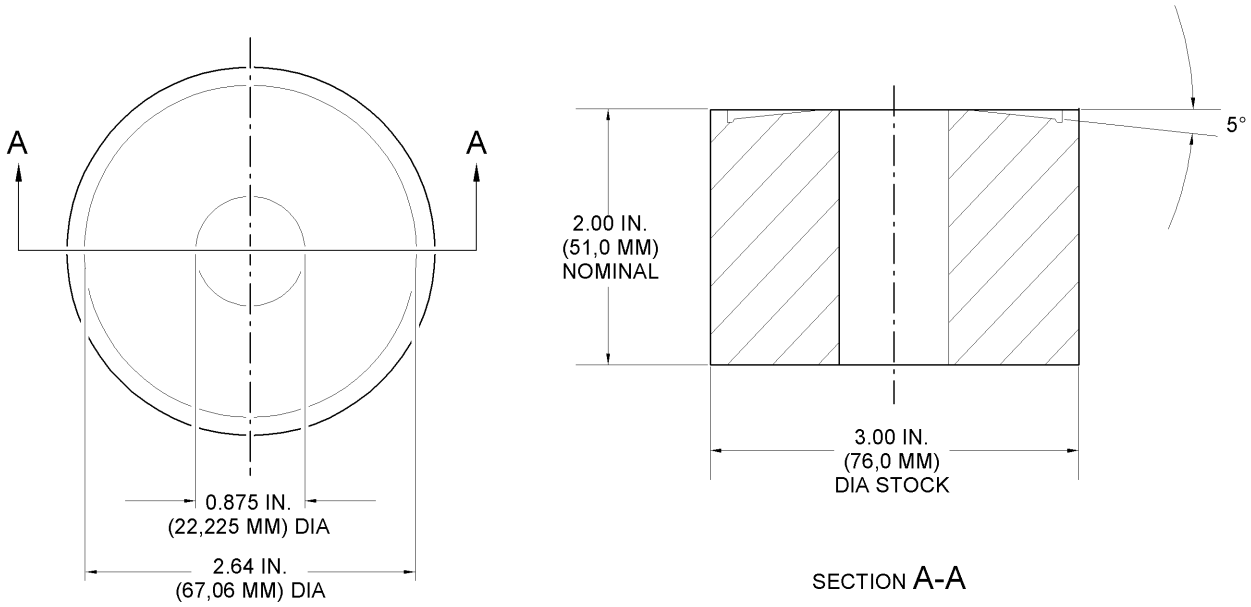
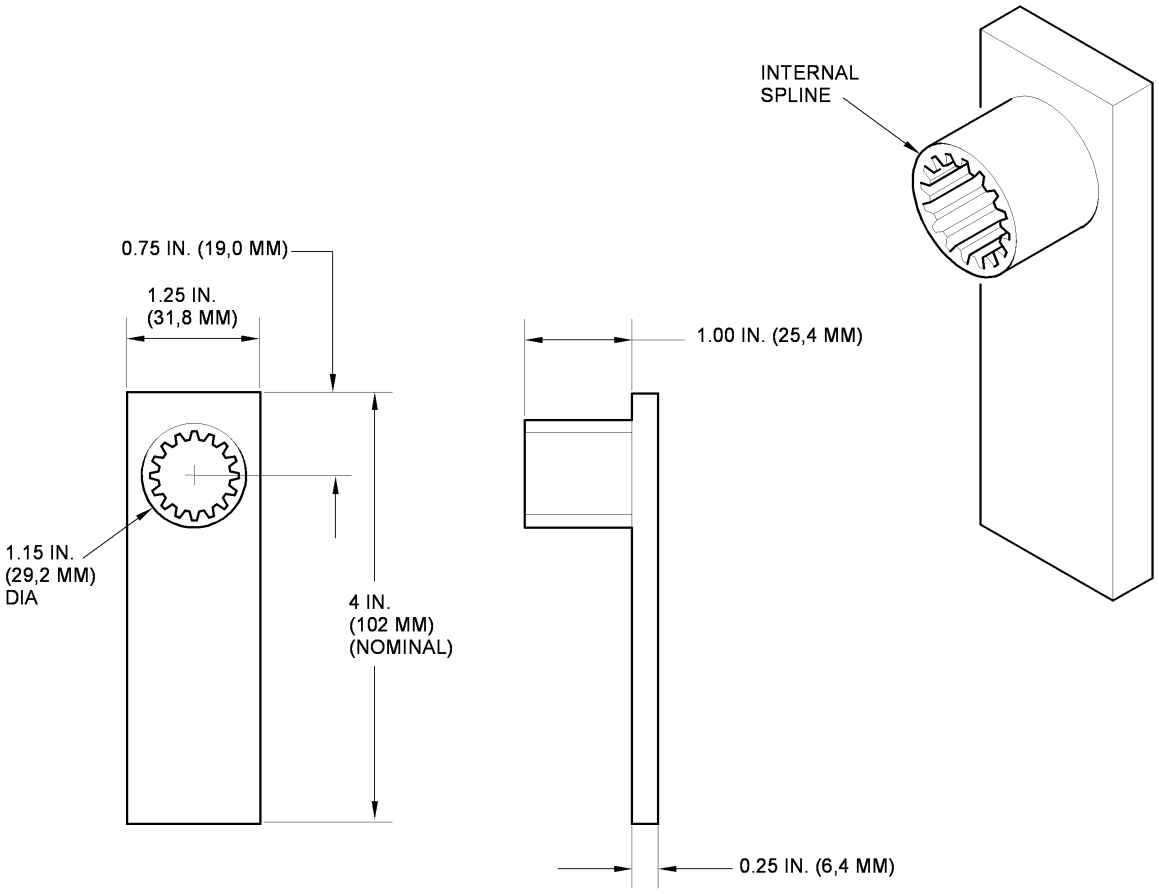


Figure 9013 - Dampener Plate Driver

L. Spline wrench. See Figure 9014.

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ± 0.05 degree. Angles ± 2 degree. Material is 1040 Steel hardened to Rockwell C 55 to 60.



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

16 TOOTH SPLINE

INTERNAL INVOLUTE SPLINE DATA FILLET ROOT SIDE FIT	INCH	MM
NUMBER OF TEETH	16	
DIAMETRAL PITCH	20/40	
PRESSURE ANGLE	30°	
PITCH DIAMETER	0.8000	20,320
MINOR DIAMETER (MIN)	0.7270	18,590
MAJOR DIAMETER (MIN)	0.8640	21,946
CHORD SPACE (MIN)	0.0728	1,849
PIN DIAMETER	0.0720	1,829
BETWEEN THREE 0.0720 IN (1,829 MM) PINS (MIN)	0.7096	18,024

Figure 9014 - Spline Wrench

M. Anti-drive end bearing hub support. 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. Material is 1040 Steel hardened to Rc 35-40, Stock size: 2.50 inch (63,5 mm) diameter.

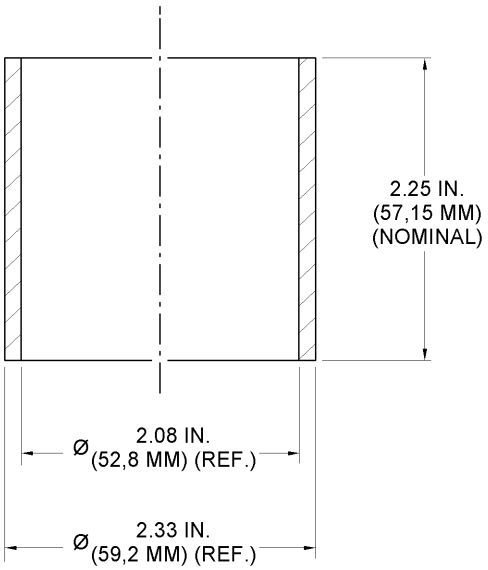


Figure 9015 - Anti-Drive End Bearing Hub Support

N. PlusNut® fastener header. See Figure 9016.

Part Number: C1000-1032

Vendor Cage Code: V 0ZVN9

Vendor details: Omni Fasteners Inc.
DBA Fastener Distributor
909 Towpath Road
Broadview Heights, OH
Ph: 440-838-1800
Fax: 440-838-6200

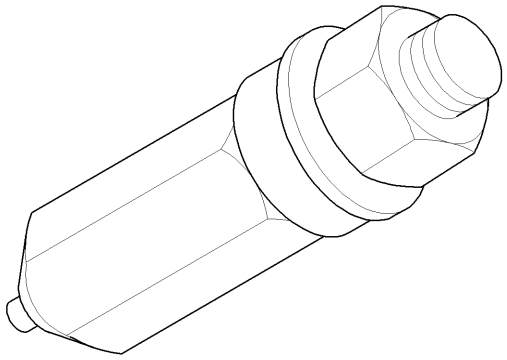


Figure 9016 - PlusNut® Fastener Header

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 starter-generator for storage or shipment are listed in Table 15001.

Description	Specification	Quantity
Bag, waterproof, vapor-proof	Commercially available. Bag must totally enclose instructions for installation and then be sealed.	1
Bag, waterproof, vapor-proof	Kraft-foil or suitable equivalent. Bag must totally enclose generator and then be sealed.	1
Box - domestic class, single wall, corrugated cardboard.	PPP-B-636 or suitable equivalent. Box must be large enough to totally enclose and restrain bagged and cushioned generator.	1
Box - WC5 overseas shipping container.	PPP-B-636 or suitable equivalent. Box must be large enough to completely enclose domestic class packaging.	1
Cardboard Tubing	Commercially available	AR
Chemically Neutral Protective Paper	MIL-B-121A, Grade A, Type II	AR
Grease, Lubricating	MIL-PRF-81322	AR
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam. (Safran Power USA's recommended method: 3 inch (76,2 mm) thick minimum expanded foam surrounding machine on all sides).	Commercially available	AR
Polyethylene (Plastic) Wrap	Commercially available	AR
Tag	Commercially available	1 (Domestic) 2 (Internat'l)
Tape - waterproof, pressure sensitive.	Commercially available	AR

Table 15001 - Packing 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) Record following information to tag(s):

- Model Number
- Serial Number
- Mod Status
- Test Date (PASSED)
- Packing Date

(3) Use packaging materials as specified in Table 15001.

B. Documentation.

Include all applicable documentation with unit:

- Testing Records
- Repair Reports
- Final Inspection/Check Records
- Packing List and Certificate of Conformance

C. Domestic packaging.

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

(1) For models 23046-019 and 23046-020, place O-ring (300) into a small plastic bag with instructions to user to lubricate and install O-ring onto drive end of drive shaft before installation of starter-generator into the aircraft. Attach plastic bag to machine.

(2) Apply lubricating grease to drive spline according to MIL-PRF-81322 and wrap it in protective paper according to MIL-B-121A, Grade A, Type II. Secure with waterproof tape.

(3) Put a section of cardboard tubing over drive shaft to prevent drive shaft from puncturing shipping container.

(4) Place unit into a waterproof and vapor-proof heat-seal bag and partially heat-seal it while forcing as much air as possible from bag.

(5) Insert vacuum tube into bag to draw remaining air out of bag.

(6) Withdraw vacuum tube quickly and complete heat-sealing of bag.

(7) Using machine's original shipping container if possible, place bagged machine into box surrounded with a minimum of 3 inch (76,2 mm) thick shock absorbing, cushioning material on all six sides.

(8) Securely and completely seal all flapped openings of box with tape.

(9) Tape tag to exterior surface of box. Make sure all information is visible.

D. Overseas shipment on surface vessels.

(1) Accomplish domestic packaging of machine in accordance with 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

A. General

(1) This section provides a listing of assemblies and detail parts for the 23046 Series I DC Starter-Generator.

(2) All replacement parts are manufactured or source-controlled by Safran Power USA with the exception of those parts given an MS, AN, NAS, ANSI, ASME or ISO, etc. part number. See Paragraph 2.B. below.

CAUTION: ANY USE OF PARTS, MATERIALS OR PROCEDURES NOT AUTHORIZED BY SAFRAN POWER USA FOR MAINTENANCE OR OVERHAUL OF UNIT(S) CAN AFFECT CONTINUED AIRWORTHINESS OR INVALIDATE CERTIFICATION.

To order authorized Safran Power USA parts, contact your regional Safran Power USA Customer Service Center.

(3) The Illustrated Parts List (IPL) is divided into the parts that follow:

- Vendor List (when applicable)
- Numerical List (when applicable)
- Detailed Parts List

B. Vendor List (when applicable)

(1) The Vendor List is included in the IPL when parts are not supplied by Safran Power USA.

(2) The list gives all supplier codes used in this manual and the names and addresses of the suppliers.

C. Numerical Index (when applicable)

(1) A Numerical Index is included when there are more than five pages of Detailed Parts List.

(2) The Numerical Index gives, in alpha-numerical sequence, all part numbers given in the Detailed Parts List. An Airline Stock Number column is given for airline use. The Total Req'd column gives the total quantity required for each part number at the figure and item entry.

D. Detailed Parts List

(1) The Detailed Parts List includes parts lists and related illustrations.

(2) Each list is in disassembly sequence but that attaching parts are given immediately after the parts they attach. These are headed (ATTACHING PARTS).

(3) More data on the Detailed Parts List is given in Paragraph 2.

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 may have a letter following a number (e.g. 10 A). This indicates that the part has the same function and location as the base number (e.g. 10), but can be different in form and material. An item number that is preceded by a dash (e.g. -30) is not illustrated in the applicable figure.

B. Part Number

The part numbers listed in this column are the only authorized parts for replacement and overhaul of the starter-generator. The list consists mainly of Safran Power USA part numbers but does include Military Standard (MS), Army Navy (AN), National Aerospace Standard (NAS) and industry standard (ANSI, ASME, ISO, etc.) part numbers.

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 (NHA). 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 or Installation Descriptive Title
. Assembly
. Attaching Parts for Assembly
. . Detail Parts for Assembly
. . . Subassembly
. . . Attaching Parts for Subassembly
. . . . Detail Parts for Subassembly

The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. A list of the terms used to show interchangeability and their definition is as follows:

Term	Parts List Abbreviation	Definition
Alternate	ALT	One of the two part numbers 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.
Modification	MOD	Modification (Mod) status details information about the effectivity of parts in regard to upgrades and modifications. Alpha variants (A through Y) (except I O Q S X and Z) are assigned to existing model numbers when necessary. Includes details of SB applicability.
Superseded	SUPSD BY	Part number listed is obsolete and must be replaced by new part listed at the next overhaul or repair. The superseded part is not to be installed or reinstalled.
Supersedes	SUPSDS	The part number listed must replace the obsolete part number at the next overhaul or repair.
Replaced by	REPLD BY	Part number listed is discontinued and should be replaced by the new part number. The original part may be used until current stock is depleted and then must be replaced by the new part listed.
Replaces	REPLS	The part listed replaces and is interchangeable with the item number shown in the notation.
Attaching Parts		Will be listed in the same column as the assembly they attach and the listing of parts will be followed by ---------- * ---------- in the same column.

D. Effect Code

This column establishes part relationships with starter-generator models, which are essentially the same, but have minor variations. These starter-generator models are the end items on the detailed parts list and are assigned reference letters such as A, B, C, D, etc. Subassemblies or detail parts, which are not common to all configurations, but are associated with one or more of the coded end items, carry the letter or letters assigned to the end item(s) with which they are associated. When parts are used on all models, the column is left blank. Effectivity codes are redefined for each major subassembly figure.

E. Units Per Assembly

The numbers listed in this column indicate the quantity of parts used per assembly at the location shown and are not necessarily the total quantity per unit. For bulk items, the abbreviation AR is used to indicate the part quantity is “as required”. The abbreviation NP indicates non-procurable and refers to items which are not procurable and may not be ordered. The abbreviation RF indicates that the item is listed for reference only.

3. Vendors List

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 USA components, and is in accordance with Cataloging Hand Books H4-1, H4-2, and H4-3. CAGE codes are listed in the NOMENCLATURE column, except for the government codes below, which are not listed:

V80205	National Aircraft Standard (prefix NAS)
V81349	Military Specifications (prefix M)
V88044	Army/Navy Standard (prefix AN)
V96906	Military Standard (prefix MS)

The Customer Support division in your region is to be contacted for parts dispatch.

4. Numerical Index

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
AN3-10A		10001-	-560A	8
AN3-7A		10001-	560	8
AN500A8-6		10001-	-670A	4
AN501A10-12		10001-	700	RF
AN502-10-14		10001-	140	1
AN535-2-2		10001-	80	RF
AN935-8L		10001-	500	8
AN936A10		10001-	710	RF
AN960-10		10001-	230	2
AN960-10L		10001-	580	8
		10001-	720	RF
AN960-416		10001-	-270A	1
AN960-416L		10001-	270	1
AN960-4L		10001-	420	6
		10001-	-420A	4
AN960C10		10001-	-750A	2
AN960C10L		10001-	-720A	2
AN960C616		10001-	-770A	3
AN961-10		10001-	750	RF
AN961-616		10001-	770	RF
G128-178		10001-	-440A	1
		10001-	440	2
M832481-113		10001-	300	1
MS16628-1078		10001-	430	1
MS20364-1032C		10001-	570	8
MS20364B1032C		10001-	740	RF
MS20364B624C		10001-	760	RF
MS21042-3		10001-	-740A	2
MS21042-4		10001-	-260B	1
MS21042-6		10001-	-760A	3
MS21045-3		10001-	-30B	1
MS21045-4		10001-	-30D	1
MS21045-L3		10001-	-30A	1
MS21045L4		10001-	-30C	1
MS21209C0615		10001-	540	4
MS21209C0815		10001-	530	4
MS21209F1-15L		10001-	-620	1
MS21318-13		10001-	100	2

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
		10001-	-80B	4
MS21318-14		10001-	-80A	RF
MS21318-15		10001-	410	6
		10001-	-410A	4
MS29561-113		10001-	-300A	1
MS35265-43		10001-	670	4
MS35266-65		10001-	220	2
		10001-	-700A	2
MS35338-42		10001-	370	8
		10001-	-500A	8
MS35338-43		10001-	-710A	2
NAS1189-08P12L		10001-	-490B	8
NAS1189-08P16KW		10001-	360	12
NAS1329H3K130L		10001-	-150A	1
01-098011		10001-	-700B	2
02-4107-01		10001-	-260A	1
02-4412-03		10001-	-60	3
02-5600-05		10001-	330	RF
02-5600-13		10001-	-330A	1
02-6100-04		10001-	-290C	1
02-6100-10		10001-	-290B	1
03-6010-08		10001-	-450A	RF
03-6010-15		10001-	-450C	RF
03-6010-18		10001-	-450D	2
05-321002		10001-	150	RF
05-322501		10001-	260	1
05-340122		10001-	190	4
05-340201		10001-	170	4
05-341303		10001-	490	8
05-341309		10001-	360B	8
05-350206		10001-	-490A	8
05-350208		10001-	-360A	12
05-360013		10001-	630	8
05-370176		10001-	380	8
05-370232		10001-	510	8
05-374094		10001-	590	8
05-420617		10001-	-60A	3
05-631145		10001-	640	8
05-652013		10001-	-730	1
05-652015		10001-	780	2

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
		10001-	-730B	1
05-652918		10001-	-730A	1
06-0017-02		10001-	-90A	1
06-123301		10001-	-120	1
06-201020		10001-	110	1
06-201054		10001-	90	1
06-209285		10001-	70	1
06-209286		10001-	-70A	1
07-111253		10001-	-450B	RF
07-11261		10001-	450	RF
23014-1039		10001-	650	4
23032-1335		10001-	-180A	1
23032-1512		10001-	-690A	1
23032-1516		10001-	690	RF
23032-1580		10001-	210	1
23032-1581		10001-	-20A	1
23032-1585		10001-	20	1
23032-1586		10001-	-20D	1
		10001-	-210A	1
23032-1900		10001-	310	1
23032-1910		10001-	320	1
23032-2710		10001-	340	1
23032-2800		10001-	-40	1
23032-2802		10001-	-40A	1
23032-2803		10001-	-40B	1
23033-1120		10001-	600	RF
23033-1121		10001-	-600B	8
23046-001		10001-	-1	RF
23046-007		10001-	-1A	RF
23046-007M		10001-	-1B	RF
23046-009		10001-	-1C	RF
23046-017		10001-	-1D	RF
23046-019		10001-	-1E	RF
23046-020		10001-	-1F	RF
23046-028		10001-	-1G	RF
23046-1020		10001-	250	1
23046-1030		10001-	-470A	1
23046-1031		10001-	470	1
23046-1070		10001-	130	RF
23046-1090		10001-	180	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23046-1110		10001-	660	1
23046-1120		10001-	290	1
23046-1124		10001-	-290A	1
23046-1132		10001-	-550	4
23046-1133		10001-	-550A	4
23046-1141		10001-	-520A	1
23046-1171		10001-	-350	1
23046-1180		10001-	400	1
23046-1191		10001-	390C	1
23046-1500		10001-	160	RF
23046-1630		10001-	-390A	1
23046-1660		10001-	50	1
23046-1662		10001-	-50A	1
23046-1670		10001-	-350B	1
23046-1673		10001-	-350D	1
23046-1674		10001-	-350C	1
23046-1678		10001-	-350E	1
23046-1679		10001-	-350F	1
23046-1720		10001-	-130A	RF
23046-1721		10001-	-130B	1
23046-1724		10001-	-130C	1
23046-1761		10001-	-50D	1
23046-1790		10001-	-50B	1
23046-2080		10001-	-390B	1
23046-2090		10001-	-50C	1
23046-2140		10001-	-250D	1
23046-2322		10001-	-390D	1
23046-303		10001-	-480A	1
23046-304		10001-	-480F	1
23046-307		10001-	-480E	1
23046-308		10001-	-480	1
23046-310		10001-	680	1
23046-313		10001-	-680B	1
23046-314		10001-	-680A	1
23046-340		10001-	-480G	1
23046-370		10001-	-480D	1
23046-377		10001-	-480C	1
23046-378		10001-	-480B	1
23046-510		10001-	10	RF
23046-512		10001-	-10D	RF

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23046-516		10001-	-10A	1
23046-517		10001-	-10B	RF
23046-520		10001-	-10C	RF
23048-1000		10001-	240	1
23048-1010		10001-	-520B	1
23048-1041		10001-	200	1
23048-1380		10001-	-610A	4
23048-1410		10001-	520	1
23048-1420		10001-	-550B	4
23048-1460		10001-	390	1
23048-1470		10001-	-350A	1
23048-1480		10001-	-250A	1
23048-1486		10001-	-250B	1
23064-1180		10001-	-610B	4
23064-1281		10001-	-550C	4
23064-1283		10001-	-550D	4
23064-1284		10001-	-550E	4
23064-1350		10001-	-600A	RF
23065-1930		10001-	-250C	1
23072-1125		10001-	-20B	1
23072-1325		10001-	-20C	1
23080-3111		10001-	460	1
23080-3112		10001-	280	1
23088-1324		10001-	-160F	RF
23093-1300		10001-	-160G	4
23093-1307		10001-	-160J	4
30010-1025		10001-	610	4
30010-1026		10001-	-160B	RF
30300-1282		10001-	-160E	RF
30300-1285		10001-	-160D	4
30300-1300		10001-	-160A	RF
30300-1303		10001-	-160C	4
30300-1286		10001-	-160H	4

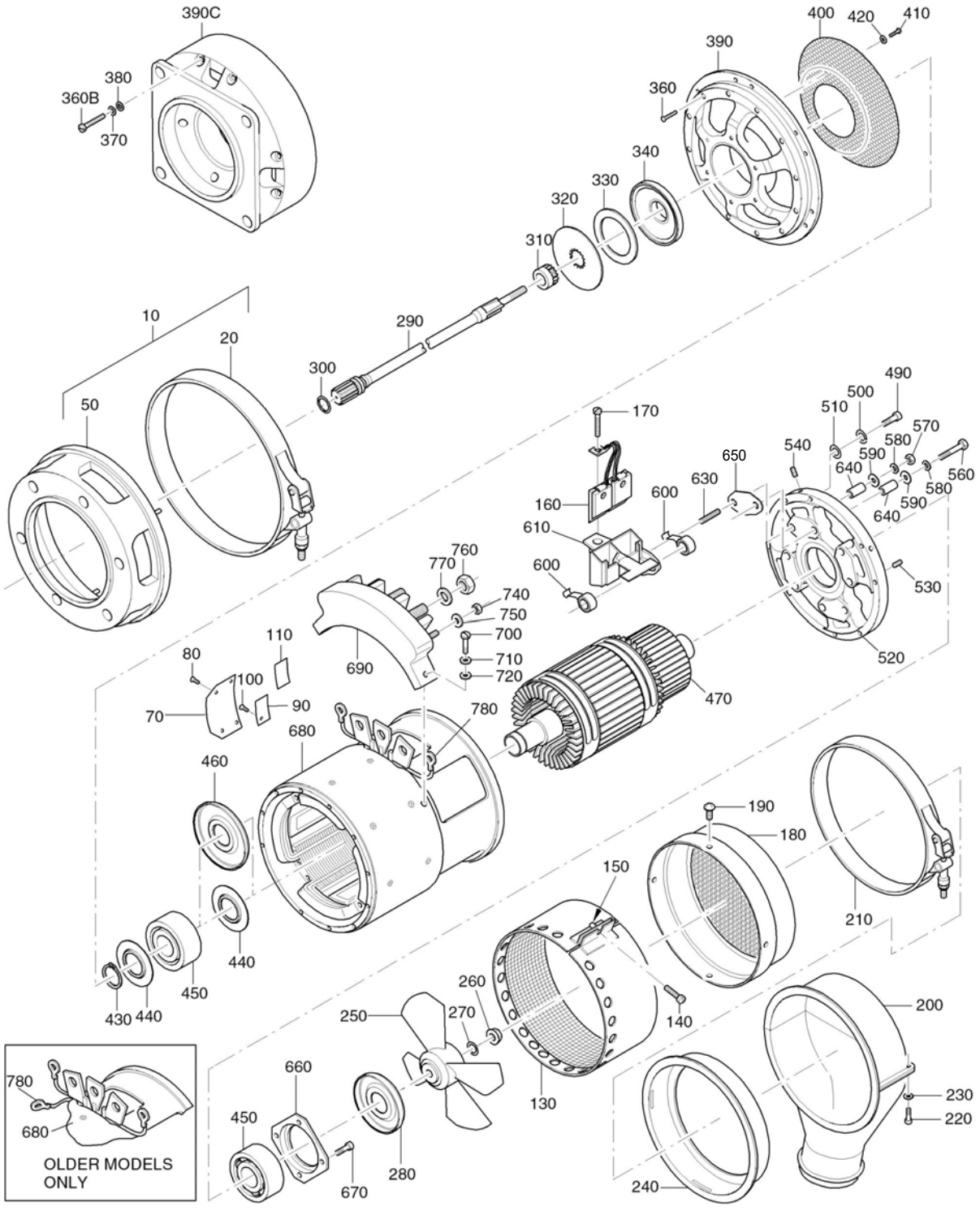

Figure 10001 - D.C. Starter-Generator Model 23046 Series I

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-1	23046-001	STARTER-GENERATOR ASSEMBLY . . .	A	RF
-1A	23046-007	STARTER-GENERATOR ASSEMBLY . . .	B	RF
-1B	23046-007M	STARTER-GENERATOR ASSEMBLY . . .	C	RF
-1C	23046-009	STARTER-GENERATOR ASSEMBLY . . .	D	RF
-1D	23046-017	STARTER-GENERATOR ASSEMBLY . . .	E	RF
-1E	23046-019	STARTER-GENERATOR ASSEMBLY . . .	F	RF
-1F	23046-020	STARTER-GENERATOR ASSEMBLY . . .	G	RF
-1G	23046-028	STARTER-GENERATOR ASSEMBLY . . .	H	RF
10	23046-510	• QAD MOUNTING KIT . . . . . (Required but not provided)	BCH	RF
-10A	23046-516	• QAD MOUNTING KIT	F	1
	23046-516	• QAD MOUNTING KIT . . . . . (Required but not provided)	G	RF
-10B	23046-517	• QAD MOUNTING KIT . . . . . (Required but not provided)	E	RF
-10C	23046-520	• QAD MOUNTING KIT, ... ALT 23046-512 (Required but not provided)	D	RF
-10D	23046-512	• QAD MOUNTING KIT, ... ALT 23046-520 (Required but not provided)	D	RF
20	23032-1585	• • CLAMP, Rim-Clenching, ... ALT 23032-1581, used on 23046-510, 23046-512	BCDH	1
-20A	23032-1581	• • CLAMP, Rim-Clenching, ... ALT 23032-1585, used on 23046-510, 23046-512	BCDH	1
-20B	23072-1125	• • CLAMP, Rim-Clenching, ... ALT 23072-1325, used on 23046-516, 23046-520	DFG	1
-20C	23072-1325	• • CLAMP, Rim-Clenching, ... ALT 23072-1125, used on 23046-516, 23046-520	DFG	1
-20D	23032-1586	• • CLAMP, Rim-Clenching, ... used on 23046-517	E	1
		(ATTACHING PARTS)		

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-30A	MS21045-L3	• • • NUT, Reduced Hex, ... Used on 23032-1581 (MS21045L3 is reference for complete P/N MS21045-L3)	BCDH	1
	MS21045-L3	• • • NUT, Reduced Hex, ... REPLD BY MS21045-3 Used on 23032-1585/-1586 (MS21045L3 is reference for complete P/N MS21045-L3)	BCDEH	1
-30B	MS21045-3	• • • NUT, Reduced Hex, ... REPLS MS21045-L3 Used on 23032-1585/-1586	BCDEH	1
-30C	MS21045L4	• • • NUT, Reduced Hex, ... used on 23072-1325 (MS21045L4 is reference for complete P/N MS21045-L4)	DFG	1
-30D	MS21045-4	• • • NUT, Reduced Hex, ... used on 23072-1125	DFG	1
-40	23032-2800	• • • T-BOLT	BCEH	1
-40A	23032-2802	• • • T-BOLT, used on 23072-1125	DFG	1
-40B	23032-2803	• • • T-BOLT, used on 23072-1325	DFG	1
		---------- * ----------		
50	23046-1660	• • END BELL, Drive End Pad, ... ALT 23046-1662	BCH	1
-50A	23046-1662	• • END BELL, Drive End Pad, ... ALT 23046-1660	BCH	1
-50B	23046-1790	• • END BELL, Drive End Pad.	FG	1
-50C	23046-2090	• • END BELL, Drive End Pad.	E	1
-50D	23046-1761	• • END BELL, Drive End Pad.	D	1
-60	02-4412-03	• • • PIN, Grooved, Headless	BCDFGH	3
-60A	05-420617	• • • PIN, Dowel	E	3
70	06-209285	• PLATE, Identification,. . . . . Replacement	BCDEFGH	1
-70A	06-209286	• PLATE, Identification,. . . . . Replacement	A	1
		(ATTACHING PARTS)		
80	AN535-2-2	• SCREW, Drive, ... REPLD BY MS21318-14	ABD	RF
-80A	MS21318-14	• SCREW, Drive, ... REPLS AN535-2-2, REPLD BY MS21318-13	ABD	RF

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-80A (Contd)	MS21318-14	• SCREW, Drive, ... REPLD BY MS21318-13	CH	RF
-80B	MS21318-13	• SCREW, Drive, ... REPLS MS21318-14	ABCDH	4
	MS21318-13	• SCREW, Drive	EFG	4
		---------- * ----------		
90	06-201054	• PLATE, Information . . . . . REPLD BY 06-0017-02	FG	1
-90A	06-0017-02	• PLATE, Information . . . . . REPLS 06-201054	FG	1
		(ATTACHING PARTS)		
100	MS21318-13	• SCREW, Drive	FG	2
		---------- * ----------		
110	06-201020	• DECAL, Instruction		1
-120	06-123301	• LABEL, FAA-PMA	H	1
130	23046-1070	• COVER, Brush Access, ... REPLD BY 23046-1720	AB	RF
-130A	23046-1720	• COVER, Brush Access, ... REPLS 23046-1070 REPLD BY 23046-1721	AB	RF
-130B	23046-1721	• COVER, Brush Access, ... REPLS 23046-1720	AB	1
	23046-1721	• COVER, Brush Access	CDEH	1
-130C	23046-1724	• COVER, Brush Access	FG	1
		(ATTACHING PARTS)		
140	AN502-10-14	• • SCREW, Machine, Drilled . . . . . Fillister Head		1
150	05-321002	• • NUT, Blind Rivet, ... REPLD BY NAS1329H3K130L		RF
-150A	NAS1329H3K130L	• • NUT, Blind Rivet, ... REPLS 05-321002		1
		---------- * ----------		
160	23046-1500	• BRUSH, Electrical Contact, ... SUPSD BY 30300-1300	AB	RF
-160A	30300-1300	• BRUSH, Electrical Contact, ... SUPSDS 23046-1500, SUPSD BY 30010-1026 and 30300-1303	ABD	RF

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-160B	30010-1026	• BRUSH, Electrical Contact, ... SUPSDS 30300-1300, SUPSD BY 30300-1303	B	RF
-160C	30300-1303	• BRUSH, Electrical Contact, ... SUPSDS 30300-1300 and 30010-1026	ABD	4
-160D	30300-1285	• BRUSH, Electrical Contact	CE	4
-160E	30300-1282	• BRUSH, Electrical Contact, ... SUPSD BY 30300-1285	FG	RF
	30300-1285	• BRUSH, Electrical Contact, ... SUPSDS 30300-1282, SUPSD BY 23088-1324	FG	RF
-160F	23088-1324	• BRUSH, Electrical Contact, ... SUPSDS 30300-1285, MOD C Refer to SB23046-0XX-24-05 SUPSD BY 23093-1300	FG	RF
-160G	23093-1300	• BRUSH, Electrical Contact, ... SUPSDS 23088-1324, MOD E 30300-1282, 30300-1285 Refer to SB23046-0XX-24-07	FG	4
	30300-1285	• BRUSH, Electrical Contact, ... SUPSD BY 30300-1286	H	RF
-160H	30300-1286	• BRUSH, Electrical Contact . . . . . SUPSDS 30300-1285 SUPSD BY 23093-1307	H	RF
-160J	23093-1307	• BRUSH, Electrical Contact . . . . . SUPSDS 30300-1286 (MOD C) Refer to SB23046-028-24-01	H	4
		(ATTACHING PARTS)		
170	05-340201	• SCREW		4
		---------- * ----------		
180	23046-1090	• COVER ASSEMBLY	ABCDE	1
-180A	23032-1335	• COVER ASSEMBLY	H	1
		(ATTACHING PARTS)		
190	05-340122	• SCREW, Binding Head	ABCDEH	4
		---------- * ----------		
200	23048-1041	• INLET ASSEMBLY, Air. . . . . (Matched Set)	FG	1
		(ATTACHING PARTS)		
210	23032-1580	• CLAMP, Rim-Clenching . . . . . ALT 23032-1586	FG	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-210A	23032-1586	• CLAMP, Rim-Clenching, ... ALT 23032-1580	FG	1
		(ATTACHING PARTS)		
220	MS35266-65	• SCREW	FG	2
230	AN960-10	• WASHER	FG	2
		---------- * ----------		
240	23048-1000	• COVER, Fan	FG	1
250	23046-1020	• FAN, ... REPLD BY 23048-1480	ABCDFG	1
	23046-1020	• FAN	E	1
-250A	23048-1480	• FAN, ... REPLS 23046-1020	ABCD	1
	23048-1480	• FAN, ... REPLS 23046-1020 REPLD BY 23048-1486	FG	1
-250B	23048-1486	• FAN, ... MOD D REPLS 23048-1480, Refer to SB23046-0XX-24-06	FG	1
-250C	23065-1930	• FAN, ALT 23046-2140	H	1
-250D	23046-2140	• FAN, ALT 23065-1930	H	1
		(ATTACHING PARTS)		
260	05-322501	• NUT, Self-Locking, ... REPLD BY 02-4107-01	ABD	1
-260A	02-4107-01	• NUT, Self-Locking, ... REPLS 05-322501, REPLD BY MS21042-4	ABCDFGH	1
	02-4107-01	• NUT, Self-Locking	E	1
-260B	MS21042-4	• NUT, Self-Locking, ... REPLS 02-4107-01	ABCDFGH	1
270	AN960-416L	• WASHER, Flat . . . . . REPLD BY AN960-416	ABCDFGH	1
-270A	AN960-416	• WASHER, Flat . . . . . REPLS AN960-416L	ABCDFGH	1
		---------- * ----------		
280	23080-3112	• SHIELD, Bearing, Anti-Drive End, ... Refer to SB23046-0XX-24-06, MOD D Only used with fan 23048-1486.	FG	1
290	23046-1120	• SHAFT, Drive	AD	1
-290A	23046-1124	• SHAFT, Drive	BCH	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-290B	02-6100-10	• SHAFT, Drive	E	1
-290C	02-6100-04	• SHAFT, Drive	FG	1
300	M832481-113	• O-RING . . . . . (M832481-113 is reference for complete P/N M83248/1-113)	FG	1
-300A	MS29561-113	• O-RING	E	1
310	23032-1900	• HUB, Dampener.		1
320	23032-1910	• PLATE, Dampener		1
330	02-5600-05	• RING, Friction . . . . . WARNING: CAN CONTAIN ASBESTOS. SUPSD BY 02-5600-13		RF
-330A	02-5600-13	• RING, Friction . . . . . SUPSDS 02-5600-05, Refer to SIL 02-5600-03		1
340	23032-2710	• BACKPLATE, Dampener		1
-350	23046-1171	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY	A	1
-350A	23048-1470	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY, ALT 23046-1670	BCD	1
-350B	23046-1670	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY, ALT 23048-1470 REPLD BY 23046-1678	BCD	1
	23046-1670	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY, REPLD BY 23048-1470	H	1
	23048-1470	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY, REPLS 23046-1670 REPLD BY 23046-1678	H	1
-350C	23046-1674	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY	E	1
-350D	23046-1673	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY REPLD BY 23046-1679	FG	1
-350E	23046-1678	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY REPLS 23046-1670, 23048-1470	BCDH	1
-350F	23046-1679	• DRIVE END BEARING SUPPORT . . . . ASSEMBLY REPLS 23046-1673	FG	1
		(ATTACHING PARTS)		

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
360	NAS1189-08P16KW	• SCREW, Flat Head	EFG	12
-360A	05-350208	• SCREW, Flat Head	BCDH	12
360B	05-341309	• SCREW, Socket Head	A	8
370	MS35338-42	• WASHER, Lock	A	8
380	05-370176	• WASHER, Flat	A	8
		---------- * ----------		
390	23048-1460	• • END BELL, Drive End, ... Machining, used on 23048-1470	BCDH	1
-390A	23046-1630	• • END BELL, Drive End, ... Machining, used on 23046-1670 and 23046-1673	BCDFGH	1
-390B	23046-2080	• • END BELL, Drive End, ... Machining, used on 23046-1674	E	1
390C	23046-1191	• • END BELL, Drive End, ... Machining	A	1
-390D	23046-2322	• • END BELL, Drive End, ... Machining, used on 23046-1679 and 23046-1678	BCDFGH	1
400	23046-1180	• • SCREEN		1
		(ATTACHING PARTS)		
410	MS21318-15	• • SCREW, Drive	BCDEFGH	6
-410A	MS21318-15	• • SCREW, Drive	A	4
420	AN960-4L	• • WASHER	BCDEFGH	6
-420A	AN960-4L	• • WASHER	A	4
		---------- * ----------		
430	MS16628-1078	• RING, Retaining		1
440	G128-178	• DISC, Baffle	ABCDEH	2
-440A	G128-178	• DISC, Baffle, ... MOD D Refer to SB23046-0XX-24-06	FG	1
450	07-111261	• BEARING, Ball, ... SUPSD BY 03-6010-08	FG	RF
-450A	03-6010-08	• BEARING, Ball . . . . . SUPSDS 07-111261, SUPSD BY 03-6010-15	FG	RF
	03-6010-08	• BEARING, Ball, ... SUPSD BY 03-6010-18	E	RF

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-450A (Contd)	03-6010-08	• BEARING, Ball, ... SUPSD BY 03-6010-15	H	RF
	03-6010-08	• BEARING, Ball, ... ALT 07-111253 SUPSD BY 03-6010-15	ABCD	RF
-450B	07-111253	• BEARING, Ball, ... ALT 03-6010-08 SUPSD BY 03-6010-15	ABCD	RF
-450C	03-6010-15	• BEARING, Ball, ... MOD A SUPSDS 03-6010-08 and 07-111253, SUPSD BY 03-6010-18	ABCDFGH	RF
-450D	03-6010-18	• BEARING, Ball, ... MOD A SUPSDS 03-6010-08 Refer to SB23046-0XX-24-04	E	2
	03-6010-18	• BEARING, Ball, ... MOD B SUPSDS 03-6010-15 Refer to SB23046-0XX-24-03/-04	ABCDFGH	2
460	23080-3111	• SHIELD, Bearing, Drive End,. . . . . Refer to SB23046-0XX-24-06, MOD D	FG	1
470	23046-1031	• ARMATURE, ... ALT 23046-1030	ABCDEH	1
-470A	23046-1030	• ARMATURE, ... ALT 23046-1031	ABCDEH	1
	23046-1030	• ARMATURE	FG	1
-480	23046-308	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-303 and 23046-378	ABD	1
-480A	23046-303	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-308 and 23046-378	ABD	1
-480B	23046-378	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-308 and 23046-303	ABD	1
-480C	23046-377	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-370, 23046-304 and 23046-307	C	1
-480D	23046-370	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-377, 23046-304 and 23046-307	C	1
	23046-370	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-304 and 23046-307	H	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-480E	23046-307	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-377, 23046-370 and 23046-304	C	1
	23046-307	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-370 and 23046-304	H	1
-480F	23046-304	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-377, 23046-370 and 23046-307	C	1
	23046-304	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY, ALT 23046-370 and 23046-307	H	1
	23046-304	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY	E	1
-480G	23046-340	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY	FG	1
		(ATTACHING PARTS)		
490	05-341303	• SCREW, Socket Head	ABCDEH	8
-490A	05-350206	• SCREW, Flat Head, ... ALT NAS1189-08P12L	FG	8
-490B	NAS1189-08P12L	• SCREW, Flat Head, ... ALT 05-350206	FG	8
500	AN935-8L	• WASHER, Lock . . . . . REPLD BY MS35338-42	ABD	8
-500A	MS35338-42	• WASHER, Lock . . . . . REPLS AN935-8L	ABD	8
	MS35338-42	• WASHER, Lock	CEH	8
510	05-370232	• WASHER, Flat	ABCDEH	8
		---------- * ----------		
520	23048-1410	• • END BELL, Anti-Drive End, ... REPLD BY 23046-1141 Used on 23046-378, 23046-377 and 23046-370	ABCDEH	1
	23048-1410	• • END BELL, Anti-Drive End, ... ALT 23046-1141 Used on 23046-303	ABD	1
-520A	23046-1141	• • END BELL, Anti-Drive End, ... REPLS 23048-1410 Used on 23046-378, 23046-377 and 23046-370	ABCDEH	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
-520A (Contd)	23046-1141	• • END BELL, Anti-Drive End, ... ALT 23048-1410 Used on 23046-303	ABD	1
	23046-1141	• • END BELL, Anti-Drive End, ... Used on 23046-308, 23046-307 and 23046-304	ABCDEH	1
-520B	23048-1010	• • END BELL, Anti-Drive End, ... Used on 23046-340	FG	1
530	MS21209C0815	• • • INSERT, Helical Coil		4
540	MS21209C0615	• • • INSERT, Helical Coil	ABCDEH	4
-550	23046-1132	• • BRUSH HOLDER ASSEMBLY. . . . . Used on 23046-303	ABD	4
-550A	23046-1133	• • BRUSH HOLDER ASSEMBLY. . . . . Used on 23046-308 and 23046-378	ABD	4
-550B	23048-1420	• • BRUSH HOLDER ASSEMBLY. . . . . Used on 23046-370	CH	4
-550C	23064-1281	• • BRUSH HOLDER ASSEMBLY, ... REPLD BY 23064-1283 Used on 23046-304	CEH	4
-550D	23064-1283	• • BRUSH HOLDER ASSEMBLY, ... REPLD 23064-1281 Used on 23046-304	CEH	4
	23064-1283	• • BRUSH HOLDER ASSEMBLY, ... REPLD BY 23064-1284 Used on 23046-377 and 23046-340	CFG	4
-550E	23064-1284	• • BRUSH HOLDER ASSEMBLY, ... REPLS 23064-1283 Used on 23046-377 and 23046-340	CFG	4
	23064-1284	• • BRUSH HOLDER ASSEMBLY. . . . . Used on 23046-307	CH	4
		(ATTACHING PARTS)		
560	AN3-7A	• • BOLT, Machine, Hex Head . . . . . Used on 23046-307 and 23046-308	ABCDH	8
-560A	AN3-10A	• • BOLT, Machine, Hex Head . . . . . Used on 23046-340, 23046-370, 23046-377 and 23046-378	ABCDFGH	8
570	MS20364-1032C	• • NUT, Self-Locking. . . . . Used on 23046-303 and 23046-304	ABCDEH	8

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
570 (Contd)	MS20364-1032C	• • NUT, Self-Locking. . . . . Used on 23046-340 and 23046-377 when brush holder assembly 23046-1283 used	CFG	8
580	AN960-10L	• • WASHER, Flat		8
590	05-374094	• • WASHER, Non-Metallic		8
		---------- * ----------		
600	23033-1120	• • • SPRING, Brush, ... ALT 23064-1350, REPLD BY 23033-1121 Used on 23064-1281	CEH	RF
-600A	23064-1350	• • • SPRING, Brush, ... ALT 23033-1120, REPLD BY 23033-1121 Used on 23064-1281	CEH	RF
-600B	23033-1121	• • • SPRING, Brush, ... REPLS 23033-1120 and 23064-1350		8
610	30010-1025	• • • BRUSH HOLDER, Machined . . . . . Used on 23046-1132 and 23046-1133	ABD	4
-610A	23048-1380	• • • BRUSH HOLDER, Machined . . . . . REPLD BY 23064-1180 Used on 23048-1420	CH	4
-610B	23064-1180	• • • BRUSH HOLDER, Machined . . . . . REPLS 23048-1380 Used on 23048-1420	CH	4
	23064-1180	• • • BRUSH HOLDER, Machined . . . . . Used on 23064-1281, 23064-1283 and 23064-1284	CEFGH	4
-620	MS21209F1-15L	• • • • INSERT, Helical Coil Locking . . . Used on 23064-1180 (MS21209F1-15L is reference for complete P/N MS21209-F1-15L)	CEFGH	1
630	05-360013	• • • STUD . . . . . Used on 23046-1132, 23064-1281 and 23064-1283		8
640	05-631145	• • SLEEVE, Insulation		8
650	23014-1039	• • PLATE, Insulation.		4
660	23046-1110	• RETAINER, Bearing.		1
		(ATTACHING PARTS)		

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
670	MS35265-43	• SCREW	EFG	4
-670A	AN500A8-6	• SCREW	ABCDH	4
		---------- * ----------		
680	23046-310	• STATOR AND HOUSING ASSEMBLY .	ABCDH	1
-680A	23046-314	• STATOR AND HOUSING ASSEMBLY .	E	1
-680B	23046-313	• STATOR AND HOUSING ASSEMBLY .	FG	1
690	23032-1516	• • BLOCK, Terminal,. . . . . REPLD BY 23032-1512		RF
-690A	23032-1512	• • BLOCK, Terminal,. . . . . REPLS 23032-1516		1
		(ATTACHING PARTS)		
700	AN501A10-12	• • SCREW,. . . . . REPLD BY MS35266-65 AND 01-098011		RF
-700A	MS35266-65	• • SCREW . . . . . ALT 01-098011, REPLS AN501A10-12		2
-700B	01-098011	• • SCREW . . . . . ALT MS35266-65, REPLS AN501A10-12		2
710	AN936A10	• • WASHER, Lock . . . . . REPLD BY MS35338-43		RF
-710A	MS35338-43	• • WASHER, Lock . . . . . REPLS AN936A10		2
720	AN960-10L	• • WASHER, Flat,. . . . . REPLD BY AN960C10L		RF
-720A	AN960C10L	• • WASHER, Flat,. . . . . REPLS AN960-10L		2
		---------- * ----------		
-730	05-652013	• • • LUG, Terminal . . . . . ALT 05-652918, 05-652015		1
-730A	05-652918	• • • LUG, Terminal . . . . . ALT 05-652013, 05-652015		1
-730B	05-652015	• • • LUG, Terminal . . . . . ALT 05-652013, 05-652918		1
740	MS20364B1032C	• • NUT, Thin Hex, #10-32. . . . . REPLD BY MS21042-3		RF
-740A	MS21042-3	• • NUT, Reduced Hex, ... Self-locking, #10-32 REPLS MS20364B1032C		2

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	QTY PER ASSY
10001-				
750	AN961-10	• • WASHER, Flat,. . . . . REPLD BY AN960C10		RF
-750A	AN960C10	• • WASHER, Flat, #10 . . . . . REPLS AN961-10		2
760	MS20364B624C	• • NUT, Thin, Self-Locking,. . . . . 0.375-24, REPLD BY MS21042-6		RF
-760A	MS21042-6	• • NUT, Reduced Hex, ... Self-Locking, 0.375-24, REPLS MS20364B624C		3
770	AN961-616	• • WASHER, Flat, Electrical, ... 0.375 diameter, REPLD BY AN960C616		RF
-770A	AN960C616	• • WASHER, Flat, 0.375 diameter,. . . . . REPLS AN961-616		3
780	05-652015	• • LUG, Terminal.		3

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